Proceedings of the International Cancer Imaging Society (ICIS) 15th Annual Teaching Course

London, UK. 5-7 October 2015

Published: 2 October 2015

These abstracts are available online at http://www.cancerimagingjournal.com/supplements/15/S1

ORAL PRESENTATIONS

MONDAY 5TH OCTOBER. 9.00-12.35

O1 Background/CaSPaR study
Diana Tait
The Royal Marsden NHS Foundation Trust, London, UK
Cancer Imaging 2015, 15(Suppl 1)O1

Accurate staging of cancer underpins the decision making for individual patients, the collection of outcomes data and the development of appropriate services. Unfortunately, this is not something that the wider oncology community has done well and there are many valid reasons why this part of cancer patient management has proved challenging. However, there are ways in which Clinical Radiologists can improve on staging reporting and contribute to better patient care. The CaSPaR project was set up to explore the value of, and the processes necessary, for proforma reporting in common cancers.

Audits of histopathology reporting of colorectal cancer stage have shown an increase in minimum staging data from 31%-100% following the introduction of proforma reporting. As a consequence, minimum data-set reporting of prognostic histopathological data for resected cancers has become a global standard of care. The impact that this has on clinical outcomes is evident from subsequent studies which have shown that patients with staging reports where data set items are missing have poorer survival outcomes.

Imaging reporting, and the accurate identification of tumour stage, plays a critical role in the allocation of patients to appropriate pathways, particularly in those cancers where preoperative strategies are employed for identifiable groups of patients.

The CaSPaR project sought to test the hypothesis that reporting practice and staging could improve through the implementation of proformas.

The results will be discussed during this meeting but they do show an absolute improvement of 40% in hospitals that successfully made the implementation. Barriers to implementation are multifactorial but there are important issues with regard to technical capability and workforce availability.

National data collection and entry into research trials requires accurate staging and both are likely to be enhanced by the consistency, completeness and accuracy that structured proformas encourage.

Acknowledgements: Academy of Medical Royal Colleges, the Royal College of Radiologists, National Cancer Intelligence Network

O2 Establishing proforma reporting in a busy DGH
Sasha L. Houghton
Department of Radiology, Maidstone and Tunbridge Wells NHS Trust, Maidstone Hospital, Hermitage Lane, Maidstone, Kent ME16 9QQ, UK
E-mail: sasha.houghton@nhs.net
Cancer Imaging 2015, 15(Suppl 1)O2

Maidstone and Tunbridge Wells NHS Trust is a large acute trust serving around 300,000 people in West Kent and East Sussex. It is also home to the Kent Oncology Centre, which provides oncology care to around 1.8 million people across the whole of Kent and a large part of Sussex. As a radiology department we had already established the use of proforma reporting for rectal cancers several years ago. We became involved in the RCR CaSPaR project [1] in 2012 and from that established the use of proforma reporting for both cervical and endometrial cancers, which we have continued to the present time, beyond the closure of the pilot. We have also independently developed a proforma report for MRI brain studies performed from our memory clinic as a response to an audit from the memory clinic team, which showed our reports were lacking critical information needed to secure approval for drug funding. With the help of our PACS team we have embedded the proforma reports into the “text box” function of our GE RIS as word documents. The proforma is then filled in and edited as appropriate by the reporting radiologist.

The use of proforma reporting represents a significant change in reporting style, adopted by some more easily than others, as with any shift in practice. Managing this is a challenge, along with the IT issues. Furthermore, cancers where the diagnosis is known before the staging imaging is undertaken (e.g. colorectal and gynaecological malignancies) lend themselves more easily to proforma reporting than others where the diagnosis is often made after the imaging is performed, as in lung cancer. However the benefits of proforma reporting, which undoubtedly improves data collection, cannot be ignored and we should therefore continue to explore how best we can implement this change.

Reference
1. An evaluation of Cancer Staging using proforma reporting in radiology (CaSPaR). Quality improvement project. RCR 2012.

O3 US perspective
Hebert Alberto Vargas
Department of Radiology, Memorial Sloan Kettering Cancer Center, 1275 York Avenue, New York, NY 10065, USA
Cancer Imaging 2015, 15(Suppl 1)O3
There are many key elements necessary to maximize the clinical utility of diagnostic imaging exams, including a pertinent clinical indication, adequate technical acquisition, accurate interpretation and effective communication of the imaging findings. The literature suggests that structured reporting in radiology leads to clearer and more thorough communication of relevant diagnostic findings than does conventional, free-form reporting. In a study of body oncologic CT examinations, structured reports were given significantly higher satisfaction ratings by both radiologists and referring physicians compared to “free-form” reports [1]. Barbosa et al, found that in addition to being preferred by the majority of the radiologists and endocrinologists participating in a study evaluating thyroid ultrasonograms, the use of structured reporting resulted in improved standardization of thyroid finding descriptors [2]. A study of coronary CT angiograms found an improved inter-observer agreement for the number of vessels with significant stenosis when a structured reporting software which required the radiologist to explicitly state which vessels were involved was used [3]. Other structured reporting software with features such as drop-down menus which facilitate data entry and minimize the amount of free-text entries have been shown to aid not only data comprehension but also reduce the length of time required for aortic aneurysm imaging [4].

However, the benefits of structured reporting cannot be accepted dogmatically. An accurate interpretation reported in “free-form” style is more clinically useful than a structured report containing erroneous information. Furthermore, the terminology used in structured reports also requires standardization. Khorasani et al reported poor agreement between radiologists and non-radiologists in the interpretation of the most commonly used phrases in radiology reports [5]. In recent surveys gathering opinions about radiology reports, 20% of the responding clinicians indicated that they found the language and style of radiology reports unclear [6]. Another study found that referring clinicians may reach different conclusions when reading the same reports [7].

Another important issue relevant to standardized reporting is the expression of diagnostic certainty. Radiologists are often tasked with summarizing multiple findings and rendering an opinion with regards to potential explanations for the radiographic findings. There are scenarios in which no differential diagnoses are warranted and the findings are reported in terms of the absolute presence or absence of a pathologic process (e.g. “no fracture”). In other cases the findings are not definitive, and radiologists need to indicate their level of certainty for their interpretation of the imaging findings. In a study of patients with prostate cancer, 38 different terms were used in MRI reports to express the levels of certainty for the presence of extracapsular extension, prior to the introduction of a 5-point “certainty lexicon” [8]. The lexicon not only simplified the communication of the radiologists’ level of suspicion but also allowed more objective quantification of the diagnostic performance of MRI for diagnosing ECE, with a reported area under the curve of 0.85 [8]. The development of standardized “lexicons” to indicate the radiologists’ level of certainty for interpreting the imaging findings should therefore be considered an integral component of structured reports.

References

O4 Spots and dots in the bones
Philippa Tyler1,2*; 1The Royal National Orthopaedic Hospital, Stanmore, Middlesex, HA7 4LP, UK; 2Institute of Orthopaedics, University College London, UK
Cancer Imaging 2015, 15(Suppl 1):O4

Cancer imaging is frequently at the cutting edge of new imaging techniques which are often rapidly incorporated into routine use. Skeletal metastatic disease is a frequent complication of neoplastic conditions, and results in specific challenges to the general radiologist and specialist oncological radiologist alike. Non-neoplastic conditions and normal variants may simulate skeletal metastases, and the radiologist must recognise such cases and avoid over-investigation and unnecessary treatment. This lecture will briefly review standard imaging techniques and demonstrate normal appearances, normal variants and non-neoplastic lesions that mimic primary and secondary skeletal malignancy, and will then review a spectrum of malignancy-associated bone lesions with the use of standard and more specialised imaging techniques, including PET MRI, PET CT and diffusion weighted imaging.

Expected post treatment imaging findings, and treatment-associated complications will also be discussed.

References

O5 Imaging of the pancreas: state of the art
G Morana*, M Fusaro, A Dorigo
Radiological Department, General Hospital Ca’ Foncello, Treviso, 31100, Italy
Cancer Imaging 2015, 15(Suppl 1):O5

Modern imaging of the pancreas has both a morphologic role, with an accurate delineation of the pancreatic tissue as well as of the pancreatic ducts and vessels, and a functional role, with the visualization of the pancreatic fluid flow and ductal dilation after secretin injection. The wide range of informations achievable with modern imaging techniques leads to a dephth knowledge of the different diagnostic value obtained by different imaging techniques. US is conventionally the first-line diagnostic tool to be used in patients with jaundice or abdominal pain, but with a low sensitivity and specificity, as the imaging feature of a hypoechoic mass cannot provide useful information to differentiate pancreatic cancer from mass-forming pancreatitis. Moreover, artifacts inside cavities can lead to difficulties in differentiating small cystic lesions from solid ones, or a false diagnosis of inhomogeneous content of
cystic lesions. With Tissue Harmonic Imaging (THI) a reduction of artefacts inside cystic lesions can be obtained, allowing a better confidence in the nature of small hypoechoic lesions of the pancreas and a better fluid-solid differentiation. Acoustic Radiation Force Impulse (ARFI) technique allows to evaluate the mechanical strain properties of deep organs by means of a focused high intensity pulse to displace the target tissue. It has been utilized in the evaluation of acute pancreatitis, in the differentiation of benign and malignant focal pancreatic solid lesions, in the evaluation of the content of cystic pancreatic lesions [1-3].

Finally, CEUS has improved the characterization of pancreatic tumors, allowing a better differentiation between pancreatic carcinoma and mass-forming pancreaticitis, adenocarcinoma and neuroendocrine tumor, serous and mucinous cystic pancreatic lesions [4].

MDCT is a robust technique to explore the pancreas, and it is the gold standard in the local staging of pancreatic carcinoma, thanks to its high spatial resolution, which allows a good depiction of the relationship of the tumor with the peri-pancreatic vessels. However, small iso-attenuating tumors can be hardly depicted with CT. New protocols with low-kV or dual energy technique improve the sensitivity of the MDCT, thus allowing the depiction of small tumors [5,6], especially with the use of new algorithms, which reduce the noise [7].

MRI it is used as a "problem solving" technique, when other imaging modalities are not able to resolve the clinical question, although in the evaluation of cystic tumor of the pancreas it is considered the gold standard, thanks to its high sensitivity to static fluids and different composition of fluids (mucin, blood, etc.). The most significant application of MR in the pancreas are:

- When dealing with Acute Pancreatitis (AP), MR can be the highly accurate in the evaluation of both intra- and extrapancreatic hemorrhagic/liquid collections.
- MRCP can permit the detection of either acquired (e.g. calculi) or congenital (pancreas divisum) causes of AP, especially after the administration of secretin. This can be particularly useful in case of recurrent AP.
- In Chronic Pancreatic (CP), MRCP enables the distinction between primitive and obstructive causes. Moreover, the functional informations obtained with MRCP after secretin injection is able to suggest the forthcoming onset of a CP when the morphological changes are still not evident.
- In the differential diagnosis between pancreatic carcinoma and mass-forming pancreaticitis, morphological, ductal, functional information as well as DWI with IVIM analysis are becoming important tools to achieve a correct diagnosis [8].
- DWI also useful improves diagnostic accuracy for differentiating malignant from benign IPMNs of the pancreas [9].

References
patient management in lengthy reports including unimportant incidental findings or fail to mention critical aspects of the findings that are crucial to the treatment and management of the current clinical problem. Structured or template reports on the other hand offer, the opportunity through the use of specific entry fields, to organize relevant information in an easily readable format and ensure completeness of the required information that is essential for patient management. For these reports to be practically helpful to the referring and treating physicians, they should be 1) concise, 2) use standardized terms and 3) easy to understand.

Several radiology societies and societies and organizations in other medical disciplines have started to provide examples of such templates to their members for use in clinical practice for ex. on their websites etc. (Radiological Society of North America, Society of Abdominal Radiology etc.). Usually the structured templates use standardized terms and avoid the use of ambiguous, vague and imprecise wording.

To take these reporting templates to the next level of being useful to the intended customer i.e. the referring medical specialist, it is essential that these reporting templates be developed in conjunction with physicians from the various disciplines that are involved in the care and management of the appropriate patient populations. This will ensure the use of mutually agreed upon terminology between the radiologist and the referring clinicians, eliminating any potential source of confusion.

For these reasons, we decided to formulate a working template for pancreatic adenocarcinoma, through a national effort. Working with the Society of Abdominal Radiology and the American Pancreatic Association, we put forth a consensus statement in 2014 which has been published simultaneously in two major journals: the American Journal of Gastroenterology and Radiology. This workshop will illustrate the working template that we and others have developed with and are utilizing in patients with pancreatic adenocarcinoma using examples. We and others will be starting to work on developing a similar working reporting template with SAR as well gastroenterologists and surgeons for cystic pancreatic lesions later this year. Templates developed at other institutions will be shown and illustrated with examples.

References

Background: Over the last three decades, surgical practice has undergone a significant change with a move towards minimally invasive surgery (MIS) as the standard of care [1]. Although this has brought with it significant benefits, problems have also been associated with the advent of MIS. Perhaps the most substantial limitation associated with MIS is the loss of haptic feedback; this deficit is at its most extreme in robot-assisted surgery, where at present such feedback is lost entirely [2]. The image-enhanced operating environment looks to mitigate for the loss of haptic feedback by providing the surgeon with visual cues to the subsurface anatomy. The use of intraoperative image guidance can be divided into that used for operative planning, to facilitate the rapid identification of critical anatomical structures, for example, and that used for task execution, an example of which is tumour resection [2]. These two steps have very different requirements, with the first needing a large amount of anatomical information to be displayed without the need to account for tissue deformation or accurate registration, while the second requires less information to be displayed, but with much greater spatial accuracy.

Methods: The solution proposed herein, the image-enhanced operating environment, utilises two different imaging modalities and plays on their respective strengths to meet the differing needs of the two outlined steps of planning and execution. The platform has been built around the image-guided robot-assisted partial nephrectomy, although its potential application extends well beyond this scope. The first step of operative planning utilises 3D reconstructions of preoperative cross-sectional imaging manipulated via a tablet-based interface [3]. This information was displayed to the surgeon both on the tablet and within the da Vinci console using the stereoscopic TilePro™ function (Intuitive Surgical, Sunnyvale, CA).

The second step of execution utilizes optically registered intraoperative ultrasound. Using a live imaging modality mitigates for the problems of deformation often faced when trying to use preoperative imaging for high precision guidance. The ultrasound data is used to create freehand 3D reconstructions which are overlaid onto the operative view [4].

Results: To date, over 60 cases have been undertaken using the tablet-based planning component of the image enhanced operating environment. Over the course of this series, a subjective benefit has been demonstrated through the analysis of prospectively-collected questionnaire results. In addition, the platform has demonstrated objective safety, with no detrimental effects observed on outcome parameters. The use of registered ultrasound has been demonstrated in vivo[5], with results of an ex vivo study demonstrating potential efficacy awaited.

Conclusions: Replacing haptic feedback with visual cues to subsurface anatomy offers a number of potential direct and indirect benefits to the patient, including improved resection quality and a reduction in positive surgical margins. In addition to these direct benefits, the use of an image-enhanced operating environment could potentially influence case selection, where surgeons are prepared to take on cases with more challenging anatomy via a minimally invasive approach, because of the improved understanding they are given by the image guidance platform.

Acknowledgements: The authors are grateful for support from the NIHR Biomedical Research Centre funding scheme

References

MONDAY 5TH OCTOBER 2.00-5.30

O8 Augmented reality: 3D image-guided surgery

Archie Hughes-Hallett1, Philip Pratt2, James Dilley3, Justin Vale4, Ara Darzi2,5, Erik Mayer1

1Department of Surgery and Cancer, Imperial College, London, W2 1NY, UK
2Hamlyn Centre for Robotic Surgery, Imperial College, London, W2 1NY, UK
3E-mail: e.mayer@imperial.ac.uk

Cancer Imaging 2015, Volume 15 Suppl 1 http://www.cancerimagingjournal.com/supplements/15/S1

Page 4 of 36
O9 Translating imaging biomarkers into clinical practice
James PB O’Connor
Institute of Cancer Sciences, University of Manchester, Manchester, M20 4BX, UK
E-mail: james.oconnor@manchester.ac.uk
Cancer Imaging 2015, 15(Suppl 1):O9

Biomarkers are ‘objectively measured and evaluated indicators of normal biological processes, pathogenic processes or pharmacologic responses to a therapeutic intervention’ that identify increased or decreased risk of patient benefit or harm [1]. Imaging biomarkers (IB) are integral to cancer healthcare and research. In oncology, patient management relies heavily on using ordered categorical IBs to stage patients (e.g. assignment of T, N and M status) and to monitor therapeutic efficacy (e.g. objective response, measured by RECIST 1.1 or equivalent criteria) [2,3]. IBs are also used to measure toxicity in cancer patients. For example, SPECT quantification of cardiac ejection fraction is an important biomarker of drug-induced cardiotoxicity [4].

The role of IBs in oncology continues to increase in the era of personalised medicine. Every year thousands of imaging studies develop IBs and test their role as putative, prognostic, predictive, monitoring and radiation planning biomarkers - both for use in healthcare and in clinical trials of novel drug or radiotherapy treatments [5]. Some IBs modify existing metrics. For example, basing response criteria largely on 18F-FDG PET signal changes rather than size changes (as in PERCIST v RECIST) may stratify patients differently but still uses the same conceptual biomarker, namely objective response [6].

In distinction, many other IBs derive parameters that measure novel aspects of tumour molecular biology, pathophysiology or structural morphology. These IBs are usually designed to quantify an unmet clinical need, such as the hallmarks of cancer that are targets for drug development. Examples include optical imaging of deoxy-Hb and oxy-Hb ratios as a biomarker of hypoxia; measuring 13C-labelled bicarbonate/CO₂ ratios through dynamic nuclear polarisation to map tumour pH; measuring changes in glucose metabolism through quantifying percentage reduction in 18F-FDG PET SUVmax; measuring changes in vascular function through quantifying percentage reduction in Ktrans; or measuring tumour heterogeneity by texture, fractal or other feature-based analyses [7-9].

Unfortunately, translation of new IBs has been disappointing. Quantitative IBs in particular have been slow to cross the translational gaps to become useful decision making tools in drug development (pharmacodynamic or PD IB) or in altering healthcare (as companion diagnostics, or for screening, response, monitoring or outcome). The key reason that IBs have failed to make substantial impact is the lack of clear roadmap for IB validation and qualification. IBs have several important differences from the more familiar biospecimen-derived biomarkers and require a different validation roadmap tailored to the strengths and limitations of IB. Recognising this need, Cancer Research UK and the European Organization for Research and Treatment of Cancer (EORTC) have sponsored an international consensus effort to devise a roadmap and produce key recommendations for the design, performance, governance and publication of future IB studies [10].

This talk aims to:
1. Challenge delegates in their understanding of what constitutes an IB.
2. Introduce current thinking around how IBs should be validated and qualified (the ‘imaging biomarker roadmap for use in cancer studies’).
3. Provide a range of examples that highlight the successes and failures of many popular and emerging IBs.

References

O10 Small bowel masses
Gabriele Masselli
Policlinico Umberto I University Sapienza, Rome, Italy
Cancer Imaging 2015, 15(Suppl 1):O10

The diagnosis of small-bowel tumours, particularly early detection and differential diagnosis, is still somewhat challenging, although many sensitive direct and indirect techniques have been adopted. Although spatial resolution of MR imaging is lower than that of a CT scan, the main advantages of the former are the combination of good soft-tissue contrast, detection of extraintestinal abnormalities, and lack of radiation exposure, which allows repeated data acquisition for functional bowel evaluation.

Enteroclysis provides greater distension of the entire small bowel than does enterography in patients suspected of having small-bowel neoplasms, because small polypoid masses that do not produce obstruction are most likely difficult to detect by using oral contrast material distension.

Moreover, MR enteroclysis delineates superficial changes more accurately than does MR enteroclysis and the evaluation of endoluminal abnormalities is particularly important in the detection of early-stage small-bowel neoplasms.

MR enteroclysis has yielded a 96.6% accuracy in the detection of small-bowel neoplasms, thereby proving to be an effective means of diagnosing or ruling out small-bowel neoplasms.

MR enteroclysis is an accurate, well-tolerated, promising imaging modality with which to diagnose or exclude small-bowel tumours in symptomatic patients with negative upper and lower endoscopy findings. MR enteroclysis might allow clinicians to select patients in whom more invasive diagnostic methods are indicated.

MR enteroclysis, which allows improved localization of small-bowel polyps in patients with Peutz-Jeghers syndrome, is performed to identify larger lesions that should be resected at double-balloon enteroscopy or surgery. It may also be helpful for excluding the presence of lesions in bowel segments not examined at endoscopy or surgery. MRI has proved to be more sensitive than CT for the detection of endoluminal erosions of the small bowel, owing to improved detection of segments with subtle abnormalities.

These findings may be due both to the better soft-tissue contrast afforded by MR imaging, which is required for tissue characterization and the detection of subtle areas of abnormality, and to its functional capabilities. Another advantage of MR imaging over CT is that the enhanced soft-tissue contrast produced by MR imaging may provide more information regarding the nature of mesenteric small bowel tumors, thereby allowing better characterization of small-bowel tumors. In this regard, benign tumors such as hemangiomas are typically strongly hyperintense on T2-weighted MR images, whereas lipomas or tumors with a marked fat content are spontaneously hyperintense on T1-weighted MR images. With few exceptions (lymphoma being one), thickening of a long segment of the small bowel is indicative of a benign condition.
MR enteroclysis and enterography are accurate non-invasive modalities in assessing the intraluminal, parietal and extraluminal neoplastic manifestations. MR signal appearances of the lesions, combined with the contrast enhancement behaviour and the characteristic of the stenosis, can help in differentiating from other non-neoplastic diseases of the small-bowel. Radiologists should therefore be familiar with the MR appearance of various small-bowel neoplasms and their mimickers.

References

O11
Management of splenic “incidentalomas” found on ultrasound and computed tomography
Richard M Gore1,2,3, Jacob S Ecanow2,3
1Department of Radiology, NorthShore University HealthSystem, Evanston, IL, 60201, USA; 2University of Chicago, Chicago, IL, 60637, USA
E-mail: rgore@uchicago.edu
Cancer Imaging 2015, 15(Suppl 1):O11

Introduction: Splenic “incidentalomas” are focal lesions of the spleen that are discovered on imaging studies that were performed for the evaluation of non-spleen related pathology. These lesions are frequently encountered on CT and ultrasound examinations. Most incidental focal splenic lesions are benign, however a systematic approach to evaluating these lesions is important, because many benign and malignant splenic masses share common imaging features [1,2].

The odds: Small studies report the prevalence of incidental splenic lesions on CT scans performed on trauma patients to be less than 1.5% [2]. Metastases and lymphoma are the two most common splenic malignancies, and although both are very rarely seen in the setting of an incidental finding. There are only a few dozen reports of isolated splenic metastases in the literature, so incidental splenic lesions without any evidence of metastasis elsewhere are unlikely to be metastatic [3]. Similarly, most splenic lymphomas are seen in patients with systemic disease, and evidence of lymphoma can be found elsewhere on the scan.

 Morphologic clues: Asymptomatic simple cysts are almost always benign; these are most commonly false cysts due to prior hematoma or infarct, as well as true congenital epidermoid cysts and pancreatic pseudocysts. Abscesses, echinococcal cysts, cystic metastases, and lymphoma can manifest as simple cysts, but these are not usually incidental; there is usually a typical history, and there are usually other clues on the study. In any event, these more commonly cause complex appearing cysts. Patients with splenic abscesses are almost always febrile and symptomatic. Abnormal enhancement patterns suggest malignant etiologies such as metastases, lymphoma, and angiosarcoma. Hypervascular masses are frequently due to benign masses such as hemangiomas, hamartomas, littoral cell angiomas, and lymphangiomas, but hypervascular metastases and lymphoma must be considered. Angiosarcomas are rare, and cause irregular hypervascular masses. The differential diagnosis of multiple small hypovascular masses includes granulomatous disease, metastases, and lymphoma. Most calcifications are benign, but several morphological forms may be associated with malignancy or infection.

Workup: Lesions with specific benign features, such as a simple cyst in an asymptomatic patient may be dismissed. Prior imaging and history are the key to evaluating indeterminate lesions such as small hypovascular masses. Stable lesions for one year or greater in patients without cancer are benign; if no prior examinations are available then indeterminate lesions in asymptomatic patients should be followed. If there is a history of lymphoma or other cancer, MRI or PET scan should be considered. The most common indication for percutaneous splenic biopsy is an indeterminate splenic mass in a patient with history of lymphoma or other malignancy [4]. Published guidelines, such as those formulated by the American College of Radiology committee on splenic and nodal findings can be extremely useful in approaching these common lesions [1].

References

O12
Small renal masses
Hersh Chandarana
Department of Radiology, New York University School of Medicine, New York 10016, USA.
Cancer Imaging 2015, 15(Suppl 1):O12

Small renal masses are increasingly diagnosed incidentally. This results in management dilemma because at histopathology significant numbers of small renal masses are either benign tumors such as angiomylipoma (AML) or oncocytoma, or are neoplasms with relatively indolent behavior [1]. Surgical treatments such as partial and total nephrectomy although provide excellent oncologic control is associated with development and worsening of renal insufficiency and associated cardiovascular morbidity [2]. Therefore, ability to non-invasively investigate renal tumor histopathology and aggressiveness can guide treatment decision and lower treatment cost. Within this paradigm, the role of radiologist and imaging is evolving from traditional role of identifying renal lesion and detecting enhancement, to predicting aggressiveness and biology of the tumor as well as providing operative guidance. MR imaging can play a very important role not only as a problem solving tool in traditional sense by detecting subtle enhancement and macroscopic and microscopic fat, but can provide deeper insight into tumor biology. Number of key observations highlighting the role of MR in evaluation of renal masses is as listed below:

1. Differentiating benign renal masses from malignant tumors: - There is some controversy regarding the role of signal loss on opposed phase chemical shift imaging in discriminating AML from RCC [3,4]. - Lipid poor AML tend to have uniform low T2 signal and uniform enhancement without evidence for necrosis [5,6]. - There is overlap in the morphologic features of Oncocytoma and RCC on conventional imaging [7]. Furthermore segmental enhancement inversion is noted in oncocytoma as well as other renal neoplasms [8].
2. Histologic subtyping RCC: - Papillary subtype of RCC usually have low T2 signal and are hypovascular when compared to clear cell RCC. Furthermore, clear cell subtype have heterogeneous T2 signal and demonstrate heterogeneous hypervascularity [9]. - Chromophobe subtype is difficult to differentiate from clear cell RCC on the basis of enhancement. However, advance diffusion and perfusion MR techniques have shown some promise [10].
3. Predicting tumor aggressiveness/outcome: - Cystic RCC with less than 25% solid enhancing component tend to be less aggressive than solid RCC [11]. - High stage clear cell RCC tend to me more heterogeneous with different texture compared to low stage RCC on Apparent diffusion coefficient (ADC) map [12]. - High grade clear cell RCC tend to have lower ADC compared to low grade clear cell RCC [13].
References

O13 Lung cancer screening: 360 degree review
Christian J Herold, Theresa C McLeod
1Department of Biomedical Imaging and Image Guided Therapy, Medical University of Vienna / AKH, Vienna, Austria; 2Department of Radiology, Massachusetts General Hospital / Harvard Medical School, Boston, Massachusetts, 02114, USA

The most compelling evidence supporting the use of low dose computed tomography in the screening of high risk populations for lung cancer was generated by the National Lung Cancer Screening Trial carried out in the United States by the National Cancer Institute and the American College of Radiology Imaging Network.[1] This trial was a randomized prospective study which included over 53,000 participants. The two arms consisted of patients who were randomized to low dose CT and those who received standard radiography. Data from the NLST demonstrated that screening reduced mortality by 20% in the CT arm. Other smaller studies carried out in Europe have reported no mortality benefit. However, these studies included a younger screening population and had a smaller number of participants and probably did not have the power to show a mortality benefit.[2] Major medical societies and US government agencies such as US Preventative Services Task Force and now the Center for Medicare Services have now recommended LDCT. These decisions not only recommend screening but require US insurance companies and Medicare in the US to provide reimbursement.[3].

O14 Imaging tumour response - challenges
Finn Rasmussen
Department of Radiology, Aarhus University Hospital, Denmark
E-mail: finnrasm@rm.dk
Cancer Imaging 2015, 15(Suppl 1):O14

RECIST criteria uses changes in tumour diameters to quantitatively obtain response assessments for traditional chemotherapeutic cancer treatments: Positive responses are identified by reductions in tumour size while tumour growth signifies non-response. Traditional chemotherapies work primarily by damaging cells that are undergoing rapid growth and division. Immunotherapies work by stimulating...
the immune system to reject and destroy tumour cells. Targeted cancer therapies block the growth of cancer cells by interfering with specific molecules needed for tumour growth and carcinogenesis. These oncological treatments as well as stereotactic radiation therapy and local treatments, such as image-guided ablations and transarterial chemo embolization (TACE) can be used alone or in combination. Local treatment, radiation therapy, immunotherapy and targeted therapy can each result in an increased tumour diameter in spite of treatment response at the cellular level and increased survival times. As a result, tumour diameter can no longer stand alone when assessing oncological treatment strategies.

Tumour heterogeneity and contrast enhancement often change during treatment, and tumour enhancement combined with tumour size has been shown to be successful in assessing treatment response in gastrointestinal stromal tumours (CHOI criteria). Modified CHOI criteria could potentially be used for monitoring the effect of oncological treatment strategies in metastatic renal cell cancer and hepatocellular carcinoma.

Dynamic contrast-enhanced imaging (DCE-US, DCE-MRI and DCE-CT) uses changes in tumour enhancement following the intravenous injection of a contrast media to create a time-versus-signal curve. From such curves, reliable quantitative estimates of blood flow, blood volume and permeability can be obtained. Diffusion-weighted MRI and PET can also be used to obtain quantitative measures of physiological processes. A major advantage of DWI-MRI and PET is the possibility of whole body coverage, while DCE imaging is limited to a single tumour or a comparatively small region. Although quantitative assessments of oncological treatment parameters using physiological parameters have been shown to be superior to size-based response in several studies, the methods mentioned are not yet standardized, and randomized multicentre studies have not yet been performed. When planning such studies, it is important to note that clinical endpoints such as progression free survival and overall survival are superior to morphological imaging results.

In the routine assessment of oncological treatment responses, it is becoming increasingly important for the radiologists to know exactly what kind(s) of treatment that the patient has received. Simply reporting changes in tumour size using RECIST is no longer sufficient considering the large percentage of patients who receive advanced and often combined treatment regimens.

O15 PET/CT imaging in prostate cancer
Tara Barwick
Imperial College Healthcare NHS Trust and Imperial College, Division of Surgery and Cancer, UK
Cancer Imaging 2015, 15(Suppl 1):O15

Prostate cancer is the second most common male malignancy worldwide with a wide spectrum of biological behaviour ranging from fairly indolent disease to highly aggressive metastatic castrate resistant tumours. In the past decade there have been advances in therapies for treating advanced and recurrent prostate cancer and improved diagnostic/prognostic tools are required to refine the therapeutic approach at various stages in the management of prostate cancer patients.

For tumour staging/lesion localisation multiparametric prostate MRI is the modality of choice. Several PET tracers are proving more sensitive than conventional imaging techniques for early detection of lymph node and bone metastases. However a general limitation of PET is the spatial resolution which limits the reliability for detection of small lesions.

The use of F-18 fluoro-deoxyglucose (FDG) PET/CT in prostate cancer has been disappointing largely due to the fact that many prostate cancers have only low level glucose metabolism. C-11/F-18 choline, markers of cell membrane metabolism, are now widely used in many institutions and in certain UK centres particularly in the scenario of biochemical relapse and high risk staging with equivocal findings on conventional work-up [1-3]. However, in cases of biochemical relapse with low PSA rise and low PSA velocity, choline PET has low detection rates [4]. Prostate specific membrane antigen (PSMA), a cell surface membrane glycoprotein, is a promising target for the diagnosis and treatment of prostate cancer. Recently Ga-68 radiolabelled ligand targeted to PSMA has been introduced to a few European centres. Early data suggests this may be more sensitive than choline PET/CT in patients with biochemical failure and low PSA [5-7]. In addition it offers the opportunity for Lu-177 or Y-90 targeted radionuclide therapy. F-18 sodium fluoride (FNaF) is highly sensitive compared to bone scintigraphy with Tc99m labelled phosphates but only assess skeletal disease [8].

Other PET tracers being explored include C-11 acetate targeting lipogenesis, tracers radiolabelling bonebmsin and targeting gastrin-releasing peptide receptor (GRPR), amino acid transport with anti-1-amino-3-F-18-fluorocyclobutane-1-carboxylic acid (FACBC) and F-18-fluoro-5a-dihydrotestosterone (FDHT) targeting the androgen receptor [9,10]. This talk reviews the diagnostic utility of PET in prostate cancer.

References

O16 Theranostics: radionuclide imaging and therapy in neuroendocrine tumours
Brent Drake1, Thomas Gruning2
Department of Nuclear Medicine, Plymouth Hospitals NHS Trust, Plymouth, Devon PL6 8DH, UK
Cancer Imaging 2015, 15(Suppl 1):O16

Neuroendocrine tumours (NETs) are a heterogeneous group with significant variation in morphological characteristics and functional behaviour. This poses challenges in terms of both biochemical and imaging assessment. Somatostatin receptor (sstr) overexpression is documented in several malignancies. The sst subtype 2 (sstr2) is overexpressed in NETs [1] and can be targeted for both somatostatin receptor scintigraphy and therapy.
In-111-octreotide (OctreoScan), a gamma imaging sst agent, binds with relatively high affinity to sst 2. This has good overall sensitivity in the detection of NETs (80-100%) [2]. However, sensitivity varies according to tumour type, grade, and location (e.g. sensitivity 24% in insulinomas) [3]. PET agents such as Ga-68-DOTA-labelled somatostatin analogues have been developed with higher receptor affinity when compared to gamma-based agents. This leads to improved target-to-background ratio and provides the improved imaging characteristics inherent of PET tracers. A 2012 meta-analysis demonstrated pooled sensitivity and specificity in detecting NETs of 93% and 91%, respectively [4] with higher detection rates compared to conventional sst imaging [5].

Whilst other PET tracers such as F-18-DOPA have shown utility and higher sensitivity than conventional sst scintigraphy, their role is limited to problem solving at present. F-18-FDG can, however, provide prognostic information with patients showing uptake having a progression free survival of 0% at 2 years compared with 75±10% in those without uptake [6].

Peptide receptor radionuclide therapy (PRRT) utilises primarily beta-emitting radioisotopes such as Lu-177 and Y-90 linked to somatostatin analogues such as DOTATATE and DOTATOC. Whilst phase 3 data comparing PRRT with other therapies is awaited, treatment with Y-90 and Lu-177 PRRT has been shown to have response rates of approximately 80% and to confer a survival advantage over historical controls [7]. Unfractionated or plasmid-based hepatic implantation is an adverse factor for progression free survival, whereas high tumour uptake in pre-therapy imaging confers prolonged survival [8].

Due to the differences in beta particle energy and path length, it has been postulated that Lu-177 PRRT would be best suited to smaller tumour volumes compared with Y-90 which emits a more energetic particle with longer path length. Kunikowska and colleagues have now demonstrated that overall survival is significantly higher in patients treated with combination Y-90/Lu-177-DOTATATE compared with Y-90-DOTATATE alone [9].

Research into the role of sst antagonists is relatively new. Several studies have shown a significantly greater number of binding sites for antagonists when compared to agonists such as Lu-177-DOTATATE. Pilot studies have shown 1.7-10.6 times higher tumour dose with the antagonist Lu-177-DOTATATE-JR11 when compared to Lu-177-DOTATATE [10]. Encouraging results have also been obtained with the use of radiosensitising chemotherapeutic agents administered together with PRRT. A phase 2 study evaluating capecitabine with Lu-177-octreotate demonstrated a response rate of 94% with no significant increase in toxicity [11]. Further work is required, however, these advances are likely to play a significant role in the future.

References

Microbubbles: from cancer detection to theranostics

David Coigtové
1 Imaging Department, Hammersmith Hospital, Imperial College, London, UK;
2 Imaging Department, King’s College Hospital, London, UK
E-mail: d.coigtove@imperial.ac.uk
Cancer Imaging 2015, 15(Suppl 1):O17

Microbubbles have proven to be useful as diagnostic agents for ultrasound [1-2]. However, they have the potential for a far wider range of uses, both in unmodified form (thus minimising regulatory barriers) and in new forms[3]. These future uses may be divided into diagnostic and therapeutic categories. Routine diagnostic uses of microbubbles relevant to oncology are mainly in the liver, where they have been endorsed by NICE for the characterisation of focal liver lesions[4]. The key attribute here is the fact that malignancies do not have the functioning sinusoidal system that accounts for the late retention of microbubbles in the normal liver and in solid focal lesions – in this application, microbubbles are as effective as CT with contrast but less costly. Many similar oncological uses exploit microbubbles’ exquisite ability to define both the macro- and microvasculature of tissue. Examples include characterising BRADS 3 and 4a breast masses, distinguishing pancreatic adenocarcinoma (hypo)fused from focal pancreaticitis (well perfused) and distinguishing complex-appearing real cyst from cystic carcinoma.

A potentially important extension is to develop targeted microbubbles that attack preferentially to cell surface molecules of interest[5]. Since conventional microbubbles of micron diameter cannot escape from the blood pool, the initial target is the blood vasculature. Ligands to VEGF1 can be attached to microbubbles; numerous preclinical studies have shown these to be effective ways to image malignant neovascularisation and the first human trial in prostate cancer has been completed[6]. A difficulty has been the relatively poor binding power of the targeted microbubbles, especially in the non-immunogenic form suitable for human use. The same strategies that are used for molecular imaging in nuclear medicine and MR can be deployed: improve the specific binding or wait for clearance of the unbound agent from the blood stream. Another approach makes use of the fast time resolution of ultrasound and tries to recognise which microbubbles are fixed and which are moving, thus enabling the bound population to be selectively imaged. Efforts have also been made to detect differences in the echoes from free versus bound microbubbles.

An important advance in allowing access to tissue beyond the endothelium is the development of nanodroplets, made by cooling and pressurising microbubbles, especially in the non-immunogenic form suitable for human use. The same strategies that are used for molecular imaging in nuclear medicine and MR can be deployed: improve the specific binding or wait for clearance of the unbound agent from the blood stream. Another approach makes use of the fast time resolution of ultrasound and tries to recognise which microbubbles are fixed and which are moving, thus enabling the bound population to be selectively imaged. Efforts have also been made to detect differences in the echoes from free versus bound microbubbles.

An important advance in allowing access to tissue beyond the endothelium is the development of nanodroplets, made by cooling and pressurising microbubbles, especially in the non-immunogenic form suitable for human use. The same strategies that are used for molecular imaging in nuclear medicine and MR can be deployed: improve the specific binding or wait for clearance of the unbound agent from the blood stream. Another approach makes use of the fast time resolution of ultrasound and tries to recognise which microbubbles are fixed and which are moving, thus enabling the bound population to be selectively imaged. Efforts have also been made to detect differences in the echoes from free versus bound microbubbles. This allows temporary opening of tight endothelial junctions, for example to open the blood-brain barrier and improve the penetration of co-administered i.v. drugs. Co-administration obviates some of the regulatory barriers to modified microbubbles and has been used to augment chemotherapy of pancreatic cancer with gemcitabine[11]. Further such trials are anticipated. Microbubbles might also be used to augment high intensity focussed ultrasound (HIFU)
which would speed up the method, thus removing one of the main barriers to its wider use.

The most direct approach to treatment with microbubbles is to tag them with active drugs such as chemotherapeutic agents; breaking these microbubbles with high MI pulses releases the agent so that high concentrations can be achieved locally. This has been shown in small animals to minimise the cardiotoxicity of Adriamycin in breast cancer [12]. This therapeutic avenue could be combined with the nanodroplets method and with remote palpation to access tumours.

Thus, the diagnostic and therapeutic possibilities for microbubbles are extensive; clinically useful approaches in oncology can be anticipated in the not too distant future.

References


6. A Pilot Trial Using BRSS Ultrasound Contrast Agent in the Assessment of Prostate Cancer. 2105.


O18

MRI with hepatobiliary contrast

Karthik S Jhaveri
University of Toronto, Abdominal Imaging, University Health Network, Mt. Sinai and WCH 610 University Ave, 3-957, Toronto, ON M5G 2M9, Canada

Cancer Imaging 2015, 15(Suppl 1):O18

Hepatobiliary contrast agents currently are essentially gadolinium based agents (Gd-EOB-DTPA and Gd-BOPTA) with dual ability to perform dynamic contrast enhanced imaging similar to extracellular gadolinium contrast as well as providing hepatobiliary uptake and excretion in later phases. Hepatobiliary uptake and excretion with gadoteric acid (Gd-EOB-DTPA) is related to OATP and cMOAT and MRP2 receptors presence on hepatocytes. Since gadoteric acid has a recommended dose which is 25 % (0.025mmol/kg) of Gd-EOB-DTPA attention to technical parameters is crucial. Improved arterial phase enhancement is obtained by MR fluoroscopic or bolus-tracking type triggering technique and either a lower injection flow rate of 1 mL/s or less as opposed to 2 mL/s, or contrast dilution.

To improve liver-lesion contrast-to-noise ratio, 3D T1-weighted gradient-echo acquisition for the hepatobiliary phase should be performed with higher flip angles (20-35°). In order to optimize workflow, Diffusion-weighted and T2-weighted imaging can be performed after gadoteric acid administration without compromising diagnostic capability; however, MRCR pulse sequences should be acquired before the contrast injection.

The clinical utilization of Hepatobiliary contrast agents is predominantly for staging of liver metastases, characterization of hepatocellular lesions such as adenoma and FNH as well as diagnosis of HCC and cirrhosis related nodules. In the preoperative setting for accurate evaluation of colorectal liver metastases and appropriate surgical planning, gadoteric acid enhanced liver MRI is recommended as it has superior sensitivity and specificity compared to ultrasound, PET, and CT. In the assessment of patients with colorectal liver metastases who have been treated with chemotherapy, preoperative imaging with gadoteric acid may be of particular benefit. For the differentiation of focal nodular hyperplasia from hepatic adenoma, gadoteric acid-enhanced MRI should be considered due to its discriminative ability between the two based on hepatobiliary phase features. The combination of hypointensity on hepatobiliary phase images and mild-to-moderate arterial enhancement for adenoma versus strong enhancement on arterial phase images and iso- or hyperintensity on hepatobiliary phase images for FNH showed sensitivity and specificity of 97% and 95% and 83.7% and 100% and 83.8% and 98.5%, respectively. However a small percentage of adenomas can exhibit hepatobiliary uptake and surveillance and or biopsy should be considered when imaging appearances are not typical. Although gadoteric acid-enhanced MRI yields significantly higher diagnostic accuracy and sensitivity compared with multiphase CT for the diagnosis of HCC in cirrhosis, its role in the clinical management of HCC has yet to be defined in North America while it has seen widespread implementation in Asia/Japan. There is insufficient evidence supporting cost-effectiveness or outcomes for recommending the utilization of gadoteric acid-enhanced MRI for HCC screening at this time. A significant percentage of nodules with hepatobiliary phase hypoenhancement but atypical enhancement on the dynamic phases have been associated with a diagnosis of HCC or future development of HCC. Biopsy or close surveillance of these lesions is recommended. Off label applications include evaluation of biliary disorders, bile leaks and hepatic function. Gadoteric acid-enhanced liver MRI is an evolving technique with potential for non-invasive quantification of liver function and staging of hepatic fibrosis.

References


Conventional ultrasound has well known short comings in the detection and characterisation of focal liver lesions. A false negative rate of up to 30% has been quoted in the detection of liver metastases and its accuracy in the characterisation of focal liver lesions is poor compared to computed tomography (CT) and magnetic resonance (MR). Ultrasound microbubble contrast agents have redressed these limitations. Ultrasound microbubbles have been available for over 20 years and are licensed for clinical use in most parts of the world. The characterization of focal liver lesions is the most important application of contrast enhanced US (CEUS), with an accuracy rivalling that of CT and MR [1-8].

Microbubbles consist of a low solubility complex gas such as a perfluorogas surrounded by a phospholipid shell. They are similar in size to red blood cells, in comparison to the molecular sizes of CT and MR contrast agents. They are pure intravascular agents. Following an intravenous injection they last in the circulation for about 5 minutes. By good fortune, microbubbles resonate in an ultrasound field at the frequencies used in everyday diagnostic sonography. During resonance they emit ‘fingerprint like’ harmonic signals (overtones) which can be selectively detected by the microbubble-specific software available on commercial ultrasound systems. Microbubbles are imaged using low acoustic power modes to reduce their destruction and thus allow real-time imaging. They are better tolerated than MR and CT agents with fewer and less severe adverse effects and are not nephrotoxic. The most widely used agent in Europe is Sonovue (Bracco).

The liver demonstrates three phases of enhancement after an i.v. bolus injection: the arterial, portal and late phases. The late phase occurs as the vascular phases subside, when the microbubbles are sequestered in the sinusoids of the liver.

Enhancement is visualized in real time alongside a B-mode greyscale image. The enhancement characteristics of liver lesions at CEUS are similar to those seen on CT and MR imaging. Since CEUS operates in real time, fast changes during the arterial phase are better captured than on CT or MR. This presentation discusses the enhancement characteristics of malignant and benign liver lesions. As a general rule, however, lesions which do not washout in the late phase (i.e. remain hyperenhancing or isoenhancing to liver parenchyma) tend to be benign (with the exception of simple cysts, haematomas, ablation cavities and abscesses, which do not enhancement in any phase), whereas lesions which do not retain contrast in the late phase (i.e. demonstrate washout) are usually malignant.

Hepatic metastases have variable appearances on B-mode ultrasound. On CEUS, hypervascular metastases typically demonstrate avid enhancement throughout the lesion in the arterial phase whilst hypovascular metastases show rim enhancement in the arterial phase with both types showing washout in the late phases appearing as defects. CEUS significantly increases the conspicuity of metastases compared to B-mode, allowing the detection of isoechic and lesions down to 3mm.

**CEUS and intervention:** The use of CEUS may allow better visualisation of a lesion than on B-mode ultrasound and allow a targeted ultrasound-guided biopsy. CEUS may also be used during interstitial ablation of a focal malignant liver lesion. The operator is able to perform repeated injections of microbubbles in order to establish whether viable tumour remains, and whether immediate further on-table ablative therapy is required.

Benign liver lesions have characteristic enhancement patterns on CEUS.

**Haemangiomas** demonstrate gradual peripheral nodular enhancement with progressive centripetal filling whereas **focal nodular hyperplasia** typically demonstrate avid arterial centrifugal enhancement in a “spoke and wheel” pattern, arising from a central feeding vessel and then become isoenhancing to liver by the late phase.

**Focal Fatty Sparing & Focal Fatty Change** demonstrate identical enhancement to the surrounding liver parenchyma in all phases of CEUS. CEUS can demonstrate enhancing septa in abscesses. CEUS may indicate suitable drainage sites.

In summary microbubbles have expanded the role of US in the real-time characterisation of focal liver lesions based on specific enhancement patterns to differentiate benign and malignant lesions. Ultrasound contrast agents have significantly improved the sensitivity and specificity of ultrasound to rival that of CT and MR.

**References**


O21 Imaging the Ancients
Rodney H Reznek
Barts Cancer Institute, Barts and The London School of Medicine and Dentistry, Queen Mary University of London, UK
Cancer Imaging 2015, 15(Suppl 1):O21

Mummified remains and artefacts, since their discovery, have attracted the interest of scientific investigators. Consequently virtually every paleoimaging modality has been applied to bioarchaeology soon after its technological development. Indeed, the first use of X-rays in mummy investigation was only one year after William Röntgen discovered X-rays in 1895 when, in March 1896, Carl Koenig, a German physicist, published the first X-rays involving mummies, that of an Egyptian mummified cat and the knees of an Egyptian child mummy. The first systematic analysis of a major mummy collection was undertaken at the Field Museum in Chicago in 1931. CT scans of mummies were first carried out in 1977. Not surprisingly, over the years, several problems have been identified in interpreting the images on CT. The presence of many layers of mummy wrapping, organ removal, diagnostic changes, particularly desiccation, may all result in confusion. Special problems in X-ray and CT scanning arise when the diagenetic changes are so massive that the remaining tissues, including bone, are severely degraded - a feature best shown by bog bodies, all of which date to the Northern European Iron Age (approximately 500 BC to 500 AD).

Recent technological advances have made MDCT an especially useful means for presentation of findings of anthropological inquiry as exemplified in a brilliant recent exhibition at the British Museum. However, this short lecture will show an almost unique personal experience of imaging of mummies performed over almost a decade in the mid-80s and early 90s. Investigations were undertaken of a bog body discovered in Lindow near Manchester, Musica bodies discovered in the Andes, and Egyptian mummies from Fayum. All three projects revealed fascinating insights into the lifestyle of these ancients and answered several lines of anthropological inquiry. This presentation will illustrate examples from each of these projects.

References

O22 Benign lesions that mimic cancer: Ovarian
Rosemarie Forstner*, Thomas Meissnitzer, Matthias Meissnitzer
Department of Radiology, Landeskliniken Salzburg, PMU, Salzburg, 5020 Austria
E-mail: R.Forstnergall.at Cancer Imaging 2015, 15(Suppl 1):O22

As ovarian masses are common in both pre- and in postmenopausal age, a life time risk of up to 5-10% to undergo pelvic surgery has been reported [1]. However, the likelihood of malignancy in these lesions is extremely low. Imaging, particularly, US and MRI, have been integrated as diagnostic tools to better define indications for adequate surgical and to guide referral to specialized centers. Imaging findings are assessed in the context with clinical data, patient history, age, and tumor markers. Furthermore, various risk assessment indices to predict malignancy have been established using clinical and/or imaging parameters.

Advances in imaging including the combination of morphologic and functional parameters have further improved the diagnostic performance of MRI. Thus the majority of indeterminate masses on US and CT can be correctly diagnosed with MRI [2,3]. MRI is most beneficial in women with a low likelihood of cancer. Endometriomas, common mimicks of ovarian cancer in CT and US, display specific imaging findings in MRI. This is also true for subserous leiomyomas, which are often difficult to differentiate from solid ovarian masses in US. Meticulos analysis of anatomical landmarks and displacement patterns aid in differentiation of benign extraovarian tumors, particular of extraperitoneal origin, e.g of neurenomas, from ovarian cancer. Some complex cystic and solid adnexal masses may be challenging to differentiate from ovarian cancer. In these lesions integration of clinical findings will allow in most cases differentiation of benign lesions from cancer. Ovarian torsion, pelvic hematoma, and extrauterine pregnancy are typically associated with pelvic pain. Pain and inflammatory laboratory findings suggest tubo ovarian abscess (TOA). TOA may mimick ovarian cancer even in advanced imaging, including MRI and PET/CT. Aspergillosis, a subtype of TOA mimicks ovarian cancer due to its complex morphology and invasive growth pattern. Differentiation of peritoneal tuberculosis from advanced ovarian cancer is difficult and requires biopsy [4]. Ovarian pseudocysts and cystadenofibroma display typical findings in most cases. However, some of the benign pelvic lesions still present a diagnostic dilemma [5]. These include rare entities, e.g. atypical dermoids, monodermal dermoids, collision tumors, and sometimes also hemorrhage of functional cysts.

References

O23 Lung and pleura
Stefan Diedrich
Department of Diagnostic and Interventional Radiology, Marien Hospital, 40479 Düsseldorf, Germany
E-mail: Stefan.diedrich@vkd-klinik.de
Cancer Imaging 2015, 15(Suppl 1):O23

Lung: Pulmonary nodules are commonly observed in patients with cancer as well as in patients with no known malignancy particularly in heavy smokers. Most of these nodules are small (less than 8 mm). Even in cancer patients a large proportion of these small nodules are benign [1]. The likelihood of malignancy depends on individual aspects (cancer type, grading, staging, molecular markers etc.), nodule size and risk factors [1]. For example, in a heavy smoker with lung cancer and one additional nodule larger than 8 mm the nodule is more likely to represent a second primary than a solitary metastasis. In a non-smoker with advanced high-grade soft-tissue sarcoma a solitary nodule is more likely to represent a metastasis. In all cancer patients a significant proportion of pulmonary nodules represent benign lesions such as pulmonary lymph nodes or granulomas [2,3]. Non-solid nodules (ground glass opacities) are more likely to represent lung cancer (adenocarcinoma) than solid nodules [4,5]. However, they may represent benign lesions such as focal fibrosis or haemorrhage. Furthermore, some (haemorrhagic) metastases may present as non-solid nodules [6]. Consolidation or diffuse ground glass usually represents benign disease such as pneumonia. However, in adenocarcinoma with predominantly lepidic growth consolidation or diffuse ground glass may be due to cancer spread in the lung.

Pleura: Pleural effusion may be due to malignant spread (pleural carcinomatosis) or to several benign conditions (heart or renal failure, haemorrhage, infection, etc.). Malignancy is usually confirmed by cytologic analysis of pleura fluid. However, imaging may suggest
malignancy if solid pleural lesions are demonstrated within the effusion particularly at the lung base. Unilateral effusion, particularly in the left hemithorax or on the side of the underlying malignancy (e.g., breast, lung cancer) also suggests malignant effusion. Solid pleural lesions may be clearly benign such as pleural lipoma or calcified pleural plaques in patients with asbestos exposure. Non-calcified focal solid lesions may be benign (e.g., following infection, haemorrhage) or malignant. Although pleural carcinomatosis is usually associated with effusion solid metastases without effusion can occur. Diagnosis usually requires histology [7].

References

024 Liver and pancreas
Jay P Heiken
Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis, MO 63110, USA
E-mail: heikenj@mir.wustl.edu
Cancer Imaging 2015, 15(Suppl 1):O24

Various inflammatory processes and atypically appearing benign masses can have an imaging appearance very similar to or in some cases indistinguishable from cancer. In the liver such processes include inflammatory pseudotumor, sclerosed hemangiomna and focal hepatic steatosis. In the pancreas heterotopic splenule, focal autoimmune pancreaticitis and solid serous cystadenoma may be difficult to distinguish from pancreatic adenocarcinoma or neuroendocrine tumor.

Inflammatory Pseudotumor is a localized benign hepatic mass that consists of fibrous stroma and chronic inflammatory infiltrates including plasma cells, histiocytes and lymphocytes. There are 3 subtypes: xanthogranuloma type (histiocyte predominance), plasma cell granuloma type and hyalinized sclerosing type. The pathogenesis is unclear, but it often is associated with chronic recurrent biliary infections. The most common CT/MR appearance of inflammatory pseudotumor is that of a heterogeneous mass, depending on the size of the cysts. Such lesions appear hypervascular and may mimic a pancreatic neuroendocrine tumor. In contradistinction, pancreatic adenocarcinoma typically has an irregular contour and may cause capsular retraction if located peripherally. It may show rim enhancement or nodular peripheral enhancement; however, in contrast to most hemangiomas the enhancement is static and does show the usual centripetal progression. On MR imaging the mass may lack the expected degree of T2 hyperintensity. If serial imaging is available, a sclerosed hemangioma may decrease in size over time, with loss of previous regions of enhancement.

Intrapancreatic splenule appears as a round enhancing mass within the tail of the pancreas. Because of its vascularity it can be mistaken for a pancreatic neuroendocrine tumor. One of the keys to diagnosis is recognition that the mass has enhancement, attenuation and/or signal intensity characteristics that parallel the spleen on all image acquisitions. The diagnosis can be confirmed with a technetium 99m heat-damaged red blood cell scan, which demonstrates radiotracer uptake within the mass.

Mass-forming chronic pancreatitis, particularly autoimmune pancreatitis, frequently is misdiagnosed as pancreatic adenocarcinoma or a neuroendocrine tumor. Most commonly mass-forming chronic pancreatitis is isodense/intense during both the pancreatic and hepatic parenchymal phases of contrast enhancement. In contradistinction, pancreatic adenocarcinomas are isoattenuating/intense during both enhancement phases; however, approximately 10% of pancreatic adenocarcinomas are isodense/intense during both phases. On MR cholangiopancreatography (MRCP) the pancreatic duct within the mass-forming pancreatitis may be visible but narrowed (duct-penetrating sign), whereas the duct within pancreatic carcinoma often is occluded. One study has shown the duct-penetrating sign to be 94% accurate in distinguishing the two entities. Elevation of serum IgG4 is the best serological marker for autoimmune pancreatitis (sensitivity 73-75%; specificity 93-95%); however, approximately 10% of patients with pancreatic cancer may have elevated IgG4.

Pancreatic serous cystadenoma is a benign mass that consists of numerous tiny cysts separated by glandular tissue and fibrous stroma. On CT it appears as a well-circumscribed hypodense mass with varying degrees of contrast enhancement, depending on the size of the cysts and the proportion of cystic to glandular tissue. In most cases it is not difficult to distinguish this multicystic lesion from a solid pancreatic neoplasm; however a small proportion of serous cystadenomas consist largely of glandular tissue and fibrous septa with only a small proportion of tiny cysts. Such lesions appear hypervascular and may mimic a pancreatic neuroendocrine tumor. Clues to the diagnosis include precontrast attenuation value within the range of fluid and the absence of small cystic areas with the enhancing mass. In addition, this diagnosis should be considered if the mass is found incidentally in an elderly individual or a patient with von Hippel Lindau disease.

References

025 Salivary glands and lymph nodes
Hamet C Thienen
University Hospital of Bern, Bern, Switzerland
Cancer Imaging 2015, 15(Suppl 1):O25
Involvement of lymph nodes in various pathologies of the head and neck is frequent not only in malignant diseases but also in inflammatory conditions. As size criteria are not sufficient to define a lymph node as malignant, other criteria such as shape, central necrosis and extracapsular spread are other helpful signs. However, micrometastases are still an unresolved problem although new imaging methods have already shown promising results. Typical imaging features of CT and MRI indicating extracapsular spread and carotid artery invasion will be discussed as these have therapeutic and prognostic implications.

Although salivary gland pathologies are relatively rare, its large variety of differential diagnoses makes it challenging. In children and pregnant women, sonography is the first step, and CT is the method of choice in inflammatory disease. MRI is the first line examination in palpable salivary gland masses to assess the exact extent of tumours, the invasion of neighbouring structures, perineural spread and bone invasion. Differential diagnoses and imaging features of the most frequent tumour types will be discussed and an approach to differentiate between benign and malignant lesions will be provided.

**O26 MRI assessment of treatment response**

Ann D King
Chinese University of Hong Kong, China
Cancer Imaging 2015, 15(Suppl 1):O26

Locoregional failure occurs in approximately 25-50% of patients with head and neck squamous cell carcinoma (HNSCC), who are treated with chemoradiotherapy (CRT). Timely identification of treatment failure allows salvage surgery to be undertaken. Imaging the post-treatment neck therefore has an important role for the early identification of a residual/ recurrent tumours while also preventing unnecessary biopsies or surgery in patients with expected post-treatment changes. This lecture will concentrate on the post CRT evaluation of primary and nodal sites in patients with HNSCC, using morphological assessment by MRI.

MRI assessment of the post treatment primary tumour bed is based on CT criteria and can be divided into (1) expected post treatment changes (low risk); (2) focal mass < 1 cm or asymmetry (indeterminate risk); (3) focal mass ≥ 1 cm (high risk). In addition MRI signal intensity can provide further information. Residual/recurrent tumours tend to have the same signal intensity as untreated tumours on all sequences, and in this regard the T2 weighted images are valuable in distinguishing tumour (intermediate signal intensity) from scar tissue (low signal intensity) and inflammation (high signal intensity). However, there may still be some overlap in the appearance of post treatment change and tumour.

The assessment of nodal response can be even more problematic, especially in the early post-treatment period. Reported morphological criteria for identifying nodal treatment response vary but most frequently nodal control is based on size (<1-1.5cm); % size reduction (>75%-90%); absence of focal abnormalities such as necrosis; absence of extranodal neoplastic spread (ENS). These criteria are often combined and report high NPVs, valuable for excluding residual malignant nodes, but the PPVs are low. The poor diagnostic performance of these morphologic criteria is partly because necrosis and ENS are inaccurate signs for residual nodal cancer, and their presence reduces the accuracy of size measurements. Of note necrotic sterile nodes often take longer to decrease in size than solid sterile nodes.

Interactive clinical cases of primary and nodal HNSCC will be used to illustrate the expected post treatment findings, residual/recurrent tumours, and indeterminate findings that cause a diagnostic dilemma. DWI will also be illustrated and there will be a brief comparison of MRI and FDG PET-CT.

**References**


**O27 Orbital tumours**

Vincent Chong
Department of Diagnostic Radiology, National University Hospital, National University Health System, Singapore 119074
Cancer Imaging 2015, 15(Suppl 1):O27

The approach to the accurate diagnosis of orbital lesions requires initial identification of the space of origin. For descriptive purposes, the orbit has been divided into the following parts: globe, intracranial and extracranial spaces [1]. As each space has unique contents, the diagnostic possibilities can to some extent be predicted accordingly. Such an approach works fairly well in clinical practice. However, some common orbital lesions such as inflammatory pseudotumour, lymphoma and metastatic disease typically affect multiple spaces. Under such circumstances, the pattern of involvement together with clinical information can often provide a reasonable tentative diagnosis.

An accurate histological prediction of a lesion is often difficult as many lesions share common imaging features. On the other hand, there are lesions with typical imaging features which render histological confirmation unnecessary. At times the delineation of disease extent is the most important role of imaging such as in the case of staging of head and neck malignancies. Radiologists should therefore be familiar with pertinent anatomical knowledge required for both tumour staging and surgical planning.

**Extracranial lesions**: Epithelial tumours represent 50% of the masses involving the lacrimal gland. The remaining lesions are due to lympho-inflammatory lesions, Pleomorphic adenomas are the most common benign epithelial tumours. Adenoid cystic and mucoepidermoid carcinomas are the most common malignant neoplasms. Dermoid cysts are not true lacrimal tumours but arise from rest cells located in the orbit.

**Intracranial lesions**: Optic nerve meningiomas are usually seen in middle age women [2]. On contrast enhanced CT or MRI meningiomas appear as tubular thickening or localised eccentric expansions. These tumours retain the same signal intensity as brain tissue on most pulse sequences and do not enhance. They are usually not suspicious on imaging studies. Optic nerve gliomas are benign tumours usually seen in childhood. CT or MRI shows fusiform thickening of the optic nerve. Tumours may show variable enhancement. On T1-weighted images, the tumour is isointense with white matter but the T2 signals are more variable. Orbital schwannomas may arise from the III, IV, V1 or VI cranial nerves. They are more commonly seen in the intracranial space but may be seen anywhere in the orbit. On CT they appear sharply demarcated, oval or fusiform.

**Multiple compartment lesions**: Of all patients with orbital lymphoma, up to 75% have systemic disease [4]. Lymphomas are homogeneous masses of relatively high density with sharp margins. Generally these lesions mould themselves without eroding or enlarging the orbit.
Plasmytomas are closely related to lymphomas. Myelomas may affect the orbit and display the same spectrum of findings as in lymphomas. Mases maybe lobulated, well defined with or without bone destruction. They may also display intense enhancement. Metastatic disease in the orbits can be seen in the eye (choroidal metastasis), optic nerve, intraconal, canal extracanal spaces [5]. Pseudotumours usually affect more than one orbital space. For descriptive purposes, pseudotumours may be classified into the following types: 1) diffuse, 2) lacrimal & dacrocystitis, 3) myosis, 4) periscleritis, 5) perineuritis, and 6) Toloso-Hunt Syndrome. References


**O28**

Hepatic lesions
Wolfgang Schima1*, Katrin S. Jha2
1Department of Diagnostic and Interventional Radiology, KH Gottlicher Heiland, KH der Barmherzigen Schwestern and Sankt Josef-Krankenhaus, Vinzenzengruppe, Vienna, Austria; 2Abdominal Imaging, University Health Network, Mt. Sinai and WCH, Toronto, Canada

Cancer Imaging 2015, 15(Suppl 1):O28

The liver presents with a variety of lesions for evaluation and appropriate triage with imaging. Ultrasound, MDCT and particularly MRI play a significant role in this objective. In patients without a known malignancy the vast majority of non-cystic lesions are benign (hemangioma, FNH, adenoma, focal fat, etc.), while a few are malignant. However, common benign hepatic lesions may pose a dilemma, if their imaging features are atypical. Although patients with a known malignancy are more likely to have a diagnosis of metastasis for a liver lesion, some studies have shown that small (<1cm) hepatic lesions are more likely to be benign even in patients with a cancer diagnosis [1,2]. While metastases may be a common diagnosis in cancer, it is important to recognise varied patterns of liver metastases after chemotherapy or after surgery. Chemotherapy-related focal or nodular fat deposition can also lead to variety of pseudolesions, and one needs to be aware of these appearances and distinguish them from fat-containing hepatic tumors [3]. Uncommon occurrence of hepatic peliosis and sinusoidal obstruction syndrome also needs to be kept in mind in patients with cancer [4].

In patients with chronic liver disease, ultrasound surveillance is the method of choice for the early detection of HCC in cirrhosis [5]. For characterization of focal lesions in cirrhosis, EASL-EORTC and AASLD recommend multiphasic contrast-enhanced MDCT or MRI. Imaging features typical for HCC is arterial phase hypervascularity and wash-out hypointensity in the venous and/or equilibrium phase, which allows non-invasive diagnosis of HCC [6]. Recently diffusion-weighted imaging (DWI) and liver-specific MR contrast agent have been introduced in the clinical routine for detection and lesion characterization. The combination of DWI and liver-specific contrast agents yields the best results in the detection liver metastases [7]. For characterization of focal lesions in cirrhosis, administration of liver-specific MR contrast agents may help a make a confident diagnosis [8,9].

In this workshop the work-up of focal liver lesions will be discussed and the varied imaging features of common and less common focal lesions will be presented.

**References**


**WEDNESDAY 7TH OCTOBER 9.00-1.00**

**O29**

Ablation for metastatic lung cancer
Thierry de Baire
Imagerie Thérapeutique, Département d’imagerie, Institut de Cancérologie Gustave Roussy, Villejuif, France

Cancer Imaging 2015, 15(Suppl 1):O29

Since first report of RFA in lung tumor in year 2000, RFA has been demonstrated to provide 80 to 90% complete ablation for tumors less than 2 cm, with decrease in efficacy for larger tumors. Percutaneous ablation is today a valid option for lung metastases in non surgical candidates with overall survival reported after RFA is in between 56 to 67% at 3 years. Such survival reported is comparable to what reported in large surgical series even if no comparative data exists. Age, disease free interval, tumor size and tumor numbers are independent predictor of survival after RFA of lung metastases. The same predictive factors have been reported as predictive of survival after surgical metastasectomy. One of the advantage of RFA over other technique such as surgery and SBRT is that it can be easily repeated in case of occurrence of new metastases which is difficult with surgery due to the aggressively of the procedure. Subsequent surgical resection are limited by pulmonary reserve. The same applies to stereotactic radiation therapy where multiple irradiation results in toxicity to lung parenchyma, skin or mediastinum. Consequently, RFA is today part of routine practice armentarium against lung metastases. However, many fields remains to be investigate to improve efficacy and to better determine the role fo RFA relative to other therapies. Investigation will be needed :

- To determine the role of various ablation technology such as microwaves, cryotherapy and irreversible electroporation, in comparison to RFA which has been today the most reported technique.
- To evaluate the need and benefit from combining local ablation and systemic therapy.
- To compare RFA with other local therapy, namely stereotactic body radiation therapy that has today indications very close to percutaneous thermal ablation. These comparisons will help to determine best treatment option in a given situation.

Future trends in treatment of pulmonary metastases will favor minimal aggressive treatments and percutaneous ablation have a role to play.
Evidence based medicine supporting the use of lung RFA metastatic disease and defining what is the best population to target with ablation or SBRT. The ideal candidate has less than 3 tumors less than 3 cm.

References

O30
Percutaneous treatment of liver metastases
Joseph P Erinjeri
Interventional Radiology Service, Department of Radiology, Memorial Sloan Kettering Cancer, New York, New York, 10024 USA
E-mail: erinjeri@mskcc.org
Cancer Imaging 2015, 15(Suppl 1):O30

Early detection of metastatic disease within the liver by advanced diagnostic imaging has driven the rise of image-guided intervention for hepatic metastases. In this talk, we will explore the rationale, indications, technique and post procedure imaging findings of percutaneous treatments of liver metastases. Curative intent ablative therapies, such as radiofrequency ablation, microwave ablation, cryoablation, and irreversible electroporation will be discussed, including the common pitfalls of reading post ablative imaging studies. In addition, bridging and palliative therapies embolotherapies for liver dominant metastatic disease, such as hepatic artery embolization, transarterial chemoembolization, drug eluting beads, and yttrium-90 selective internal radiation therapy, will be reviewed.

O31
MR guided focused ultrasound
Władysław Gedroyc
Radiology Department Imperial College Healthcare NHS Trust, London, UK
Cancer Imaging 2015, 15(Suppl 1):O31

Focused ultrasound utilizes powers of approximately 5000 to 10,000 times that of conventional diagnostic ultrasound which can be focused to a very small point in the tissues of the body where it produces rapid very intense heating which causes almost instantaneous ablation of heated tissues at the target site. No intervention is required and the whole process in this format is carried out within an MR scanner. MR allows excellent targeting of the site to be ablated and can provide an in vivo thermal map of heat delivery as it is deposited in the target tissue so that an accurate and very safe procedure can be performed as long as there is a suitable acoustic window available to reach the target site through the anterior tissues. This lecture will describe the areas where MR guided focused ultrasound has been utilized and will describe areas of evolving technology and the technological problems that are encountered in these applications. Whilst some of the applications described such as the utilization of focused ultrasound in fibroids and in the brain are not directly applications that treat malignancy the principles of these treatments can be applied to other malignant disease processes and will in the future allow malignancy to be treated at these sites.

The largest experience in the world in this therapy is available in the pelvis in the treatment of uterine fibroids and this procedure will be described. The 2nd FDA approved application of MR guided focused ultrasound is in the treatment of bone secondary and the utilization of focused ultrasound this area and its problems and potential will be described. MR guided focused ultrasound shows immense promise in the treatment of liver tumours but the technological problems in this application are huge and these will be described briefly and the methods by which we hope to overcome these problems will be provided. Focused ultrasound utilization in the treatment of prostate cancer is one of the oldest applications of this technology and new transducers are now available utilising MR guidance which will substantially improve the complications seen with all types of prostate cancer treatment by providing excellent targeting accuracy of the deposition of destructive energy within the prostate and avoiding the neurovascular bundles.

A brief description of the brain applications will be provided and although these are not malignant at the moment the future holds out significant promise in this field and this application is of great interest to all physicians in this field.

Drug activation with focused ultrasound will become a very large field of its own and a very brief description of how this may work and what technologies are required will be given although this field has not yet entered the full clinical arena and 1st in human trials have not started yet but the promise that this type of approach provides is immense.
Patterns of distant failure and organ to organ. The details of the benefits of surveillance are for asymptomatic cancer survivors be possible effects of other treatment modalities. Higher accuracy for skeletal metastases can be achieved by diphosphonate SPECT/CT or fluoride PET/CT in place of planar scintigraphy [5] whilst integrated FDG-PET/MRI has the potential to optimise detection of skeletal and hepatic recurrence in a single examination [6,7]. The new PET tracer Gallium-68 Prostate Specific Membrane Antigen demonstrates high accuracy for nodal and skeletal recurrence prostate cancer [8].

Imaging protocols for cancer staging are now well established. Increasing cancer survivorship has created a need to develop equivalent protocols for the diagnosis and assessment of tumour recurrence.

References

033 Imaging and cancer survivorship: challenges and changing concepts
Kenneth A Miles1,*, Dalveer Singh1
1Department of Diagnostic Imaging, Princess Alexandra Hospital, Woolloongabba, Queensland, 4102, Australia; 2Institute of Nuclear Medicine, University College London, London, NW1 2BU, UK

Cancer Imaging 2015, 15(Suppl 1):033

The widening gap between cancer incidence and mortality testifies to the increasing success of cancer treatment. For example, in Queensland Australia, there are now more than 7 cancer survivors for each patient newly diagnosed with cancer. These individuals represent a population at risk for recurrent malignancy for whom there is a growing demand for imaging services.

Imaging for suspected recurrence may be prompted by symptoms or rising tumour markers, whilst for some tumours, imaging contributes to regular surveillance. The benefits of early detection of recurrence through imaging surveillance need to be balanced against cost, patient anxiety and radiation exposure. A recent study has estimated the absolute risk of second cancer induction resulting from use of radiological examinations in this context to be between 0.1% and 10% [1]. Targeting patients at greatest risk of recurrence would improve the balance between risk and benefit for imaging surveillance and is potentially achievable through the use of prognostic imaging biomarkers derived from imaging procedures performed at staging or post-treatment [2].

Increasingly sophisticated treatments for recurrent disease present further challenges to the use of imaging in cancer survivorship. There are now more therapeutic options for patients with localised disease or recurrence to a few sites (oligometastatic disease). Although well established for hepatic metastases from colorectal cancer, surgical resection of localised recurrence is increasingly adopted for alternative sites of recurrence and for other tumour types. For tumour sites unamenable to surgery, stereotactic body radiotherapy can allow focal delivery of high-dose radiation with single or few fractions with promising local control and overall survival rates [3].

These developments create new questions for imaging. Firstly, should imaging surveillance programmes of asymptomatic cancer survivors be developed to allow identification of the oligometastatic state prior to disseminated disease? The potential benefits of surveillance are highlighted by a study of patterns of distant failure and progression in breast cancer which found oligometastatic disease to be more common amongst asymptomatic patients [4]. Secondly, how can imaging be optimised to distinguish oligometastatic from disseminated disease? Imaging in this context must have high sensitivity and specificity on a lesion-by-lesion basis because an accurate assessment of the number of metastases is required to avoid the morbidity of inappropriate oligometastatic treatment, as well as the possibility of oligometastatic treatment being wrongly withheld due to the presence of benign lesions that are indistinguishable from additional metastases. Hybrid imaging techniques that combine modalities with complementary sensitivity and specificity are likely to offer the greatest opportunities for accurate assessment of oligometastatic disease. Higher accuracy for skeletal metastases can be achieved by diphosphonate SPECT/CT or fluoride PET/CT in place of planar scintigraphy [5] whilst integrated FDG-PET/MRI has the potential to optimise detection of skeletal and hepatic recurrence in a single examination [6,7]. The new PET tracer Gallium-68 Prostate Specific Membrane Antigen demonstrates high accuracy for nodal and skeletal recurrence prostate cancer [8].

Imaging protocols for cancer staging are now well established. Increasing cancer survivorship has created a need to develop equivalent protocols for the diagnosis and assessment of tumour recurrence.

References

034 Imaging techniques to diagnose radiation damage
Massimo Bellomi
European Institute of Oncology, Milan, Italy
E-mail: massimo.bellomi@ieo.it

Cancer Imaging 2015, 15(Suppl 1):034

Radiotherapy affects all tissue of the body, but the evidence and the timing of these changes vary from organ to organ. The details of the radiotherapy, including the volume and shape of the area treated, dose, time from completion of therapy, possible effects of other treatment including chemotherapy, and the variability of human response are all factors in the appearance of radiotherapy change.

Different techniques have to be used according to the organ and to the pathology to be investigate: “conventional” imaging is still a cornerstone in main situation, as swallowing fluoroscopy in irradiated neck, Chest X-ray in radiation pneumonitis, Ultrasound in radiation pericarditis, MRI in postradiation bony changes etc. The new imaging tools able to evaluate tissue perfusion (both by CT or MRI) and cellularity (Diffusion Weighted MRI) can be applied to evaluate vascular damage prior the ischemic changes and especially in differential diagnosis of fibrosis versus recurrent tumor.

When the patient complains symptoms that can be referred to the previous radiotherapy and imaging documents tissue changes that explain symptoms
and are likely due to the treatment, the communication to the patient has to be clear, understandable and bluntly: the base of this relationship is grounded on a correct information on benefits and risks given at the time of treatment. When tissue changes are incidental finding and not related to any symptom, as for example a mild peripheral lung fibrosis after breast irradiation, this raises the issue of how to report the finding. It has to be done without rising concern in the patient, nor instilling doubt that something went wrong with the therapy and a sentence as “due to normal outcome of radiotherapy” could be suggested if agreed with the Radiotherapist. In conclusion, the use of radiation to treat primary and metastatic tumors results in damage to normal tissue that is often evident on imaging studies. Treatment techniques have continued to evolve dramatically and techniques such as IMRT and proton therapy are specifically designed to decrease dose and injury to tissues surrounding malignant tumors. However some patients treated with definitive radiation therapy over the past several decades continue to survive and present for surveillance. Evaluation of imaging studies in these patients requires an understanding of the expected changes post therapy.

**References**


**O35**

Chemo cured the cancer: what about the patient?

Nina Tunaru

Radiology Department, Royal Marsden Hospital, London, UK

E-mail: nina.tunaru@icr.ac.uk

Cancer Imaging 2015, 15(Suppl 1)O35

In 2012, two million cancer survivors were reported in the United Kingdom. Using a model of prevalence as a function of incidence, survival and population demographics, Maddams et al projected that by 2040, the number of cancer survivors in the United Kingdom will increase by approximately one million per decade[1]. Late effects of cancer treatment can come from chemotherapy, radiation and surgery. With the increasing number of people that undergo curative treatments or long times of cancer remission, and subsequent prolonged survival time, late effects of cancer treatment can become clinically evident decades after completion of therapy. Modern oncological treatment regimens often incorporate multiple agents whose deleterious effects might be additive or synergistic, making their identification and treatment more challenging. The spectrum of late anti-cancer treatment effects is broad and includes vision and hearing loss, early menopause, cardiomyopathy, infertility, nephropathy, hepatitis and pseudocirrhosis, pneumonitis, neuropathy, cognitive impairment, osteoporosis, sexual dysfunction and increased risk of second malignancy. Childhood cancer survivors may also experience memory problems and learning disabilities and short stature, caused by arrested or impaired growth and vasculopathy.

A greater understanding of sometimes multifactorial mechanisms of injury can prolong the lives and improve life quality of those cured of their malignancy, but left with potentially devastating sequelae. A such example is the cardio-vascular toxicity experienced by patients secondary to the malignant process itself or its treatment[2]. Oncological treatments have been associated with life-threatening arrhythmia, ischaemia, infarction, and damage to cardiac valves, the conduction system, or the pericardium. The increased awareness of cardiac late toxicity has resulted in development of strategies[3] to monitor and to prevent or to mitigate the effects of cardiovascular damage[4].

Whilst the focus of oncological care continues to be on cure, there is a growing need of recognition that for many patients, cancer has become a chronic disease; the paradigm must shift from illness to optimum wellness. Management of long-term chemotherapy-related toxicity involves screening for symptoms, use of supportive medication, and referral for specialty consultation as needed. Survivorship experts have promoted risk stratification to determine the intensity and setting for post-treatment follow-up[5]. Thus prediction of both the life-threatening effects and the psychosocial morbidity and sexual dysfunction that can significantly impair quality of life represents a critical next step[6] to allow implementation of optimal long term programs and resources in cancer survivors care.

**References**

1. Principles and Practice of Pediatric Oncology, Pizzo and Poplack , 6.

**O36**

Pediatric bone and soft-tissue sarcomas

Beth McCarville

Department of Diagnostic Imaging, St. Jude Children’s Research Hospital, 262 Danny Thomas Place, MS 220, Memphis, TN 38105, USA

E-mail: beth.mccarville@stjude.org

Cancer Imaging 2015, 15(Suppl 1)O36

In this session I will review the clinical and imaging features of the most common pediatric bone and soft tissue sarcomas and several benign lesions that may mimic them. These malignancies often have unique features that can help narrow the differential diagnosis. The material will be presented in an informal manner and audience participation is encouraged. A review of the appropriate diagnostic work-up will also be presented, including the role of various imaging modalities to detect local-regional and distant metastatic disease. At the end of this session participants should be able to identify clinical features (age, race, etc.) and imaging features that are suggestive of the correct diagnosis.

**References**

1. Principles and Practice of Pediatric Oncology, Pizzo and Poplack , 6.

**O37**

Paediatric renal tumors

Alexander J Towbin

Cincinnati Children’s Hospital, Department of Radiology, Cincinnati, Ohio 45229, USA

E-mail: alexander.towbin@cchmc.org

Cancer Imaging 2015, 15(Suppl 1)O37

Pediatric renal masses are uncommon and the differential diagnosis list is made up of a mix of benign and malignant lesions. While there is some overlap in the entities affecting children and adults, the majority of lesions arise in childhood. The child’s age, clinical history, and imaging findings all help to distinguish the majority of tumors. The purpose of this interactive session is to review the renal lesions that affect the pediatric population.
describe their imaging findings, and discuss how the different lesions are
differentiated on imaging. The following tumors will be included:
Benign tumors.
1. Nephroblastomatosis.
2. Metanephric adenoma.
3. Multilocular cystic nephroma.
4. Angiomyolipoma.
Malignant tumors.
1. Wilms tumor.
2. Renal cell carcinoma.
3. Clear cell sarcoma.

O38
Ovarian cancer: imaging in treatment selection and planning with FIGO update
Evis Sala
Department of Radiology, Memorial Sloan Kettering Cancer Center, 1275
York Avenue, New York, NY 10065, USA
Cancer Imaging 2015, 15(Suppl 1):O38
The International Federation of Gynecologists and Obstetricians (FIGO) staging system for ovarian cancer is surgically based. It does not formally include imaging but the FIGO committee encourages the use of imaging techniques if available to assess the important prognostic factors such as disease resectability and lymph node status. FIGO has recently revised the staging of ovarian cancer [1]. It includes a revision of the stage III patients and allotment to stage IIIA1 is based on spread to the retroperitoneal lymph nodes without intraperitoneal dissemination, because an analysis of these patients indicates that their survival is significantly better than those who have intraperitoneal dissemination [1]. The standard of care for patients with newly diagnosed advanced ovarian cancer has been comprehensive staging laparotomy and primary optimal surgical cytoresection followed by adjuvant chemotherapy. However, the use of neoadjuvant chemotherapy followed by interval debulking surgery (IDS) as a suitable alternative is supported by multicenter randomized controlled trials [2]. Imaging is therefore of paramount importance in helping triage patients for appropriate management by accurately evaluating the extent and anatomical location of peritoneal spread, which in turn dictates the feasibility of cytoreductive surgery and predicts the likelihood of optimal primary cytoreduction. Optimal cytoreductive surgery (residual disease <1 cm) is a very strong predictor of survival, and even after the threshold for optimal cytoresection has been reached, it is important to remove as much of the residual tumor as possible.
CT is the primary imaging modality used to stage ovarian cancer. It is complimentary to surgical staging identifying possible sites of unsuspected disease such as pelvic peritoneum, paraortic nodes, diaphragm and chest [3]. The thorax frequently harbors undiagnosed pleural disease at the time of the initial diagnosis which is likely to affect survival even in cases of optimal debulking [4]. Accurate imaging helps guide the surgeon to areas of disease that may be difficult to identify surgically. Relative criteria for non-optimally resectable disease have been developed [5,6]. They include lymph node enlargement above the renal hilum, presence of abdominal wall invasion, parenchymal liver and subcapsular liver metastases, peritoneal implants of >2 cm along the diaphragm, lesser sac, porta hepatitis, intersegmental fissure, gall bladder fossa, gastroplenic, gastrohepatic ligament and small bowel mesentry. However, it is important to realize that these criteria may vary and will depend on the aggressiveness of the surgical procedure and on the performance status of the patient. Therefore, they should only be used as a basis for a multidisciplinary consensus [6,7]. It is important to note that upper abdominal disease and pleural metastases can be surgically resected, but this requires careful planning as it involves a team of surgeons (e.g. liver surgeon for hepatic resection). There has been a growing awareness of the potential of diffusion weighted magnetic resonance imaging (DW-MRI) in improving the mapping of the extent of ovarian cancer [8,9]. There is also growing evidence that FDG-PET/CT may play a role in pre-operative staging of patients with advance ovarian cancer [10].

References
goyo.2013.10.001

WEDNESDAY 7TH OCTOBER 2.15-5.30
O39
Brain gliomas: reporting essentials and treatment response
Bradley J Erickson
Department of Radiology, Mayo Clinic, Rochester, MN, 55902, USA
E-mail: bje@mayo.edu
Cancer Imaging 2015, 15(Suppl 1):O39
The diagnosis of brain glioma can challenging, particularly when the masses are very large. While the majority of gliomas are astrocytomas or oligodendrogliomas, enough are of other types that awareness of these others is critical. This course will begin with a review of some of the distinctive features of common and less common brain tumours, with particular focus on the distinctions that make a difference in approach. Once a tumour is diagnosed and therapy instituted, clinicians will appreciate it greatly if you interpret the images with a mind to how they measure therapy response. This requires an awareness of the treatment regimen the patient is on, and changes in agents like steroid dose. RECIST is applied throughout most of the body, but recently, the Response Assessment in NeuroOncology (RANO) criteria were published, to address some of the specifics of neurooncology [1]. These are still largely visually based, and some are retrospective, designed for clinical trials, not well-suited for patient management. If the patient is on trial, the referring physician may wish to have RANO-based assessments, but in cases where they are not on protocol, other styles of reporting are likely to be more valuable. RANO is largely focused on conventional anatomic imaging methods, but new quantitative methods reflecting water diffusion and tumour perfusion appear to improve response assessment. Diffusion restriction typically reflects higher cell density seen in viable tumour as well as higher grade tumour [2]. Changes in apparent diffusion coefficient (sometimes referred to as functional diffusion mapping) can be very helpful in understanding an imaging examination [3]. Higher cerebral blood volume is also seen in viable tumour and higher grade tumours. When conventional, diffusion and perfusion all agree, the confidence in one’s assessment can be high and some have proposed mathematical combinations to further improve
diagnostic performance [4,5]. However, they often do not agree, and it is critical to be aware of the limitations and pitfalls in these methods that might lead to a contradiction and an error in assessment.

The combination of temozolomide and radiation has been shown to improve survival but also has a high rate of pseudoprogression, which is present in 1/2 to 1/2 of subjects, particularly when the tumour is MGMT methylated [6]. It is important to distinguish pseudoprogression from true progression so that patients can be maintained on effective therapy. Patients with true progression are often switched to anti-angiogenic agents that can dramatically reduce enhancement and cerebral blood volume, suggesting response, when the tumour is still growing (pseudoresponse). Imaging findings that can help to diagnose pseudoresponse will also be discussed. Newer agents like measles vaccine can also produce imaging findings that can be confusing and confounding, and examples will be presented.

References

O40 Brain lesions in oncology patients: recognising metastatic versus non metastatic lesions
Philip Rich
Department of Neuroradiology, St George’s University Hospitals NHS FT, Consultant Neuroradiologist, The Royal Marsden NHS FT, UK
Cancer Imaging 2015, 15(Suppl 1):O40

Therapeutic developments across a range of primary tumours have resulted in more cancer patients with cerebral metastatic disease undergoing active management and imaging surveillance. There has been an increase in the caseload and range of disease presenting to oncology and neuro-oncology MDTs. In this lecture I will present examples of intracranial metastases, discuss differences in appearance according to primary site and tips for differentiating from primary intracranial tumours and non-neoplastic mimics.

Aim: Dual energy CT (DECT) has already proven its potential in oncological imaging, e.g. for contrast media quantification, tissue characterisation and monitoring targeted therapies. Considering that oncological patients have repeated follow-up examinations, dose issues should not be neglected. Purpose of this study was to evaluate radiation dose of conventional single energy CT (SECT) versus DECT abdominal imaging in clinical routine.

Methods: 100 patients (62y (± 14)) had either SECT (44) or DECT (56) in clinical routine. Computed tomography dose index (CTDIvol), dose length product (DLP) and CTDI normalised to amount of contrast media (CTDIn) were reported. CTDivol was transformed to patient specific dose estimate (SDSE). Image noise (SD) was recorded as the mean measurement of three ROIs placed in subcutaneous fat and was normalised to absorbed dose by $SD_{\text{N}} = SD \times \sqrt{\text{CTDIvol}}$. Statistical significance was tested with two-sided t-test ($\alpha < 0.05$).

Results: There was no significant difference of the reported parameter between DECT and SECT: mean DECT-CTDIvol was 14.2 mGy (±3.9), mean SECT-CTDIvol 14.3 mGy (±4.5). Mean DECT-DLP was 680 mGycm (±220), mean SECT-DLP 665 mGycm (±231). Mean CTDIn was for both DECT and SECT 0.11 mGy/ml (±0.02). Mean DECT-SDSE was 15.7 mGy (±1.9), mean SECT-SDSE 16.1 mGy (±2.5). Mean DECT-SDn was 42.2 HU*mg/cm (±13.9), mean SECT-SDn 47.8 HU*mg/cm (±14.9).

Conclusion: Advanced abdominal imaging with DECT is feasible without increasing radiation dose. This is of special interest in oncology, where targeted therapies demand more than simple size measurements. Functional information from dual energy CT will, without dose penalty, contribute to sophisticated oncological imaging.

P2 Contrast enhancement for early cancer imaging by Gd-nanoparticles and active feedback MRI
S Ray*, C-H Hsu, F-C Lin, Z Li, T Kim, Y-Y Lin
Department of Chemistry of Biochemistry, University Of California, Los Angeles, 607 Charles E. Young Drive East, Los Angeles, CA 90095-1569, USA
E-mail: sayoni@chem.ucla.edu
Cancer Imaging 2015, 15(Suppl 1):P2

Aim: Early detection of high-grade malignancy using enhanced MRI techniques significantly increases not only the treatment options available, but also the patients' survival rate. For this purpose, we have developed a new method, termed “Active-Feedback MRI”. An active feedback electronic device was homebuilt to implement active-feedback pulse sequences to generate avalanching spin amplification, which enhances the weak field originated from $T_1$ contrast agents such as Gd-nanoparticles that target and label the cancer cells.

Methods: The general principles of the “Active-Feedback MRI” can be found in our previous work (e.g., Science 290, 118, 2001). Here, its specific applications to image Gd-nanoparticles in early cancers were developed and demonstrated. (i) First, an active-feedback electronic device was home-built to generate feedback fields from the received FID current. The device is to filter, phase shift, and amplify the signal from the receiver coils and then retransmit the modified signal into the RF transmission coil, with adjustable and programmable feedback phases and gains. (ii) Next, an active-feedback pulse sequence was developed to enhance the contrast originated from local magnetic-field gradient variations due to Gd-nanoparticles.

Results: In vivo subcutaneous glioblastoma multiforme (GBM) and cervical cancer mice models were imaged. While $T_2$ parameter images, $T_2$-weighted images, and $T_1$-Gd-weighted images could not clearly locate the early cancers, our active-feedback images and decay constant mapping successfully highlight the early cancers with a close correlation with histopathology. Statistical results show that this new approach provides significant improvements in cancer detection sensitivity, as measured by “contrast-to-noise ratio” (CNR) or “Visibility”.

Conclusion: In vivo subcutaneous xenografts GBM and cervical cancer mouse models validated the superior contrast/sensitivity and robustness of this approach towards early cancer detection. Spin dynamics and results from computer simulations will also be discussed.
P3

Increase in lesion enhancement on gadoxetic acid enhanced MRI is associated with complete response to neoadjuvant chemotherapy in colorectal liver metastases

S Islam*, R Yin, A Riddell, H Tam, K Jhaveri, DM Koh
Royal Marsden NHS Trust, Surrey, UK
E-mail: Shahriar.islam@mnh.nhs.uk
Cancer Imaging 2015, 15(Suppl 1):P3

Aim: The aim was to determine whether the degree of enhancement on hepatocellular phase gadoxetic acid enhanced MRI and the apparent diffusion coefficient (ADC) before and after neoadjuvant chemotherapy could identify pathologic complete responders in colorectal liver metastases (CRLM).

Methods: In this retrospective study, 22 patients (15 M: 7F; mean age = 65) with CRLM were evaluated with gadoxetic acid enhanced MRI before and after chemotherapy. Regions of interest were drawn encompassing metastases on T1W images and ADC map by an expert radiologist to record their average signal intensities (SI) normalised to the SI of paravertebral muscle and the average ADC value. We compared the median ADC value; pre-contrast and hepatocellular phase normalised SI and their percentage change in pathologic complete responders and pathologic non complete responders before and after chemotherapy using Mann-Whitney test. Receiver operating curve characteristics (ROC) of these parameters were determined. A p-value of ≤ 0.05 was deemed statistically significant.

Results: All patients received FOLFOX/FOLFIRI based-chemotherapy, while 8 patients were given chemotherapy agents as bevacizumab. There were 37 CRLM at histology, of which 10 showed complete pathological response. There was a significant difference in the median percentage increase in the hepatocellular phase normalised SI of CRLM after neoadjuvant chemotherapy between pathologic complete responders (18%) and pathologic non complete responders (2.5%) (p = 0.04). By ROC analysis, an increase in the median hepatocellular phase normalised SI of 6% after chemotherapy has a sensitivity of 85% (95%CI:55-98%) and specificity of 70% (35-93%) for identifying pathologic complete responders (p=0.03). The other parameters including ADC were not statistically significant.

Conclusions: An interval increase in the hepatocellular phase normalised SI of CRLM is associated with pathologic complete response following neoadjuvant chemotherapy.

P4

Hepatocellular carcinoma: current imaging techniques

S De Luca, E Casalini Varek, A Vazquez, M Wirtz, F Troncoso, E Eyheremendy
Hospital Aleman, Buenos Aires, Argentina
E-mail: sdeluca@hospitalaleman.com
Cancer Imaging 2015, 15(Suppl 1):P4

Learning objectives: Describe the use of current imaging techniques to reach a correct diagnosis of hepatocellular carcinoma. Emphasise the knowledge of complementary tools for the evaluation of early response to treatment.

Content organisation: Our cases will be presented in a pictorial essay mode.

It is important to consider: The radiologic diagnosis of HCC can be made by either CT or MRI methods.

Typically, HCC enhances during the arterial phase due to the presence of an intense arterial blood supply of the hepatic arteries. TC dual Energy: Dual-energy CT (DECT) is an innovative imaging technique that operates on the basic principle of application of two distinct energy settings that make the transition from CT attenuation-based imaging to material-specific or spectral imaging. DECT can also aid in evaluation of response to therapy and detection of oncology-related disorders. MDCT perfusion: non-invasive method of quantification of tumour blood supply, related to the formation of new arterial structures (neoangiogenesis), which are essential for tumour growth.

Conclusion: Dual energy and perfusion CT are innovative techniques to detect suspicious lesions of hepatocarcinoma. Dual Energy CT also helps to reduce radiation exposure by using low dose imaging protocols without affecting diagnostic purpose.

The Perfusion provides information on the neovascularization of an injury (predicting malignancy) and assesses early therapeutic response (before displaying morphological changes).

P5

Role of MRI in evaluation of small bowel disease

Foad Serag El-Dein, Khaled M Moghazy*, Amany El-banna, Ahmed Hafez Alfii, Abeer Abo-Elilela
Radio-diagnosis Department, Alexandria University, Alexandria, Egypt
E-mail: moghazy20@yahoo.com

Introduction: Magnetic Resonance Imaging of the Small Bowel (MR Enteroigraphy, or MRE) is becoming increasingly popular as the first imaging modality for the diagnosis and follow-up of small bowel diseases. The aim of this work was to evaluate the role of recent MRI sequences and techniques in evaluation of small bowel disease.

Patients and methods: The study population included 24 patients who were referred to multiple radiology centers by gastroenterologist for magnetic resonance enterography (MRE) for evaluation. The examination was done on 1.5 Tesla superconducting magnet MRI.

Results: All studied patients had small bowel lesions. 15 patients were neoplastic (64%) and 9 patients were inflammatory (36%). Among 15 cases of small-bowel neoplasm; 12 were malignant; and 3 were benign. The malignant cases were classified as follows: lymphoma (6 patients); adenocarcinoma (4 patients); GIST (1 patients) and carcinoid tumour(1 patient). Nine patients out of 24 had inflammatory bowel diseases. Eight cases out of 9 proved to be specific inflammatory disease and 1 chronic non specific ileocolitis. Seven cases out of 8 proved to be Crohn’s disease and 1 proved pathologically to be TB of small bowel. The final diagnosis was confirmed by surgical or endoscopic data and follow up.

Conclusions: MRE is accurate non-invasive modalities in assessing the intra-luminal, paretial and extra-luminal small bowel tumour without the need for ionizing radiation. MR signal appearances of the lesions, combined with the contrast enhancement behavior and the characteristic of the stenosis, can help in differentiating neoplastic from other non-neoplastic diseases of small bowel.

P6

Factors in the success of the subcutaneous central venous port catheter in 626 colorectal carcinoma patients: long-term follow-up results according to the treatment groups

BK Aribas*, T Uylar, MY Aksoy, I Turker, F Yildiz, R Tiken, I Akdulum
Dr. Abdullaheman University Ankara Oncology Education and Research Hospital Ankara, Turkey
E-mail: bilginaribas@hotmail.com
Cancer Imaging 2015, 15(Suppl 1):P6

Aim: Our purpose is retrospectively to investigate the effect of factors on the patency of subcutaneous central venous port catheters inserted to 626 colorectal carcinoma patients.

Patients and methods: Subcutaneous central venous port catheters were inserted in 1,408 patients. 241 were female, 383 were male. Patients were given chemotherapy agents as bevacizumab in 106, cetuximab in 30, and outside of these target-directed agents in 488. The groups to chemotherapy time were divided by 3 days cut-off. Age, gender, jugular-subclavian access, the chemotherapy to be given in 3 days as bevacizumab, cetuximab, other chemotherapy agents were also investigated.

Results: The average age was 57.7 ± 11.3. The average follow-up period was 443.2 ± 387.8 days (1-1787 days). The catheters were removed depending on the port complications in 6 patients of bevacizumab group, 3 patients of cetuximab, and 11 patients of other chemotherapy group. A significant difference was observed in 3 days chemotherapy between cetuximab and out-of bevacizumab-cetuximab groups (p=0.013), also between bevacizumab and out-of bevacizumab-cetuximab the groups (p=0.007). No significant difference was observed out of 3 days chemotherapy (p>0.05). There was no difference between groups in Cox regression test. Significant difference was observed in catheter patency of
bevacizumab-cetuximab group, due to the skin necrosis and thrombosis (p=0.011).

Conclusion: Significant effect was found by reducing the duration time in patients with the target-directed chemotherapy agent as bevacizumab-cetuximab.

P7
Characterisation of hepatobiliary lesions in an African referral hospital: initial MDCT dose challenges

TM Mutala, NM Tole, NM Kimani
University of Nairobi, Nairobi, Kenya
E-mail: mutala@uonbi.ac.ke
Cancer Imaging 2015, 15(Suppl 1)p7

Aim: To assess the justification of abdominal CT examinations carried out, quantify radiation dose and evaluate the optimisation of scanning parameters that contribute to patient radiation dose.

Methods: A crosssectional survey was carried out on 69 patients who underwent triple phase CT imaging for suspected hepatobiliary neoplastic involvement at a referral hospital in Kenya that had acquired its first multidetector CT scan (16 slice) between July 2008 and March 2009. Justification of examination (matching clinical indications and imaging findings), optimisation of scanning parameters such as mAs and KVP as well as radiation doses in dose length product (DLP) and effective dose were assessed.

Results: Seventy three per cent of the patients had diagnosis that was supportive of their management while 20 % had negative findings and 7% had indeterminate findings that required further imaging evaluation. The mAs and KVP were 300 and 120 respectively. DLP range was from 2633 to 3990 mGy.cm with a mean 3087.5 and standard deviation 322.81. The estimated effective dose mean was 52.38 mSv and a standard deviation of 5.49.

Conclusion: The findings of this study acknowledge that triple phase imaging has a clear diagnostic advantage where the indication is qualified. However, more technical support is required for optimisation of imaging protocols to contain radiation doses to internationally expected levels for any new technology especially in regions where medical physicists are few.

P9
Oxygen-enhanced MRI can accurately identify, quantify and map tumour hypoxia in preclinical models

JPB O’Connor, JKR Boult, Y Jamin, M Babur, KG Finegan, KJ Williams, AR Reynolds, RA Little, A Jackson, GMP Parker, JC Waterton, SP Robinson
University of Manchester, Oxford Road, Manchester, M13 9PL, UK
E-mail: james.oconnor@manchester.ac.uk
Cancer Imaging 2015, 15(Suppl 1)p9

Aim: There is need for non-invasive methods to identify, quantify and map tumour hypoxia. In this study we used an emerging technology – 18F-FDG PET/MRI (FDG-PET/MRI) – to distinguish those tumour sub-regions that respond to hypoxic gas challenge from refractory sub-regions. We hypothesised that the proportion of refractory tumour tissue (Oxy-R) would be a robust biomarker of tumour hypoxia across multiple models with different vascular and hypoxic phenotypes.

Methods: PET/MRI signal precision, stability and reliability of tissue pO2 were evaluated in well vascularised renal cancer 786-O xenografts. Dynamic sensitivity of proportional Oxy-R to acute changes in hypoxia was evaluated using hydralazine challenge. Relationship of proportional Oxy-R to tissue immunohistochemistry and gadolinium DCE-MRI were explored in parental and drug-resistant 786-O models and in SW620 xenografts.

Results: Phantom and in vivo experiments demonstrated the accuracy, precision and stability of R. Measurement. The proportion of tumour Oxy-R increased significantly following hydralazine challenge (p=0.045) relative to control. The proportion of tumour with perfused Oxy-R voxels was correlated to chronic hypoxia in well perfused 786-O-R xenografts (r=0.810, p=0.028) and in relatively necrotic SW620 xenografts (r=0.929, p=0.002).

Conclusion: The proportion of tumour perfused Oxy-R is a robust biomarker of tumour hypoxia. Voxel-wise analysis of dual oxygen and gadolinium challenge has potential to quantify and map tumour hypoxia as prognostic, predictive and pharmacodynamic biomarkers that could facilitate personalised healthcare.

P8
First case report of usefulness of 18F-FDG PET/CT in diagnosing typhilitis (an oncological emergency)

ZA Khan1, F AlSugair1, R AlSaioom1, AR AlNaim1, M Abouzeid1, A AlSugar1
1Department of Radiology and Nuclear Medicine, King Faisal Specialist Hospital & Research Centre, Riyadh, Kingdom of Saudi Arabia, 2Al-Imam University, Riyadh, Kingdom of Saudi Arabia
E-mail: zuby106@yahoo.com
Cancer Imaging 2015, 15(Suppl 1)p8

Aim: Typhilitis (neutropenicenterocolitis) is a life-threatening condition with 50% mortality occurring in 3.5% of adult neutropenic patients. With no definitive physical findings, diagnosis is usually made with contrast-enhanced computerised tomography (CECT). We present the first-ever case report of usefulnesse of 18F-FDG PET/CT.

Methods: A 35-year-old lady was admitted with febrile neutropenia in July 2008. The initial MDCT dose was 2.6Gy. The patient developed septic shock and was subsequently diagnosed with typhilitis. Following some improvement in clinical details and/or clinical images was obtained from the patient/parent/guardian/relative of the patient.

Results: PET/CT showed moderate uptake (SUVmax S.1) in the caecum and rectum which were swollen and oedematous on unenhanced CT. A diagnosis of typhilitis was made. There was hepatosplenomegaly and increased bone marrow activity. There were a few foci of abnormal mild uptake in distal right humerus and both distal femora, which possibly represented scattered early osteomyelitis. The patient unfortunately continued to deteriorate and died just under two weeks later.

Conclusion: 18 F-FDG PET/CT is a useful technique for diagnosis of typhilitis. Being hybrid, it provides both structural and functional information. Whole body coverage may show additional findings allowing comprehensive patient management.

Consent to publish: Written informed consent for publication of their clinical details and/or clinical images was obtained from the patient/parent/guardian/relative of the patient.

P10
Role of molecular functional imaging in present era of evidence based cancer medicine: to image or to imagine?

A Mahajan1,2,*, G Cook*, V Goh1, S Basu3, M Thakur4, A Weeks2
1Tata Memorial Centre, Mumbai, India, 2St Thomas’ Hospital, Kings College London, London, W2R 2LS, UK
3St Thomas’ Hospital, Kings College London, London, W2R 2LS, UK
4St Thomas’ Hospital, Kings College London, London, W2R 2LS, UK
E-mail: abhishek.mahajan@tlcl.ac.uk
Cancer Imaging 2015, 15(Suppl 1)p10

Learning objectives: Molecular functional imaging (MFI) has given a newer insight to the medical imaging and has diversified the role of imaging in the field of the translational cancer medicine and has an indispensable role to play in screening, early diagnosis, staging, predicting prognosis, therapy delivery, therapy monitoring and follow-up. Overall there has been a significant development in the field of molecular imaging and its utilisation in the perspective of the biomedical research which has led to better understanding of the signalling pathways in the tumourgenesis and novel drug discoveries.

Review and Highlight the complementary role of these techniques in the detection and staging of tumours and which of these techniques is more appropriate for clinical scenarios in oncology.

Content organisation: • Cancer And Molecular Functional Imaging (MFI).
  • MFI Of Gene Expression, Receptors And Signalling Pathways.
  • MFI of Multidrug-Resistance In Cancer.
MFI Of Extracellular Matrix And Its Key Components.
MFI Of Neangiogenesis, Hypoxia And Metabolism.
MFI And Small Animal Imaging.

Conclusion: The future of molecular functional imaging in the coming era is its exploitation into understanding the gene expression profiling in-vivo and optimising the patient specific therapies using gene expression profiling. Quantitative molecular functional imaging, in conjunction with quantitative structural imaging, will be the future of ‘personalised radiology,’ ‘personalised oncology,’ ‘personalised medicine,’ and of oncologic research in the 21st century and beyond.

P11
Value of PET-CT in plasma cell dyscrasias: a literature and pictorial review
R Aggarwal*, Y Griffin
Leicester Royal Infirmary, Infirmary Square, Leicester, LE1 5WW, UK
E-mail: reena.aggarwal@doctors.org.uk
Cancer Imaging 2015, 15(Suppl 1):P11

Learning objectives: • To evaluate indications for PET-CT in plasma cell dyscrasias and its added value over other imaging modalities with review of literature based evidence and reference to the RCR/RCP guidelines.
• To discuss the use of PET-CT and subsequent clinical impact at our institution with pictorial illustration.
• To discuss the limitations and potential pitfalls of PET-CT with pictorial illustration.

Content organisation: • Role of imaging in the diagnosis, management and follow up of plasma cell dyscrasias.
• Indications for PET-CT and circumstances in which it is and is not likely to be beneficial with review of literature based evidence and RCR/RCP guidelines.
• Use of PET-CT at our institution with subsequent clinical impact in staging of non-secretory disease, myeloma, PDEMMS disease, assessing plasmacytoma response to treatment and MGUS transformation to myeloma with pictorial illustration.
• Limitations and potential pitfalls of PET-CT with pictorial illustration.

Conclusion: Although PET-CT is recommended by Durie-Salman Plus, it is not widely adopted. RCR guidelines advise PET-CT for monitoring non-secretory myeloma and assessing active disease. At our institution, PET-CT influenced patient management in 95%. PET-CT is useful in staging myeloma, in detection of occult bone/nodal disease and in detecting residual active disease or recurrent disease post chemora/diatherapy/bone marrow transplant. It is of less value in diffuse bone marrow involvement. PET-CT has added value to conventional imaging techniques especially when they are normal, indeterminate or contraindicated.

P12
An imaging review of extramedullary myeloma
M Kay*, A King, B Shepherd, E Rutherford, J Smart, K Tung
University Hospital Southampton, Tremona Road, Southampton, Hampshire, SO16 6YD, UK
E-mail: michael.kay@uhs.nhs.uk
Cancer Imaging 2015, 15(Suppl 1):P12

Learning objectives: Numerous studies have demonstrated increasing overall survival in patients with multiple myeloma over the last 40 years. Novel agents including thalidomide and bortezomib used in induction therapy, together with autologous stem cell transplant in consolidation, have improved patient outcomes. Whilst extramedullary myeloma can be a presenting form of the disease, it is becoming increasingly recognised that extramedullary disease is common in patients who have relapsed disease, often after multiple lines of therapy. Whether this is due to either a possible “sanctuary site” effect from treatment in extramedullary tissues, prolonged overall survival leading to an evolution in the natural history of the disease, or the improved sensitivity of imaging techniques is not clear.

Content organisation: We present a multimodality pictorial review of cases of extramedullary myeloma imaged at our tertiary oncology institution, demonstrating the common appearances on conventional imaging and the advantages of functional imaging such as PET/CT in these cases.

Conclusion: Being aware of the possibility of extramedullary disease, especially in cases of disease relapse, and the common imaging appearances, is vital due to the increasing incidence of this manifestation of the disease.

P13
Patient experience of whole body diffusion weighted magnetic resonance imaging (WB-MRI) for staging myeloma
S Otero*, M Kaiser, C Pawlyn, S Giles, E Scutt, C Messiou
The Royal Marsden Hospital (Surrey), Sutton, Surrey, SM2 5PT, UK
E-mail: oterosofia@hotmail.com

Aim: WB-MRI provides a fast, highly sensitive assessment of disease burden in myeloma. The 2015 International Myeloma Working Group consensus statement recommends WB-MRI for staging asymptomatic myeloma and for workup of solitary bone plasmacytoma. The technique is noisy, employs whole body surface coils, and takes longer than a standard MRI spine. We assessed patient experience of WB-MRI and identified causes for incomplete examinations.

Methods: 36 consecutive patients undergoing WB-MRI for myeloma (whole body DWI and Dixon, fast T1w and T2w spine) were included. Patients anonymously completed a ten-question survey about their experience. The reporting radiologist recorded technical details and radiological findings.

Results: WB-MRI was well tolerated in most patients. 89% completed the protocol; kyphosis and claustrophobia were causes of incomplete studies. 85% found the scan ‘not at all unpleasant’ or ‘not too unpleasant’, 96% were satisfied with the quality of information provided to them prior to the examination. 93% had had a previous MRI and 86% were not worried about having WB-MRI. 93% would have a repeat study.

Average scan length was 48 minutes. Two-thirds of patients found this acceptable. 18% of patients cited claustrophobia as the reason for finding the examination too long. 44% of patients had chronic vertebral fractures, but this did not correlate with the level of discomfort experienced. Half of scans were positive for active disease.

Conclusions: Patients report a high level of satisfaction with WB-MRI at our institution. The protocol was completed in almost all patients, and most stated they would have a repeat study.

P14
Radiogenomics of glioblastoma: a window into its imaging and molecular variability
A Mahajan*, A V Moiyadi, R Jalali, E Sridhar
Tata Memorial Centre, Mumbai, India
E-mail: abhishek.mahajan@tmc.tmc.ac.in
Cancer Imaging 2015, 15(Suppl 1):P14

Learning objectives: Gliomas, the most frequent tumours occurring in the CNS, are defined and graded on the basis of histological features to predict prognosis and management. Owing to biological heterogeneity, the histological diagnosis and expected clinical outcome do not match in a significant number of patients. The combination of imaging and gene expression, referred to as “radiogenomics,” has the potential to give insight into tumour biology that would be difficult to acquire from either technique alone.

• Throwing light upon individual imaging feature and biological/ molecular alterations, analyses that may detect subsets of morphologically identical tumours with different clinical behavior (diagnostic markers).

Content organisation: • Classification and grading of Gliomas as per Haarlem consensus.
• Imaging features of glioblastomas may correlate with molecular mutations.
• Identification of imaging parameters that has the potential as a non-invasive biomarker for common molecular mutations associated with gliomas and their associated clinical impact.
• Review of current radiogenomics literature.

Conclusion: • Given the noninvasive nature of medical imaging and its wide use in clinical practice this approach facilitates the association
of complex molecular signatures with readily identifiable imaging characteristics.
• As we move toward a more individualised approach to therapy for glioblastoma on the basis of its specific genetic and biochemical features, radiologists may contribute to the future development of targeted agents for treatment of glioblastoma.

P15
Gadobenate dimeglumine (MultiHance) or gadoterat emeglumine (Dotarem) for brain tumour imaging? An intra-individual comparison
M Vaneckova, M Hermann, MP Smith, M Mechl, KR Maravilla, C Calosimo, A Bonafé, S Lui, MA Kirchin*, G Pirovano
Bracco Imaging SpA, Milan, Italy
E-mail: miles.kirchin@bracco.com
Cancer Imaging 2015, 15(Suppl 1):P15

Purpose: To intra-individually compare 0.1 and 0.05 mmol/kg gadobenate (MultiHance) with 0.1 mmol/kg gadoterate (Dotarem) for contrast-enhanced MRI of brain tumours.

Method and materials: One hundred seventy-seven adult patients with suspected or known brain tumours were randomised to one of two study arms to undergo two identical exams at 1.5T, one with gadobenate at 0.1 (Arm 1; 70 patients) or 0.05 (Arm 2; 107 patients) mmol/kg bodyweight, and the other with gadoterate at 0.1 mmol/kg bodyweight. The agents were injected in randomised order separated by 2–14 days. Imaging sequences (T1SE and T1GRE) and acquisition timing were identical for the two exams. Three blinded readers evaluated images qualitatively for diagnostic information (lesion extent, delineation, morphology, enhancement, global preference) and quantitatively for % lesion enhancement and lesion-to-background ratio (LBR). Safety assessments were performed.

Results: In Arm 1, readers 1, 2 and 3 demonstrated highly significant global preference for gadobenate (31 vs. 1, 51 vs. 2, 43 vs. 2 patients, respectively; p<0.0001, all readers), all other qualitative endpoints (p≤0.0023; all readers) and for % enhancement (p≤0.0006) and LBR (p≤0.0001). Significant (p=0.023) differences between 0.05 mmol/kg gadobenate and 0.1 mmol/kg gadoterate (in favour of gadobenate) were noted only by reader 2 for % enhancement. Study agent related adverse events were reported by 2/169 (1.2%) patients after gadobenate and by 5/175 (2.9%) patients after gadoterate.

Conclusion: Significantly superior morphologic information and contrast enhancement are demonstrated on brain MRI with 0.1 mmol/kg gadobenate compared to 0.1 mmol/kg gadoterate. No meaningful differences were recorded between 0.05 mmol/kg gadobenate and 0.1 mmol/kg gadoterate.

P16
The value of head imaging after PET-CT staging in NSCLC
A Kamil*, L Bashir, Y Griffin
University Hospitals Of Leicester NHS Trust, Leicester, UK
E-mail: arnerik@hotmail.co.uk
Cancer Imaging 2015, 15(Suppl 1):P16

20–40% of patients with non small cell lung cancer (NSCLC) can develop brain metastases. Physiological activity on 18F- FDG PET-CT can mask FDG-avid brain metastases. At our institution PET-CT is acquired from orbits to thighs and will not identify brain metastases extrinsic to the posterior fossa. Inaccurate staging could initiate futile radical treatment. The British Thoracic Society recommends NSCLC patients, considered for radical treatment (particularly stage III), should have a CT or MRI brain.

Aim: We evaluated results of patients who underwent head imaging in those considered for radical treatment of NSCLC and effect on baseline 18F- FDG PET-CT staging.

Method: Retrospective study. 200 NSCLC cases from 2010 to 2015 that underwent PET-CT for potentially curative disease, were reviewed.

Results: 17% (34/200) patients had head imaging. There was an average interval of 115 days between head imaging and PET-CT, ranging from 1 day up to 2 years. 67% (23/34) patients received head imaging due to presenting neurological symptoms.

32% (15/49) patients with Stage IIIA disease had a CT/MRI brain resulting in 27% (4/15) having their initial PET-CT staging increased. 7.5% (15/200) patients had brain metastases. 93% (14/15) of these patients had presenting neurological symptoms.

Conclusion: Occult brain metastases can cause under staging with 18F- FDG PET-CT imaging. CT/MRI head imaging requires more vigorous implementation into routine staging of patients with potentially resectable NSCLC.

P17
Relating neurological symptoms to cerebral metastases at the time of initial staging scan
C Corbally*, S Bready, O Cram
New Southern General, Greater Glasgow and Clyde NHS, Glasgow, UK
E-mail: corbally@nhs.net
Cancer Imaging 2015, 15(Suppl 1):P17

Aims: Cerebral metastases represent a significant obstacle in the treatment of patients with systemic malignancies, occurring in 10–30% of patients with cancer. Brain imaging in neuro-asymptomatic patients is advised for some malignancies but not for others. Our aim was to examine the incidence of cerebral metastases in patients with a new diagnosis of the primary malignancies that commonly spread to the brain, and relate this with the patients’ neurological symptoms, if any.

Methods: Using our PACS and reporting system we retrospectively looked at all initial staging scans performed in the year 2013 for the following primaries: lung, breast, colorectal, melanoma, renal. From this list we selected out those patient in whom a CT brain was performed within six weeks of staging to assess for metastases. Using the hospital referral system and electronic records, we compared this with the patients’ neurological symptoms at time of scanning.

Results: From a total of 4063, 343 patients met our inclusion criteria, the vast majority of which were patients with a lung primary (266). We found varying rates of positive scans among the different primary malignancies, approaching 44% for lung primaries. While the most common indication for brain imaging was altered mental state, the symptom most predictive of cerebral metastases was new seizure activity.

Conclusion: Our findings support routine brain imaging for patients with lung primaries, in keeping with the literature. Although it was the most common indication, altered mental state such as confusion was not very predictive of cerebral metastases.

P18
Accuracy of MRI for prediction of response to neo-adjuvant chemotherapy in triple negative breast cancer
GI Bansal*, DS Santosh
Breast Centre Llandough, University Hospital of Llandough, Penlan Road, Llandough, CF64 2XX, UK
E-mail: gbansal@gmail.com
Cancer Imaging 2015, 15(Suppl 1):P18

Aim: The aim of this study was to compare the accuracy of MRI for prediction of response to neo-adjuvant chemotherapy in triple negative breast cancer, with respect to other molecular types.

Methods: The study comprised of 82 patients who underwent MRI before and after neo-adjuvant chemotherapy but just before surgery. Triple negative cancers were analysed with respect to others subtypes in terms of presentation on MRI (mass or non-mass like enhancement), grade, axillary involvement, shrinkage pattern on MR following chemotherapy and imaging and pathological complete response rate. Accuracy of MRI for prediction of pathological complete response was also compared between different subtypes, by obtaining ROC curves. SPSS (version 21) was used for all data analysis with p value of 0.05 as statistically significant.

Results: Out of a total of 82 patients, 29 were luminal (HR+/HER-), 23 were triple negative (HR-,HER-), 11 HER positive (HR+,HER-), 19 (HR+/HER+ hybrid). Triple negative cancers are more likely to present as masses on MRI on the pre-chemotherapy MRI scan, were grade 3 and show concentric shrinkage following chemotherapy. Triple negative cancers are more likely to have both imaging and pathological complete response following chemotherapy (p=0.035). For the triple negative group, MR had a sensitivity of 0.745 and...
specificity of 0.700 (p=0.035), with an area under curve (AUC) of 0.745 (95% CI 0.526-0.965).

Conclusion: Triple negative breast cancers present as masses and show concentric shrinkage following chemotherapy. MRI is most sensitive and specific in predicting response to chemotherapy in this group, compared to others subtypes.

P19
A pictorial series of interesting and unusual cases of breast malignancy encountered at triple assessment
N Roszkowski1, N Patel, R Oppe, M Stahrink
University Hospitals Southampton, Tremena Rd, Southampton, Hampshire SO16 6YD, UK
E-mail: natalia.roszkowski@uhs.nhs.uk
Cancer Imaging 2015, 15(Suppl 1):P19

Learning objectives: This pictorial series illustrates four cases with interesting imaging presentations of some unusual primary and secondary breast malignancies and aims to exemplify the range of appearances of malignancy and stimulate discussion of atypical differential diagnoses in appropriate cases.

Content organisation: We present a pictorial series of four patients with unusual breast pathology who initially presented to the triple assessment breast clinic in a tertiary university institution. For each case the imaging features and final diagnoses are critically appraised, along with a review of the literature. We illustrate a case reminiscent of bilateral invasive ductal carcinoma which, after further histological immune profiling, is confirmed to be the first presentation of a metastatic lung cancer. A sarcomatoid carcinoma presents as a densely calcified well-defined lesion on mammography accompanying a synchronous invasive ductal carcinoma and could initially have been seen as benign. We present the imaging features of a fibroadenoma which interestingly was shown to contain DCIS. We also highlight the appearances of a recurrent pleomorphic invasive lobular carcinoma within latissimusdorsi muscle following mastectomy and reconstruction.

Conclusion: Interesting and unusual differentials for malignant breast lesions are presented pictorially with an emphasis on the initial presentation and imaging findings. It is hoped that this will both educate and stimulate discussion of differential diagnoses in the breast imaging setting.

P20
The role of magnetic resonance imaging (MRI) in invasive lobular breast cancer based on mammographic density
Gj Bansal1, D Santosh, E Davies
Breast Centre Llandough, University Hospital of Llandough, Penlan Road, Llandough, CF64 2XX, UK
E-mail: gjbansal@gmail.com
Cancer Imaging 2015, 15(Suppl 1):P20

Patients and methods: We carried out a single centre retrospective analysis of all lobular cancers diagnosed between 2011-2015. We divided the patients into two groups, one with MRI performed preoperatively and other with no MRI. We analysed mammographic density, imaging size and post-operative histological size between the two groups. We also compared their surgical procedures and analysed if surgical procedure was altered after MRI. In case of alteration, we analysed if the change was adequate by comparing post-operative histological findings.

Results: There were a total of 97 patients, 36 had pre-operative MRI and 61 had no MRI. 27/36 (75%) in the MRI group had mammographic density > 50% versus 17/61 (27.8%) in the ‘no MRI’ group (p=0.009). MRI picked clinically relevant findings in 22/36 (61.1%) of patients. 12/36 (33.3%) had mastectomy following MRI, out of which 9 (25%) had change in surgical therapy following MRI. There was no overtreatment in the MRI group. Patients in the ‘No MRI’ group had larger histological size of tumours following mastectomy, with a higher mastectomy rate 26/61(42.6%) in this group, which was again appropriate.

Conclusion: Our choice of MR in preoperative planning of invasive lobular patients, based on mammographic density seems adequate. MRI led to appropriate change in surgical therapy in 25%. Although other factors such as patient choice for either mastectomy or conservative treatment plays an important role in pre-operative planning, we recommend breast mammographic density as one of the criteria.

P21
Chemotherapy induced cardiomyopathy: an overview, imaging features, and future prospective
D Divito, M Bondin, SK Kirschner, J Stojanovska, E Ibrahim, L Frank
University of Texas Medical Branch, 301 University Boulevard, Galveston, TX, USA
E-mail: lufrank@utmb.edu
Cancer Imaging 2015, 15(Suppl 1):P21

Learning objectives: To review the spectrum of imaging findings of chemotherapy- induced cardiomyopathy in correlation with most common cytotoxic drugs and regimens.

Content organisation: Cardio toxic effect of chemotherapy is a well-recognised problem in cancer patients. Cardio toxicity depends on multiple predisposing factors, specific components of the chemotherapy regimen, length of treatment, and dosage. We will present the spectrum of most common cardiotoxic chemotherapy agents and their combinations, specific effects on the myocardium, and imaging features of cardiomyopathies induced by chemotherapy.

We will review pathophysiology of chemotherapy induced cardiomyopathy including:
- Dose dependent cardiomyopathy.
- Predisposing conditions –diabetes, presence of coronary artery disease, age.
- Potential reversibility.

We will discuss imaging characteristics of chemotherapy induced cardiomyopathy.
- Imaging modalities (Echocardiography, Cardiac MR, and MUGA).
- Importance of monitoring cardiac function during and after treatment.
- Distribution of late Gadolinium enhancement (LGE).
- Emerging technologies for early diagnosis of cardiomyopathy in cancer patients.

Conclusions: Chemotherapy induced cardiomyopathy is a common problem among cancer patients, increasing long term morbidity and mortality and often leading to disability. Patients receiving chemotherapy treatment, particularly cardio toxic agents, should be routinely assessed for cardiac function to diagnose cardiomyopathy during the early phase of treatment and to prevent development of irreversible heart failure.

P22
CT characteristic of early local recurrence after resection of the squamous cell carcinoma: comparison with CT characteristics of granulation tissue at stump site
Hye Jeon Hwang1, Mi Young K2, Chang-Min Cho3,4
1Department of Radiology, Hallym University College of Medicine, Hallym University Sacred Heart Hospital, Korea; 2Department of Radiology and Research Institute of Radiology, University of Ulsan College of Medicine, Asan Medical Center, Seoul 138-736, Korea; 8 Asanbyeongwon-Gil, Songpa-Gu, Seoul 138-735, Korea; 3Pulmonary and Critical Care Medicine, University of Ulsan College of Medicine, Asan Medical Center, Seoul 138-736, Korea; 8 Asanbyeongwon-Gil, Songpa-Gu, Seoul 138-735, Korea; 4Oncology, University of Ulsan College of Medicine, Asan Medical Center, Seoul 138-736, Korea; 8 Asanbyeongwon-Gil, Songpa-Gu, Seoul 138-735, Korea
E-mail: mimowdr@naver.com
Cancer Imaging 2015, 15(Suppl 1):P22

Aim: To compare thin section CT characteristics of the early local tumour recurrence after the resection of squamous cell carcinoma (SCC) with those of the stump deformity or granulation tissue.

Methods: Twenty nine consecutive patients with local recurrence after definitive SCC operation from April 2006 to September 2012 were
Local recurrence were commonly observed as round/oval shape, peripheral eccentric lesion or central contour bulging lesion on CT, while the stump deformity or granulation tissue were commonly demonstrated as irregular or flat shape, focal wall thickening. The size of suspected soft tissue and the distance between stump staples and suspected soft tissue were significantly different between two groups (median; 19mm and 3mm; 18mm and 0mm, respectively, p< 0.001). The univariate analysis showed that the size of soft tissue and the distance between soft tissue and stump site were associated with the predictive factors of local recurrence (p< 0.001). On the receiver operating characteristic analysis, the optimal cut-offs of the size of soft tissue and the distance between soft tissue and stump staples were 6mm and 5mm, respectively.

**Conclusion:** The proper knowledge of stump recurrence regarding the size and the distance around the stump on CT imaging will help us achieve an early and higher diagnostic rate of recurved SCC.

---

**P23**

4th year medical student elective in multidisciplinary thoracic oncology

LE Quint*, RM Reddy
University of Michigan, 500 S State St, Ann Arbor, MI, USA
E-mail: lequint@umich.edu

Cancer Imaging 2015, 15(Suppl 1)P23

**Learning objective:** The objectives of this poster are to describe the methodology and curriculum content employed by a senior medical student elective entitled “Multidisciplinary Thoracic Oncology.” This elective provides students with experience in a focused area of oncologic practice and is valuable to those pursuing careers in a variety of related fields.

**Content description:** This month-long elective employs a flipped classroom approach with didactic teaching materials that are delivered on an interactive online platform. Materials include recorded videolectures with pre-lecture, post-lecture and embedded multiple choice questions (MCQs); case studies with a sequential, question and answer learning approach and embedded MCQs; a pre-course quiz and a post-course exam. These didactic materials are viewed by students at their own time and pace, typically during off hours. During daytime hours, the students rotate through relevant clinics, seeing patients and reviewing their cases with attending faculty, and occasionally assisting in surgical/interventional procedures. The areas covered include Medical Oncology, Pathology, Pulmonology, Radiation Oncology, Radiology and Thoracic Surgery, focusing on patients with lung, esophageal and other thoracic neoplasms. Each student presents one or more patients at the weekly Thoracic Tumour Board meeting. The capstone project is a written case study or an oral presentation based on a relevant topic. Comments from students who took this elective during the past year indicated enjoyment of “full engagement in the learning process and the patient care team” and “obtaining a well-rounded, multidisciplinary understanding of the presentation and treatment of these patients.”

---

**P24**

Imaging spectrum of lung adenocarcinoma with histopathological correlation

V Noble, A Shah*, F Mcleod
Oxford University Hospitals NHS Trust, Windmill Road, Oxford, OX3 7LD, UK
E-mail: aartishah1@gmail.com

Cancer Imaging 2015, 15(Suppl 1)P24

**Learning objectives:** The aim of this pictorial review is demonstrate the radiological appearances of adenocarcinoma with particular focus on more unusual appearances such as cystic adenocarcinoma.

**Content organisation:** Non-small cell lung cancers account for almost 85% of all lung cancers and of these, adenocarcinoma is the most common. This entity has recently been reclassified to reflect increased understanding of the underlying pathology and thus it is crucial for radiologists to understand the new classification, the role of radiology in identifying pre-invasive lesions and the guidelines for management of subsolid nodules. We present the spectrum of imaging appearances from ground glass nodules (GGNs) to solid mass lesions with histopathological correlation.

**Conclusion:** It is important for radiologists to recognize the spectrum of appearances of lung adenocarcinoma and follow appropriate algorithms for surveillance or further management.
P27
Factors on patency periods of subcutaneous central venous port: long-term results of 1,408 patients
BK Airas1*, T Uylar1, MY Aksoy2, I Turker1, F Yildiz1, R Tiken1, I Akdulum1
Dr. Abdurrahman Yurtaslan Ankara Oncology Education and Research Hospital, Ankara, Turkey
E-mail: bilginairas@hotmail.com
Cancer Imaging 2015, 15(Suppl 1):P27

Aim: To examine factors on patency times including complications of subcutaneous venous chest ports insertion using ultrasonography guidance in 1,408 patients with long-term follow-up.

Patients and methods: Between April 2009 and March 2014, subcutaneous venous chest ports were placed in 1,408 patients, 574 women and 834 men, mean age of 55.4±12 1 years. Factors on patency times and complications rates of ports were compared. Age, gender, access, site of malignancy, and coagulation parameters were variables and multivariable Cox regression test was used. The successes of jugular and subclavian groups were compared by univariate Kaplan-Meier survival analysis, also. Port was used for treatment after 3 hours on the procedure day.

Results: Fifty-seven patients underwent port removal due to complications. As a rate in 100 catheter days, ports were explanted in 29 (0.0054) due to thrombosis, in 9 infection (0.0017), in 8 (0.0015) for catheter malposition, in 5 bleeding (0.0009), in 5 skin necrosis with infection in one (0.0009), one port reservoir flip-over (0.0002), total 57 patients (0.0107). Patency times were not different in jugular and subclavian veins (p=0.230). Any factor was not significant except for malignancy site (p=0.002).

Conclusion: There was no significant difference of factors on patency times including complications in jugular vein access or subclavian vein access using ultrasonography. Malignancy site was the only significant factor in success. Malignancy site and gender were significant factors in thrombosis, as significantly higher in extremity and involving > one regions and in female patients.

P28
Are contouring time and multimodality imaging prognostic factors for radiation therapy of advanced head and neck cancer?
Y Elter1, ND Klass2, M Schmuckling2, O Elcin1, R Bieger2, J Tille1,3, S Frankhausser1, N Mertineit1, B Raeser1, A Geretschlaeger1,6
1Department of Radiation Oncology, Inselspital, Bern University Hospital and University of Bern, Bern, Switzerland; 2Department of Radiology and Radiation Oncology, Radiation Center Hamburg / CyberKnifeCenter Hamburg, Hamburg, Germany; 3Division of Medical Radiation Physics, Inselspital, Bern University Hospital and University of Bern, Bern, Switzerland; 4Department of Nuclear Medicine, Inselspital, Bern University Hospital and University of Bern, Bern, Switzerland; 5Department of Radiology, University Hospital Basel, Basel, Switzerland; 6Department of Radiation Oncology, St. Claraspital, Basel, Switzerland
E-mail: yannickeller@insel.ch
Cancer Imaging 2015, 15(Suppl 1):P28

Background: To evaluate if contouring time and multimodality imaging are prognostic factors for radiation therapy of advanced head and neck cancer (HNC) 207 patients were analyzed retrospectively between 2001-2012.

Material and methods: Before 2007 radiation treatment planning-CT was done without contrast enhancement, MRI and 18F-FDG-PET/CT were used only occasionally. From 2007 contrast enhanced planning-CT in addition to multimodality imaging was used routinely for every HNC. Additionally, in unclear or equivocal imaging findings of lymph nodes a re-report was performed with a higher sensitivity at the expense of specificity to minimise geographical miss in the contouring procedure for radiation treatment and to maximise the binary decisions for each lymph node (malignant vs. benign). These reports were done in conjunction with radio oncologists, nuclear physicians and radiologists. The mean contouring time was 60min before 2007, 150min after 2007 (including the time for a re-report). Clinical outcome was assessed in two groups (group I: 2001-2007, n=113 vs. group II: 2008-2012, n=94).

Results: Regional control was significantly higher in group II (log-rank-test p<0.03) group I after 2 years 76%, group II after 3 years 88%. Locoregional control for 207 patients shows no difference in survival (p=0.08); however, inclusion of 340 patients would lead to a p-value p<0.05.

Conclusion: Imaging findings of multimodality imaging and a critical re-report of these imaging findings in conjunction with a longer contouring time may have an impact on clinical outcome. However, this overtime is not reimbursed. A close collaboration of radiooncologists, nuclear physicians and radiologists in the radiation treatment planning process may have a benefit for patients with advanced HNC.

P29
Reducing error: benign abnormalities mimicking malignancy when reporting scans of patients with known malignancy
S Jenkins1, G Joseph1
Velindre Cancer Centre, Cardiff, UK
E-mail: sjanie47@gmail.com
Cancer Imaging 2015, 15(Suppl 1):P29

Learning objectives: To improve the ability to accurately report CT and MRI by learning to recognise benign findings that may mimic malignant pathology in the setting of scans performed on patients with known malignancy.

Content organisation: CT and MR images will be displayed demonstrating benign abnormalities that are easily misinterpreted as metastases, recurrent tumour or residual tumour in patients with known malignancy. Examples of benign findings will be displayed next to the corresponding malignant abnormalities to demonstrate the potential error.

Conclusion: The ability to accurately differentiate between benign and malignant disease can be challenging and can contribute to reporting discrepancies even amongst experienced radiologists. This can be especially demanding when imaging patients with known malignancy and is a concern for general and specialist radiologists. Being aware of abnormalities that mimic malignancy will help to increase the accuracy of CT and MR reports and ensure the correct treatment plans are implemented.

P30
Structured reporting of metastatic disease for improving communication in comprehensive cancer centers– a feasibility study
J Tesdorff1, D Simons, HP Schlemmer
German Cancer Research Center Heidelberg, Department of Radiology, Germany
E-mail: j.tesdorff@dkfz.de
Cancer Imaging 2015, 15(Suppl 1):P30

Background: To communicate imaging findings and interpretation precisely and comprehensively within a multidisciplinary treatment team written radiology reports are essential. Structured reporting systems increasingly take advantage of conventional free-form reports. Therefore we developed a visual imaging report chart and evaluated its acceptance by radiologists and oncologists in comprehensive cancer centers.

Method: Six imaging report charts of representative CT follow-up examination of patients with metastatic melanoma were recorded. Each chart includes a short and focused written text as well as a visual reporting diagram, which is composed of two sections: (1) patient characteristics; and (2) schematic documentation and graphical and pictorial visualization of the radiologic findings including documentation of imaging findings, treatment response according to qualitative or standardised criteria, clinical recommendation and the course of tumour burden. In total 36 reviewers (18 radiologists, 18 clinicians) compared the report charts with the corresponding conventional free-text report by a questionnaire grading their degree of satisfaction by a 10 point Likert-scale. Statistical significance was evaluated by one-way analysis of variance (ANOVA) and Student’s t-test.

Results: Referring oncologists rated improvement of therapy decision making for oncoplastic patients significantly higher than radiologists (p<0.01). A significant difference (p<0.005) was observed between radiologists and clinicians regarding their opinion on time-saving in working routine due to our reporting chart (5.1 vs. 8.7 respectively).

Conclusion: Structured reporting and documentation of CT examinations in metastatic disease is well appreciated by referring oncologists. The
We emphasise the importance of adequate clinical information and multidisciplinary interrelationship for the correct imaging interpretation in oncological patients.

**P31**

**RECIST criteria: our experience in daily practice**
S De Luca¹, C Carrera, E Casalini Vañek, L Tolkachier, L Alarcon, E Eyheremendy
Hospital Aleman, Buenos Aires, Argentina
E-mail: sdeluca@hospitalaleman.com
Cancer Imaging 2015, 15(Suppl 1):P31

**Learning objectives:** Describe the utility and limitations of RECIST 1.1 criteria.

- Emphasise the knowledge of complementary tools for the evaluation of response to treatment of solid tumours.

- Content organisation: Our cases will be presented in a pictorial essay mode. Key differential diagnostic points will be highlighted in the discussion of each case.

- It is important to consider:
  - Complete knowledge of clinical-oncologic status and treatments time points.
  - Recognition of smallest measured value (NADIR) between time points for adequate selection of comparative review.
  - Sum of target lesions (baseline and current time points) including percentage of change.
  - Select no more than two target lesions by sector.
  - Complete knowledge of anatomic extension field which often could present different behavior than other lesional sites.

- Local tumour growth over vital organs regardless strict RECIST criteria in exceptional cases.

- Further criteria utilization in line with oncological disease being studied (mRECIST criteria for hepatocellular carcinoma or CHOI criteria for GIST).

- Use of SUL on baseline PET CT studies with greater accuracy in assessing response on further evaluations (PERCIST criteria).

- Conclusion: RECIST 1.1 proposes internationally accepted criteria to unify and standardise response to treatment of solid tumours in oncologic patients. These criteria are reproducible but in some oncologic scenarios, we need to widen its use, due to the large number of treatment modalities and possible combined responses.

**P32**

**Reporting oncoimaging in the appropriate oncology setting**
S De Luca, C Carrera, E Casalini Vañek, L Tolkachier, L Alarcon, E Eyheremendy
Hospital Aleman, Buenos Aires, Argentina
E-mail: sdeluca@hospitalaleman.com
Cancer Imaging 2015, 15(Suppl 1):P32

**Learning objectives:** Demonstrate the importance of multidisciplinary interrelationship between the oncologist and the radiologist for correct imaging interpretation.

- Illustrate in a pictorial essay scenario, cases in which, considering clinical condition, laboratory values, complementary examinations and evolution of lesions on imaging exams are essential for an adequate presumptive diagnosis.

- Content organisation: The cases we will present include:
  - Young male patient with malignant germ cell tumour, treated with bleomycin. With pulmonary small nodules in a control MDCT suspected of metastasis in the setting of negative humoral markers and surgical biopsy confirmed drug hypersensitivity.
  - Male patient with mixed germ cell tumour in control MDCT which derived to PET CT demonstrated new hypermetabolic lymphadenopathy of mediastinum without elevated humoral markers and biopsy by mediastinoscopy confirmed sarcoidosis.
  - Patient with colorectal adenocarcinoma with lung, liver and adrenal metastasis in the context of onset of dyspnea. According to RECIST criteria represented a pulmonary stable disease but one of the nodules produced greater extrinsic compression of the nearest main bronchus so we considered real progressive disease clarifying that we did not take into account the classical criteria.

**P33**

**Tractography of the prostatic neurovascular bundles: technique and interpretation**
A Lakhani, T Barvick, W Gedroyc, J Lavdas, N Ngo, A Rockall, J Vale, M Winkler
Imperial College London, Exhibition Road, London, SW7 2AZ, UK
E-mail: a.rockall@imperial.ac.uk
Cancer Imaging 2015, 15(Suppl 1):P33

**Learning objectives:** To be familiar with the diffusion tensor sequence acquisition used to delineate the tracts of the prostatic neurovascular bundles.

- To understand the method for seeding and identifying the tracts and displaying the anatomy for surgical planning.

- To be familiar with the potential imaging and interpretation pitfalls.

- Content organisation: Diffusion tensor imaging (DTI) may be used for tractography of the peri-prostatic neurovascular bundles (NVBs). We will describe the MR acquisition technique that may be used to demonstrate the NVB’s. The method used for seeding the tracts will be illustrated with examples in healthy volunteers and in cases of prostate cancer.

- Correlation of the tractography with the histological sites of NVB’s will be demonstrated. Pitfalls related to the MR acquisition will be discussed and potential difficulties with interpretation will be presented.

- Conclusion: Tractography of the prostatic NVB’s is feasible and has the potential to demonstrate the anatomical position of the NVBs in relation to prostate cancer. This information could in future influence surgical decision-making.

**P34**

**Detection of gynaecological cancer in pregnancy**
F Cutbert, N Bhawani, A Rockall
Brighton and Sussex University Hospital, 177 Preston Road, Brighton, BN1 6AG, UK
E-mail: fecutbert@googlemail.com
Cancer Imaging 2015, 15(Suppl 1):P34

**Learning objectives:** The purpose of this educational poster is to:

- Review the challenges and limitations of imaging gynaecological cancer in pregnancy.
- To illustrate that optimizing imaging can provide diagnostically useful information to the multidisciplinary team, in particular we will review the principles and protocols of MR imaging in this context.
- Review the imaging appearances of gynaecological cancer in pregnancy.

**Content organisation:** When a pregnant patient presents with gynaecological cancer several issues must be considered by the multidisciplinary team – disease stage, nodal status, gestational age, obstetric complications and, importantly, the patient’s wishes regarding treatment where a balance must be sought between foetal well-being and optimal maternal therapy.

As always, diagnostic imaging is key to these decisions but in pregnant patients we are limited, we avoid CT and contrast agents and therefore ultrasound and MRI become paramount. We are further limited when diagnostic image quality is reduced by foetal movement artefact. We suggest and justify MR protocols written to maximise diagnostic yield.

We will present a narrative on the incidence and presentation of cervical cancer and ovarian cancer in pregnancy followed by a pictorial description of their key imaging findings at various disease stages. In the context of cervical cancer we will discuss considerations post fertility-preserving surgery.
P35

Fertility preservation in gynaecologic malignancy: imaging role in treatment planning
I Papadopoulou, M Qureshi, N Butterfield, N Bharwani, A Rockall
Imperial College London, Exhibition Road, London, SW7 2AZ, UK
E-mail: a.rockall@imperial.ac.uk
Cancer Imaging 2015, 15(Suppl 1):P35

Learning objectives: To know the options for fertility preservation in women with cervix, ovarian or endometrial cancer.
To understand the role and limitations of imaging in selection of patients for fertility preserving options.
To recognise the appearances of early stage disease that fulfil the criteria for eligibility for fertility preservation.

Content organisation: A significant number of women with gynaecological cancer are of childbearing age and have not completed their families. In these younger women, consideration of fertility-sparing options is very important. This poster will describe the fertility-sparing treatment options that are currently available and delineate the role of imaging in the selection of suitable patients. A review of the medical literature will be presented to provide an evidence base. In cervix cancer, MRI is used to delineate the size, position and stage of the tumour for the selection of patients suitable for radical trachelectomy. In complex adnexal masses, MRI with diffusion and perfusion is used to categorise the likelihood of invasive or borderline malignancy in order to allow potential fertility preservation where possible. In endometrial cancer, MRI is used to rule out imaging signs of invasive disease prior to consideration of hormonal treatment. Imaging is also used in patient follow-up for the detection of recurrent disease. Each of these scenarios will be illustrated.

Conclusion: Imaging plays a major role in the management of patients who are considering fertility-preserving treatment options for gynaecologic malignancy.

P36

MRI in intracavitary brachytherapy planning for cervical cancer malignancy, the pitfalls and complications
G Coniglio, O Roche, C Maciel, A Sahdev
St Bartholomew’s Hospital, W Smithfield, London, EC1A 7BE, UK
E-mail: giovanni.coniglio@bartshealth.nhs.uk
Cancer Imaging 2015, 15(Suppl 1):P36

Learning objectives: - Discuss the role and benefits of MRI in planning for brachytherapy treatment in cervical cancer.
- Discuss the key mechanisms of the applicator and the technical aspects of planning brachytherapy.
- Discuss the role of MRI imaging in recognising the features of appropriate applicator placement and common complications.
- Review key MRI features of radiation-related alterations in the pelvis post treatment and tumour response assessment.

Contents: - Anatomy of the female pelvic organs on MRI.
- Key MRI imaging features of cervical cancer on MRI.
- Advantages of brachytherapy versus external beam radiotherapy in treating cervical cancer.
- Technical aspects of applicator selection and positioning in brachytherapy.
- MRI features in assessment of appropriate placement of brachytherapy device, recognition of ‘organs at risk’.
- Benefits of MRI versus more traditional imaging techniques CT and Radiographs, in brachytherapy planning.
- ‘Red flag’ features of brachytherapy device misplacement in MRI.
- Features of tumour response and target organ assessment.

- Complications of brachytherapy including post radiation fibrosis.

Conclusion: - Analysis of MRI findings at the time of brachytherapy with the applicator is essential in the assessment of gross tumour volume, clinical target volumes and patho-anatomical structures.
- T2-weighted MRI images minimise potential misinterpretation due to partial volume effects, which improves depiction of tumour in parametria, vaginal fornices, and cervix.

P37

Pears and pitfalls in diagnosing prostate cancer using multiparametric MRI (mpMRI)
JJ Joshi, S Lee, P Acher, SH Liyanage
Southend University NHS Hospital Trust, UK
E-mail: jayjosh20@gmail.com
Cancer Imaging 2015, 15(Suppl 1):P37

Learning objectives: Using our experience of over 500 patients who have undergone pre-biopsy mpMRI (T2, DWI +/- DCE) and subsequent transperineal saturation prostate biopsy, we aim to:
- Illustrate the commonly overlooked areas in diagnosing prostate cancer with mpMRI.
- Emphasise technical factors that can contribute to suboptimal image interpretation.
- Highlight normal anatomical structures and non-cancerous abnormalities that mimic tumour.
- Demonstrate the use of mpMRI to direct further management.

Content organisation: mpMRI may be used in the pre-biopsy setting to determine type of biopsy (targeted vs. transperineal vs. transrectal), and predict biopsy outcome to the extent that biopsies may be avoided altogether. Tumour localisation within the prostate gland aids targeted biopsy and influences treatment (e.g. suitability for nerve sparing or radiation dose escalation). Tumours with unusual appearances and those in uncommon sites hinder MRI interpretation, potentially leading to false-negative or –positive findings. These areas of pitfall can be divided into normal anatomical structures in the peripheral or transitional zones or non-cancerous abnormalities that mimic tumours (e.g. granulomatous prostatitis).

It is also important to acknowledge that mpMRI itself has limitations. Technical challenges in relation to DWI may lower tumour sensitivity due to anatomical distortion, inadequate suppression of benign prostate tissue and suboptimal ADC map windowing.

Conclusion: It is paramount that radiologists are aware of the commonly missed locations of prostate cancer, tumour mimics and the limitations of mpMRI, particularly in the context of a multidisciplinary team setting. This would serve to improve diagnostic accuracy, target areas for biopsy more precisely and correctly influence management.

P38

Patient selection and treatment response assessment in radium-223 therapy
M Kay, F Sundaram
University Hospital Southampton, Tremora Road, Southampton, Hampshire, SO16 6YD, UK
E-mail: michael.kay@uhns.nhs.uk
Cancer Imaging 2015, 15(Suppl 1):P38

Learning objectives: Radium-223 is an alpha emitter, licensed in 2013 for treatment of symptomatic bone metastases in metastatic castration resistant prostate cancer. The treatment consists of 6 intravenous administrations and ongoing patient management before, during and after treatment. In our institution, this service is led by the nuclear medicine department.

The ALSYMPCA trial, published in 2013, demonstrated improved overall survival (14.9 vs 11.3 months) and prolonged time to first symptomatic skeletal event (15.6 vs 9 months) for patients administered Radium-223 vs placebo.

Imaging plays a key role in the selection criteria and response assessment for this new therapeutic modality. We present an educational review of
the spectrum of multimodality imaging techniques employed for pre-
therapeutic assessment and also for therapeutic response assessment.

Content organisation: • A brief overview of the criteria for treatment
with radium-223 will be provided.
• Examples of CT and MRI scans of patients suitable for treatment,
including pre and post therapeutic findings.
• Isotope bone scans of patients before and following treatment,
demonstrating the effect of radium-223 on skeletal lesions.

Conclusion: Radium-223 is an emerging innovative treatment for
symptomatic bone metastases from castrate resistant prostate cancer and
may well be the standard of care in the future. Cancer imagers should be
aware of the suitability criteria for treatment, which will help inform
discussions when patients are being considered for this treatment. They
should also be aware of the multimodality imaging findings on post
therapeutic response assessment studies.

P39
The value of 68Ga-PSMA enhanced PET-CT and MR-PET in patients
with biochemical recurrent prostate cancer
E Rummery1, K Holzapfel, T Maurer, G Weinich, E Gischwend, M Eiber
Klinikum rechts der Isar, Technical University Munich, Munich, Germany
E-mail: ernst.rummery@tum.de
Cancer Imaging 2015, 15(Suppl 1):P39

Aim of study: In patients with prostate cancer increased levels of PSA
can be measured. Recently a new tracer, 68Ga-PSMA, was developed as a
specific marker for hybrid imaging (PET/CT, MR-PET). In this study we
evaluated the accuracy of 68Ga-PSMA in patients with rising PSA after
radical prostatectomy, so called “biochemical recurrent prostate cancer”
(BRPC).

Materials and methods: A total of 322 patients with BRPC underwent
either a PET-CT or a MR-PET examination (Siemens Biograph mMR) after
injection of about 150 mBq 68Ga-PSMA. Images were evaluated in
cosensus by one experienced nuclear medicine physician and one
radiologist. Pelvine lymphnode dissection was performed in most of the
patients according to a predefined template with 8 fields. Lymphnode
involvement was evaluated according to a 5 point scale with a patient-
and a field-based analysis. These findings were stratified according to
PSA-values.

Results: Four patients were excluded from the study for different reasons.
Sensitivity for detection of recurrence was 95.7 % for PSA-values > 2ng/
ml, 81.4 % for PSA-values of 1-2 ng/ml, 76% for PSA-values 0.5-1 ng/ml,
and 51% for PSA values ≤ 0.5 ng/ml. In comparison to the MR-images
alone MR-PET was of superior diagnostic value.

Conclusions: MR-PET using 68Ga-PSMA is a sensitive and highly accurate
technique for the diagnosis of biochemical recurrence of prostate cancer
after radical prostatectomy. It yields high diagnostic performance at
relatively low PCA-values.

P40
Tumour characterisation, staging and operability assessment in ovarian
carcinoma: whole body diffusion-weighted MRI versus CT
K Michielsen1, J Vergote2, R Vanslambrouck1, E Musselaer3, F Amant2, K Leunen2,
P Moerman5, S Fieuws4, F De Keyzer1, G Souverijns3, S Dymarkowski1, V Vandecaveye1
1Department of Radiology, Leuven Cancer Institute, University Hospitals Leuven, KU Leuven, Belgium;
2Department of Obstetrics and Gynaecology, Division of Gynaecologic Oncology, Leuven Cancer Institute, University
Hospitals Leuven, KU Leuven, Belgium; 3Department of Pathology, Leuven Cancer Institute, University Hospitals Leuven, KU Leuven, Belgium;
4Department of Public Health and Primary Care, Leuven Cancer Institute, University Hospitals Leuven, KU Leuven, Belgium;
5Department of Radiology, Jessa Hospitals, Hasselt, Belgium
E-mail: katrin.michielsen@amedis.kuleuven.be
Cancer Imaging 2015, 15(Suppl 1):P40

Aim: To prospectively evaluate whole body diffusion-weighted MRI (WB-
DWI/MRI) for tumour characterisation, staging and prediction of complete
(R0)-resection compared with computed topography (CT) in patients with
suspected ovarian carcinoma.

Methods: One-hundred-sixty patients suspected for ovarian carcinoma
underwent 3T WB-DWI/MRI using 2 b-values (b=0-1000 s/mm²),
T2-weighted and contrast-enhanced T1-weighted sequences in addition
to contrast-enhanced CT. WB-DWI/MRI and CT were independently and
blindly evaluated and correlated with pathological findings at surgery as
reference standard. Superiority was assessed using two-tailed McNemar
tests for following parameters: characterisation of the malignant nature
and primary origin of the ovarian mass, assessment of disease extent
according to FIGO stage and prediction of R0-resection according to
predefined operability criteria. Inter observer agreement for WB-DWI/MRI
and CT was determined using Cohen’s kappa statistics.

Results: For characterisation of malignancy, WB-DWI/MRI showed
significantly higher accuracy compared with CT (93 versus 82%, p<0.001).
WB-DWI/MRI correctly depicted a non-ovarian-malignant mass in 24/32
(75%) of cases compared to only 6/32 (19%) for CT (p<0.001). WB-DWI/
MRI assigned more ovarian carcinoma patients to the correct FIGO stage
(71/94, 76%) compared with CT (39/94, 41%). For prediction of R0-
resection, WB-DWI/MRI showed significantly higher sensitivity (95 versus
80%), specificity (92 versus 74%) and accuracy (94 versus 77%) compared
with CT (p=0.039, p=0.012 and p<0.001, respectively). Interobserver
agreement was moderate to almost perfect (k=0.53-1.00) for WB-DWI/MRI
and slight to moderate (k=0.04-0.52) for CT.

Conclusion: WB-DWI/MRI is superior to CT for lesion characterisation,
staging and operability assessment of ovarian cancer justifying its
development for pre-operative assessment of ovarian cancer patients.

P41
Efficacy of PI-RADS in prebiopsy prostate-MRI at a urological cancer
centre: a comparison with histology
MD Patel1, B Rangarajan2
1The Royal Wolverhampton NHS Trust, Wolverhampton, UK
E-mail: markandpatel@nhs.net
Cancer Imaging 2015, 15(Suppl 1):P41

Aims: The European Society of Urogenital Radiology (ESUR) prostate
imaging-reporting and data system (PI-RADS) standardises reporting of
multiparametric (MP) prostate cancer MRI. At our uro-oncology centre
there has been a shift to using PI-RADS/MPI prior to transrectal
ultrasound-guided biopsy (TRUSGB). We aim to assess the efficacy of
using PI-RADS in targeted TRUSGB.

Methods: A retrospective review was performed on 50 consecutive
patients who underwent prostate MRI and subsequent TRUSGB between
January-March 2015. Data were collected from MRI reports/TRIADS to
score lesion level of suspicion and location, which was correlated to
Gleason grading from histology obtained through TRUSGB. Analysis and
basic statistics were performed.

Results: Histology was positive for high-grade cancer in 27/50 patients.
Lesions deemed to be suspicious for cancer (PI-RADS score 4 and 5) had
a positive predictive value of 83% (25/30), and were located correctly in
88%. Lesions deemed to be benign (PI-RADS score 1/2) had a negative
predictive value of 80% (8/10). Equivocal lesions (PI-RADS score 3) were
histologically higher grade (Gleason 3+4 and greater) in 30% (3/10),
Gleason 3+3 in 10% (1/10) and negative in 60% (6/10). The overall
sensitivity/specificity was 93% and 62% respectively.

Conclusion: In this sample of patients, the use of PI-RADS on prebiopsy
prostate MRI has shown to have a high sensitivity and high positive
predictive value in detecting/localising prostate cancer, which makes it a
useful tool for targeting biopsy and detection. Going forward the high
sensitivity would also have implications on the more selective use of
TRUSGB.

P42
FDG-PET/CT pitfalls in gynecological and genitourinary oncological
imaging
A Lakhani, S Khan, N Bharwani, V Stewart, A Rockall, T Banwick, S Khan
Imperial College Healthcare NHS Trust, London, UK
E-mail: amlakhani@gmail.com
Cancer Imaging 2015, 15(Suppl 1):P42
Learning objectives: 1. To understand the role of FDG PET/CT imaging in the multimodality investigation of gynecological and genitourinary cancers. 2. To describe the mechanism of action and technical pitfalls of FDG-PET/CT. 3. To highlight key imaging features of physiological and non-physiological FDG uptake and show how this is essential for interpretation of gynecological and genitourinary PET/CT studies. 4. To review the pathophysiological mechanisms leading to potentially false-positive and false-negative assessments.

Content organisation: Introduction of FDG-PET/CT.
- Mechanism of action.
- Role in gynecological and genitourinary oncological imaging.
- FDG-PET/CT imaging protocols.
- False positives in gynecological and genitourinary oncological imaging:
  - Physiological FDG-PET uptake – pictorial examples of uptake in endometrium and ovaries.
  - Non-physiological FDG-PET uptake – pictorial examples of pelvic inflammatory disease, fibroids, endometriosis. False negatives in gynecological and genitourinary oncological imaging:
  - Physiological FDG-PET uptake – pictorial examples of urinary excretion masking malignant lesions.
  - No/low FDG uptake – pictorial examples of necrotic lymphadenopathy and low grade tumours.
  - Artefacts. Pearls explaining how to minimise false interpretation.

Conclusion: FDG-PET/CT has a useful role in gynecological and genitourinary oncological imaging. However, understanding of physiological and non-physiological FDG-PET uptake is vital to understand potential false positive and false negatives in interpretation. FDG PET/CT should be used as one part of the multimodality investigation of gynecological and genitourinary cancers.

Role of high resolution MR in assessment of cervical uterine carcinoma: staging, treatment planning and correlation with histopathology findings
MF Grana1, M Nazar, F Saquier, M Di Cecco, F Troncoso, E Eyheremendy, S De Luca, L Tolkachier, M Wirtz
Hospital Alman, Buenos Aires, Argentina
E-mail: florenciagrana@hotmail.com
Cancer Imaging 2015, 15(Suppl 1)P43

Discuss the accuracy of high resolution MR for diagnosis and staging of cervical uterine carcinoma.
Discuss the correlation between MR findings, FIGO staging and treatment strategy.
Discuss the correlation between MR features and histopathology findings in resected tumours.

Content organisation: • Uterine cervical carcinoma.
  - FIGO staging.
  - High resolution MRI.
  - Dedicated protocol.
  - Primary tumour detection.
  - Myometrial invasion.
  - Lymph node involvement.
  - Parametrial invasion.
  - Bladder and rectal invasion.
  - PET.
  - Vaginal involvement.
  - Treatment strategies.
  - Histopathology correlation.

Conclusion: Cervical cancer remains a major threat to women’s health worldwide. MR is the imaging modality of choice to depict the primary tumour and assess local extent. Comparing the radiological findings with the postoperative histological reports, high resolution MR with a dedicated protocol demonstrated to be useful for primary tumour detection and for the assessment of myometrium invasion, lymph node commitment, parametrium invasion, bladder and rectal infiltration and vaginal involvement. This ability of MRI to demonstrate accurately the local extension of the tumour in patients with cervical cancer has become a useful tool to identify prognostic risk factors such as the depth of the infiltration, the tumour volume and the commitment of the adjacent structures. A correct evaluation of these factors is crucial for choosing and planning the most appropriate treatment.

P44 Rectal cancer in Australia and New Zealand: an audit from the PETACC-6 trial
KLM Gormley1, C Corcia1, T Wells1, N Tebbutt2, JA Harvey1, K Wilson4, H-J Schmoll3, T Price6,7
1Dr Jones and Partners Medical Imaging, Adelaide, Australia; 2Olivia Newton-John Cancer and Wellness Centre, Austin Health, Melbourne, Melbourne, Australia; 3Princess Alexandra Hospital, Woolloongabba, Australia; 4HHHR Clinical Trials Centre, University of Sydney, Sydney, Australia; 5Martin Luther University, Halle, Germany; 6The Queen Elizabeth Hospital, University of Adelaide, Adelaide, Australia; 7AGITG, Australia
Cancer Imaging 2015, 15(Suppl 1)P44

Introduction: An MRI audit study was conducted of patients who underwent an MRI prior to treatment in Australia and New Zealand as part of the international PETACC-6 trial in locally advanced rectal cancer.
Method: 82 patients of the 127 Australasian patients from 15 centres had rectal MRI scans reviewed for technique, data included in reports and comparison of reports with blinded central reporting by 2 experienced radiologists.
Results: 82% performed minimum T2 sagittal and T2 axial oblique sequences. The high resolution T2 sequence parameters varied significantly with only 33% obtaining a voxel size of ≤1 mm. The rate of inclusion of relevant findings in the reports was; T3 distance in mm 21%, N stage 84%, CRM status 72%, EMVI status 29% and distance from the puborectalis sling 17%. 31% of reports included all of T stage with T3 stage, N stage and CRM involvement. 17% of reports included these 3 findings and EMVI. Eleven reports used a template with 82% of these including the first 3 findings. The agreement with central reports was T stage 76%, N stage 70%, CRM status 57% and EMVI 16%.
Conclusion: There is significant variation in scan quality and low rates of inclusion of all clinically relevant findings in rectal MRI reports reviewed for this audit. The authors recommend adoption of routine sequences and template reports to improve scan technique and report accuracy in rectal cancer MRI staging scans across Australia and New Zealand.

P45 Female pelvic malignancy: spectrum encountered in district hospital: an aid to a general radiologist
D Santosh, A Butler
Princess Of Wales Hospital, Bridgend, UK
E-mail: divya.santosh@gmail.com
Cancer Imaging 2015, 15(Suppl 1)P45

Purpose: Initial diagnosis and staging of gynaecological malignancy is often the remit of the local general radiologist. The ‘incidentaloma’ is not infrequently encountered on pelvic imaging undertaken for other indications. It can be daunting to those without a solid knowledge of the female pelvis.
Learning objectives: To recognise the spectrum of female pelvic malignancy and appreciate relevant incidental findings.
To identify the pearls and pitfalls of diagnosis, understand important points in staging and restaging disease.
To identify potential complications of both tumour and treatment and discuss imaging strategies in suspected local recurrence.
Content organisation: We provide an overview of imaging modalities used, review pertinent anatomy and cover the spectrum of malignancy specific to the female pelvis, incorporating common and uncommon tumours. Emphasis is placed on imaging features that are important in treatment planning and evaluating prognosis.
Summary: This exhibit will enhance the confidence of general radiologist in a district hospital setting when encountering potential female pelvic malignancy at initial diagnosis or when assessing for complications of tumour or treatment in the acute setting.

Do we need to wait? Does reducing time to prostrate MRI postbiopsy interfere with staging?

J Rowlands
The Shrewsbury and Telford NHS Trust, UK
E-mail: jennifer.rowlands@sath.nhs.uk
Cancer Imaging 2015, 15(Suppl 1):s46

Aims: With an MRI scanner at the limit of capacity (and no immediate prospect of an additional scanner) we are unable to offer pre biopsy MRI due to the workload expansion - further 24 slots/month. We aimed to evaluate if reducing the time between biopsy and scan led to a decrease in staging accuracy due to post biopsy haemorrhage.

Methods: Retrospective study comparing haemorrhagic artefact and staging accuracy in MRI studies performed before and after a pathway change reduced the time to MRI post biopsy.

Results: No difference in rate of post biopsy haemorrhage deemed to affect diagnostic accuracy.

No significant staging error in either group.

Reduced time to discussion on MDT led to improvement in treatment time and no RTT (Referral To Treatment) pathway breaches.

Pathway improved by 8.65 days (14% of RTT time).

Conclusion: In a capacity limited service there is no option to go to prebiopsy service with the increase in demand that would ensue. It is reassuring to know that reducing the time between biopsy and scan results in no difference in number of studies affected by haemorrhage, no difference in diagnostic accuracy and leads to improvement in patient treatment pathway.

Value of DWI volumetry for assessment of complete rectal cancer response after CRT

M Nazar*, A Vazquez, L Alarcon, M Pascuzzi, M Wirtz, E Eyheremendy
Hospital Aleman, Buenos Aires, Argentina
E-mail: m69nazar@gmail.com
Cancer Imaging 2015, 15(Suppl 1):s47

Learning objectives: To determine the diagnostic performance of DWI volumetry for the assessment of complete response after CRT in patients with locally advanced rectal cancer and to compare with volumetry on standard T2-weighted MRI, by means of volumetric signal intensity measurements.

Content organisation: We retrospectively analyzed 25 patients with locally advanced rectal cancer. Patients underwent pre and post-CRT standard T2-weighted MRI and DWI MRI. We placed free-hand regions of interest and each tumour-containing section to determine pre and post-CRT tumour volumes. Histologic findings were the standard of reference.

Conclusion: Volumetry of the viable tumour remnants based on signal intensity characteristic on DW images after CRT was shown to be more valuable than volumetry of the tumour based on morphologic T2w images for the differentiation between a pCR and residual tumour in locally advanced rectal cancer.

MR and PET/CT imaging in diagnosis of large pelvic masses

S De Luca*, MF Grana, E Casalini Valhek, L Tolkachier, L Alarcon, E Eyheremendy
Hospital Aleman, Buenos Aires, Argentina
E-mail: sde Luca@hospitalaleman.com
Cancer Imaging 2015, 15(Suppl 1):s48

Learning objectives: Discuss possible causes of pelvic masses in female patients.

Imaging of pheochromocytoma and paraganglioma: moving beyond “lumpology” with SSTR, FDG and MIBG molecular imaging

MS Hofman*, D Pattison, RJ Hicks
Centre for Molecular Imaging and Neuroendocrine Tumour Service, Peter MacCallum Cancer Centre, Melbourne, Australia and Department of Medicine, University of Melbourne, Australia
E-mail: michael.hofman@petermac.org
Cancer Imaging 2015, 15(Suppl 1):s49

Learning objectives: Cancer staging traditionally uses CT or MRI for detecting suspected malignant lesions with characterisation performed by histopathology following biopsy. In this “lumpology” paradigm, the number, size and location of lesions are used to determine prognosis and guide treatment strategies. To provide an educational exhibit to highlight the utility of molecular imaging to diagnose, stage and characterise pheochromocytoma (PCC) and paragangliomas (PGL) phenotype and guide patient management.

Content organisation: Pictorial review of 68Ga-DOTATATE (GaTate), 18F-fluorodeoxyglucose (FDG) and 123I/124I-metaiodobenzylguanidine (MIBG) imaging. Within the “lumpology” paradigm, molecular imaging performs well with a superior sensitivity and specificity compared to CT or MRI. The real strength of molecular imaging, however, is in characterizing different PCC/PGL phenotypes which can assist in identifying the underlying type of PCC/PGL with consequent management impact including selection of patients for radionuclide therapy. PCC/PGL can be broadly divided into a pseudohypoxic cluster and tumours mutations of receptor tyrosine kinase signalling. Mutations in the pseudohypoxic cluster lead to inhibition of oxidative phosphorylation and activation of glycolytic pathway via the Warburg effect leading to high sensitivity of FDG. Owing to high somatostatin receptor expression across the range of PCC/PGL, GaTate PET/CT is emerging as the single most useful modality. Positivity of MIBG is variable paralleling the varied catecholamine secretion profile of PCC/PGL. Knowledge of other patterns such as activation of brown fat on FDG or suppression of physiologic adrenal activity on GaTateare important in interpretation.

Conclusion: Molecular imaging is valuable in diagnosing, staging, restaging and characterizing PCC/PGL. Integration of the molecular imaging phenotype into patient management is complementary to genetic testing and histopathology, and critical to the true realization of personalized medicine.

Whole-body diffusion-weighted MRI for staging of women with cancer during pregnancy: a pilot study

RC Dresen1*, SN Han2*, K Michaelsen1, F De Keyzer1, MM Gziri1, F Amant1, V Vandeveere1
1Department of Radiology, Leuven Cancer Institute, University Hospitals Leuven, KU Leuven, Leuven, Belgium; 2Department of Obstetrics and Gynaecology, Division of Gynaecologic Oncology, Leuven Cancer Institute, University Hospitals Leuven, KU Leuven, Leuven, Belgium
E-mail: elleke.dresen@uzleuven.be
Cancer Imaging 2015, 15(Suppl 1):s50

Aim: To evaluate whole-body diffusion weighted magnetic resonance imaging (WB-DWI) for staging of women with cancer during pregnancy.
Methods: Twenty patients diagnosed with cancer during pregnancy underwent WB-DWI additional to conventional imaging in this prospective single centre study. Reproducibility of WB-DWI between 2 readers was evaluated using Cohen’s κ statistics and accuracy was compared to conventional imaging for assessing primary tumour site, nodal metastases and visceral metastases. Histopathology after surgery or biopsy was the primary reference standard.

Results: Ten patients had breast cancer, 3 lymphoma, 2 cervical uterine cancer, 1 ovarian borderline tumour, 2 colon cancer, 1 lung cancer and 1 a conjunctival tumour. The WB-DWI readers showed very good agreement for lesion detection, κ = 0.94. With WB-DWI, reader 1 detected 38 of 41 malignant lesions, reader 2 thirty-nine lesions and conventional imaging 27. WB-DWI showed sensitivity of 95% (95% CI: 74-99) for both readers and specificity up to 99% (95% CI: 76-99) compared to 50% sensitivity (95% CI: 28-72) with 100% (95% CI: 97-100) specificity for conventional imaging. For staging distant metastases, WB-DWI sensitivities were 66.7% (95% CI: 13-98) and 100% (95% CI: 40-100) respectively for reader 1 and 2 with specificities of 94.1% (95% CI: 69-99) and 100% (95% CI: 40-100) compared to sensitivity of 33.3% (95% CI: 1.7-87) and specificity of 100% (95% CI: 77-100) for conventional imaging.

Conclusion: WB-DWI is feasible for single-step non-invasive imaging based cancer staging during pregnancy showing additional value to conventional imaging procedures for detecting distant and nodal metastases.

Learning objectives: Describe DWI MRI and fusion T2-DWI techniques and findings for detection and characterisation of tumours, list the current and potential applications of DWI in cancer patient management and review causes of false-positive and false-negative results in lesion detection.

Content organisation: The detection and characterisation of malignant lesions can often be difficult, principally when the disease is small or when the tumour is combined with normal tissues. Forty five patients with malignancies underwent both DWI MRI and T2-DWI to detect and characterise primary and metastatic tumours. We acquired DWI (b0, b400, b600), FAT SAT T1w imaging before and after gadolinium administration and STIR images. The standard reference was histopathology findings.

Conclusion: DWI-MRI and fusion T2-DWI imaging is a powerful clinical tool for directing the care of patients with cancer. Three- dimensional fusion imaging of high b value DW-MRI with anatomic imaging have a number of utilities including data presentations to clinicians for detecting and guiding biopsy to variable tumour.

P53

The value of the FDG-GaTate and proliferation marker (ki-67) in the assessment of neuroendocrine tumours (NETs)

AS Fatihul Fakir1*, NJ Abdul1, S Ramdave2, R Syahik-Eid2

1Centre for Diagnostic Nuclear Imaging, Serdang, Selangor, Malaysia; 2PET Centre, Moorabbin Hospital, MonashHealth, Melbourne, Australia

E-mail: ahmadsaadff@gmail.com

Cancer Imaging 2015, 15(Suppl 1):P53

Aims: A combined tracer evaluation of Ga-68 DOTATATE (GaTate) and F-18 FDG (FDG) positron emission tomography (PET-CT) and the ki-67 marker have potential advantages over a single marker in determining the differentiation of NETs. This study is sought to evaluate their association and the potential role as predictive markers for the management impact.

Methods: Twenty-one combined FDG-GaTate studies were performed in various NETs lineages. A retrospective blinded review was performed based on the grade of tumour differentiation of ki-67 (European NET Society-ENETS) and the correlated Krenning scales (Grade 1-4) of the FDG-GaTate PET-CT images. Subsequent management impact (high and low) was determined by follow-up to assess metabolic response of the pre and post treatment GaTATE-FDG PET-CT results.

Results: Significant correlation were noted in the Ki-67 (mean: 6.16± 8.21 %) and the FDG SUVmax (mean: 5.72±5.2.4.2g/dl < 0.01) and inversely correlated with the Ga SUVmax (mean: 15.80± 10.57g/dl; p< 0.05). Management impact in 12/21 patients was high (partial metabolic response or no recurrence) in 75% and low in 25% (progressive metabolic disease). The combined ki-67-GaTate marker had independent predictive significance for management impact (likelihood ratio test for the whole model, p=0.008).

Conclusion: Dual-tracer assessment of FDG-GaTate PET-CT provide a valuable information on the NETs’ cellular differentiation. Combination of ki-67-GaTate may potentially be used as a reliable predictive marker for the NETs’ management impact.

P52

Value of DWI- ADC and FUSION T2-DWI in the management of oncological patients

M Nazar1*, F Saguei2, L Alarcon3, M Pascuzzi, M Witz2, E Eyheremendy2

Hospital Aleman, Buenos Aires, Argentina

E-mail: m69nazar@gmail.com

Cancer Imaging 2015, 15(Suppl 1):P52

The potential of DECT in oncology has not been fully exploited yet. DECT improves oncologic imaging with improved tumour detection, tumour characterisation and grading, therapy monitoring and follow-up, reduction of radiation dose, and the integration of imaging and therapy in oncology.

Aims: Dual-energy CT (DECT) can amply contribute to a more efficient workflow in oncologic imaging. DECT has the potential to reduce the radiation dose and to replace classical dual-phase protocols. DECT improves oncologic imaging with improved tumour detection and opens up avenues for tissue differentiation and characterisation. DECT allows for optimised and repeatable therapy monitoring and for the integration of imaging and therapy in oncology.

Methods: Twenty patients diagnosed with cancer during pregnancy underwent WB-DWI additional to conventional imaging in this prospective single centre study. Reproducibility of WB-DWI between 2 readers was evaluated using Cohen’s κ statistics and accuracy was compared to conventional imaging for assessing primary tumour site, nodal metastases and visceral metastases. Histopathology after surgery or biopsy was the primary reference standard.

Results: Ten patients had breast cancer, 3 lymphoma, 2 cervical uterine cancer, 1 ovarian borderline tumour, 2 colon cancer, 1 lung cancer and 1 a conjunctival tumour. The WB-DWI readers showed very good agreement for lesion detection, κ = 0.94. With WB-DWI, reader 1 detected 38 of 41 malignant lesions, reader 2 thirty-nine lesions and conventional imaging 27. WB-DWI showed sensitivity of 95% (95% CI: 74-99) for both readers and specificity up to 99% (95% CI: 76-99) compared to 50% sensitivity (95% CI: 28-72) with 100% (95% CI: 97-100) specificity for conventional imaging. For staging distant metastases, WB-DWI sensitivities were 66.7% (95% CI: 13-98) and 100% (95% CI: 40-100) respectively for reader 1 and 2 with specificities of 94.1% (95% CI: 69-99) and 100% (95% CI: 40-100) compared to sensitivity of 33.3% (95% CI: 1.7-87) and specificity of 100% (95% CI: 77-100) for conventional imaging.

Conclusion: WB-DWI is feasible for single-step non-invasive imaging based cancer staging during pregnancy showing additional value to conventional imaging procedures for detecting distant and nodal metastases.

SPEAKER PRESENTATIONS

S1

Multiparametric magnetic resonance tomography and MRI/TRUS-fusion-biopsy for index lesion detection: correlation with radical prostatectomy specimen

JP Radtke1*, C Schwab1, MB Wolf2, MT Freitag3, C Alt4, C Kesch5, IV Popeneicul, C Huettenbrink, C Bengsraesser-Gasch1, T Klim, S Duensing1, S Roth1, HP Schlemmer6, M Roethke1, M Hohenfellner7, B Hadaschik1

1Department of Urology University Hospital Heidelberg, Heidelberg, Germany; 2Department of Radiology German Cancer Research Center Heidelberg, Heidelberg, Germany; 3Department of Diagnostic and Interventional Radiology University Hospital Dusseldorf, Dusseldorf, Germany; 4Institute of Pathology University Hospital, Heidelberg, Germany

E-mail: j.pradtke@dkfz-heidelberg.de

Cancer Imaging 2015, 15(Suppl 1):S1
Aim: To prospectively evaluate the predictive value of pretreatment histogram analysis of apparent diffusion coefficients (ADC) at whole body diffusion-weighted imaging (WB-DWI/MRI) for patient outcome in primary ovarian cancers.

Methods: Institutional review board approval and informed consent were obtained for this prospective study. Forty-four women diagnosed with FIGO stage III or IV ovarian carcinoma underwent 3-Tesla WB-DWI/MRI using 2 b-values (b=0–1000 s/mm²), T2-weighted and contrast-enhanced T1-weighted sequences prior to treatment. The primary tumour was delineated using semi-automated software and was analysed using an ADC histogram approach: mean and median ADC, standard deviation (SD), coefficient of variation (CoV, SD/mean), kurtosis and skewness were calculated. Kaplan-Meier with log-rank statistics were used to correlate baseline ADC parameters to disease free survival (DFS). Effects of confounding patients- and tumour-related factors were taken into consideration using Cox proportional hazard model.

Results: Patients underwent primary- and 39 interval debulking surgery completing 6 cycles of platinum-based chemotherapy. Survival analyses showed that lower CoV was associated with significantly longer DFS (median ± SD; 19±2 months for CoV<0.2601 versus 12±1 months for CoV>0.2601; p=0.002). After multivariable analysis, CoV remained an independent prognostic biomarker for DFS (p=0.003) when taking patient’s age, FIGO stage, tumour grade and cancer antigen (CA)-125 level into consideration as clinical prognostic factors.

Conclusion: In this pilot study, pre-treatment ADC histogram analysis of primary ovarian cancer using the CoV was an independent predictive marker for DFS suggesting a correlation between tumour heterogeneity and treatment resistance. Further research should elucidate the correlation with overall survival.

56

Comparison of functional imaging in multiple myeloma patients: Indication for hybrid-imaging with PET/MRI?

J Mosebach 1, C Sachpekidis 2, J Hellenga 3, U Haberkorn 4, A Dimitriakopoulou-Struas 5, H-P Schlemmer 6, S Delorme 1
1 Department of Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany; 2 Clinical Cooperation Unit Nuclear Medicine, German Cancer Research Center (DKFZ), Heidelberg, Germany; 3 Department of Medicine V, Multiple Myeloma Section, University of Heidelberg, Heidelberg, Germany; 4 Division of Nuclear Medicine, University of Heidelberg, Heidelberg, Germany
E-mail: jmosebach@dkfz-heidelberg.de

Cancer Imaging 2015, 15(Suppl 1):S6

Aim: Comparison of the sensitivities in lesion detection of 18F-FDG positron emission tomography (PET) and diffusion-weighted imaging (DWI) in multiple myeloma patients.

Methods: 24 primary and pre-treated patients diagnosed with multiple myeloma according to the International Myeloma Working Group criteria were examined by 18F-FDG PET/CT and whole-body MRI including DWI (b=0, and b= 800 s/mm²). 18F-FDG PET/MRI was used to achieve correct matching of findings in the corresponding PET/CT study. Suspicious lesions were defined by the imaging gold-standard of non-enhanced T1-w/T2-w MRI and low-dose CT.

Results: Sensitivities were 77% for DWI and 47% for PET in a per-lesion analysis of 128 lesions shown on MRI/CT. In untreated patients however, sensitivity was 90% for both functional modalities.

Conclusion: Discrepancy of DWI and references resulted mainly from limitations due to under diagnosing smaller lesions and missing lesions near the edge of the field of view in this whole-body protocol setting. Mismatches of PET and references were retrospectively predominantly seen in 5 previously treated patients, who had responded to therapy. Since glucose metabolism is a sensitive parameter that responds prior to size regression in the course of chemotherapy, our reference may have revealed false positive findings, i.e., responding but morphologically persistent lesions. Since PET also has limitations in spatial resolution and detection of diffuse infiltration, PET/MRI might combine excellent soft-tissue contrast (T1/T2FatSat) with a sensitive response assessment without missing focal infiltration of prognostic significance.

57

Value of pretreatment MRI determined parameters for predicting outcome after radio-frequency ablation of hepatocellular carcinoma

R Dresen 1, K Michielsen 1, F De Keyzer 1, C Verstuyf 2, B Topal 3, R Aerts 4, V Vandecaveye 4
1 Department of Radiology, Leuven Cancer Institute, University Hospitals Leuven, KU Leuven, Leuven, Belgium; 2 Department of Obstetrics and Gynaecology, Leuven Cancer Institute, University Hospitals Leuven, KU Leuven, Leuven, Belgium
E-mail: elleke.dresen@uzleuven.be

Cancer Imaging 2015, 15(Suppl 1):S7

Aim: To evaluate whether pretreatment magnetic resonance imaging (MRI) determined imaging parameters are predictive for outcome in hepatocellular carcinoma (HCC) treated with radio-frequency ablation (RFA).

Methods: Thirty-seven patients with HCC treated by RFA were evaluated. Lesion number, size and segmental location, T2-weighted (w), arterial, portal-venous and venous contrast-phase, b600 diffusion-w imaging (DWI) and delayed phase contrast-enhanced imaging pattern were assessed at MRI. The separate imaging patterns as well as pretreatment clinical variables were correlated with outcome (disease free survival longer or shorter than 1 year) using a chi-square test with multiple variables and Mann-Whitney U test respectively. Pretreatment clinical variables and imaging parameters were correlated with Keratin 19 and microvascular invasion status at the biopsy during RFA.

Results: None of the pretreatment patient- or tumour-related parameters correlated to disease free survival (p>0.5).

55

Pre-treatment ADC histogram-analysis at whole body diffusion-weighted MRI predicts disease free survival in ovarian cancer

K Michielsen 1, J Vergote 1, F Aman 1, K Leuven 1, S Dymarkowski 1, F De Keyzer 2, V Vandecaveye 2
1Department of Radiology, Leuven Cancer Institute, University Hospitals Leuven, KU Leuven, Leuven, Belgium; 2Department of Obstetrics and Gynaecology, Leuven Cancer Institute, University Hospitals Leuven, KU Leuven, Leuven, Belgium
E-mail: katrin.michielsen@med.kuleuven.be


Aim: To prospectively evaluate the predictive value of pre-treatment histogram analysis of apparent diffusion coefficients (ADC) at whole body diffusion-weighted imaging (WB-DWI/MRI) for patient outcome in primary ovarian cancers.

Methods: We selected 120 consecutive patients who underwent transperineal fusion-biopsy before RP. All men received a saturation biopsy (SB) in addition to targeted biopsies of lesions with PIRADS ≥ 2. On RP specimen, the index lesion was defined as highest Gleason score (GS) or highest tumour volume (TV). GS=G+3+3 and TV≥1.2ml or GS=3+4 and TV≥0.7ml or GS=3+4 were considered significant PC. We performed Spearman’s correlation analysis between mpMRI and RP and Fisher’s test between mpMRI, TB and SB.

Results: Overall, 120 index lesions and 71 non-index lesions were detected. 107 index and 51 non-index lesions harbored significant PC. MpMRI detected 110/120(91.7%) index lesions, while TB alone diagnosed only 96/120(80.0%) and SB alone 110/120(91.7%). The combination of SB and TB detected 115/120(95.8%) index lesions. The combination of TB and SB outperformed TB alone (p=0.017) for detection of all significant PC. Additionally, TB performed significantly worse compared to SB alone for all significant tumour detection (p=0.034). Spearman’s correlation coefficient for index lesion concordance between mpMRI and RP was 0.865(p<0.001). TB provided greatest benefit in men undergoing repeat biopsy.

Conclusions: MpMRI detected 91.7% index lesions compared to RP. However, TB alone missed 21.5% of all significant foci. Thus, the combination of both biopsy approaches should be incorporated in the biopsy workflow to predict PC most accurately.
The portal-venous, venous phase and b600 DWI imaging pattern showed strongest correlation with disease free survival (p=0.00023, p=0.00003 and p=0.0002 respectively). Also correlation was found for T2w imaging pattern (p=0.007), and hepatobiliary phase imaging pattern (p=0.017). Patients with tumour recurrence within 1 year (n=14) showed persistent venous rim- or nodular enhancement in 13 patients and b600 DWI rim-like hyperintensity in 9 patients correlating with microvascular invasion at biopsy (p=0.04). Patients disease free for at least 1 year (n=23) showed venous wash-out in 22 of 23 patients and whole-lesion hyperintensity b600 DWI in 18 patients.

**Conclusion:** Pretreatment venous rim-enhancement and rim-like intensity at b600 DWI were strongest predictors of treatment failure within the first year after RFA of HCC.

Results: The agreement for M-staging between standard protocol and WB-MRI was 83.5% (111/133). M- staging of WB-MRI agreed to that of standard protocol in 96.0% (97/101) for M0, and 43.7% (14/32) for M1. M-staging agreement between standard protocol and “true” M-staging was 86.5% (115/133); standard protocol agreed to “true” M-staging in 86.8% (99/114) for M0 and in 88.9% (16/18) for M1. WB-MRI showed 94.0% (125/133) of agreement to “true” M-staging: the agreement rates between the two were 97.4% (111/114) for M0 and 77.8% (14/18) for M1. One patient who was reported as having lung metastasis on both protocols was confirmed with primary lung cancer on biopsy.

**Conclusion:** WB-MRI showed high agreement with standard protocol for initial rectal cancer staging and “true” M-staging.

**511**

Quantification of tumour heterogeneity and glucose metabolism on pre-chemoradiation PET/CT predicts survival in anal cancer

A Afaz, B Ganeshan, T Grenader, G Azzopardi, R Endozo, J Bridgewater, A Groves

University College London, Gower Street, London, WC1E 6BT, UK

E-mail: asim.afaz@ucl.ac.uk

**Cancer Imaging 2015, 15(Suppl 1):S11**

**Aim:** To investigate CT Texture Analysis (CTTA, marker of tumour heterogeneity) and metabolic information from PET as potential prognostic biomarkers in patients with anal squamous cell carcinoma (SCC) treated with chemoradiotherapy (CRT).

**Methods:** 42 patients (median age 60.2 years, range 36.8-80.2; 19 males) with anal SCC, who received CRT with pre-treatment 18F-FDG PET/CT were retrospectively reviewed. CTTA was performed on the largest tumour diameter CT image using TexRAD software. CTTA used a filtration-histogram technique, extracting fine, medium and coarse texture features, followed by quantification of histogram parameters. SUVmax, metabolic tumour volume (MTV) and total lesion glycolysis (TLG) were measured using Metavol software. Mean follow-up period was 39.6 months. Kaplan-Meier analysis assessed the relationships between CTTA, PET and clinical parameters against progression free survival (PFS) and overall survival (OS).

**Results:** Mean PFS was 65.6 months (95% CI55.0-76.1) and mean OS was 73.0 (95% CI63.9-82.2) months. Higher pre-treatment CTTA kurtosis was consistently a significant predictor of PFS and OS respectively (best at medium-scale: p=0.007, p=0.022).

PET and clinical parameters significantly predicted PFS and OS respectively included SUVmax (p=0.0138, p=0.0038), MTV (p=0.0049, p=0.005), TLG (p=0.0027, p=0.0011), tumour stage (p=0.01, p=0.0003) and nodal stage (p=0.002, p=0.0003).

**Conclusion:** This study identified kurtosis, as a marker of tumour heterogeneity on pre-treatment CTTA was associated with poorer OS and PFS. SUVmax, MTV and TLG were also all predictors of poorer survival as were higher stage tumours. A multi-parametric approach with these features may provide prognostic information in patients with anal SCC undergoing treatment with chemoradiotherapy.

**512**

CT texture analysis as a prognostic marker in metastatic colorectal cancer patients treated with bevacizumab

Shih-Hsin Chen, Julien Edeline, Kai-Keen Shiu, Sarah Benafif, Sofia Wong, Ashley Groves, John Bridgewater, Balaji Ganeshan

University College London, Gower Street, London, WC1E 6BT, UK

E-mail: jedeline@ucl.ac.uk

**Cancer Imaging 2015, 15(Suppl 1):S12**

**Aim:** Following anti-angiogenic treatment, response might be represented by changes in tumour heterogeneity and may not be reflected on traditional size-based criteria. CT texture analysis (CTTA) is one emerging tool to quantify tumour heterogeneity, and has been shown to be prognostic in different tumour applications. We aimed to assess the association of CTTA with overall survival (OS) in a series of metastatic colorectal cancer (mCRC) patients treated with bevacizumab.

**Methods:** We retrospectively gathered clinical and imaging data from mCRC patients treated with bevacizumab plus chemotherapy from 3 centres
in the UK. CTTA comprised the image filtration-histogram technique using commercially available TexRAD research software platform (TexRAD ltd http://www.texrad.com, part of Feedback Plc).

**Results:** 101 patients were identified, of which 67 patients had both pre-treatment and first post-treatment CT scans available for image analysis and response evaluation. 38 patients were treated in first line, 29 in latter lines. Median OS was 12.4 months. Several texture parameters were significantly associated with OS at pre- and post-treatment scans, including mean (p=0.001), mean of positive pixels (p=0.002), entropy (p=0.001) and kurtosis (p=0.004). Furthermore change in entropy between post- and pre-treatment scans was significantly associated with OS (p=0.009) with an increase in post-treatment entropy (>0.1) associated with worse outcome. Particularly post-treatment entropy > 4.51 was the best univariate marker of survival (HR: 3.0, 95% CI = 1.5-5.9, p=0.001).

**Conclusion:** This retrospective study highlighted the potential of CTTA to be a prognostic marker in mCRC patients treated with bevacizumab and chemotherapy.