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CARDIAC / CHEST & LUNG

P063 Feasibility of cardiac sparing in isotoxic dose escalated radiotherapy for NSCLC

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Background: Heart constraints used in NSCLC radiotherapy planning have not changed greatly in the past two decades, despite evidence that there may be an association between heart irradiation and decreased survival. We have therefore carried out a planning study to determine the extent to which heart doses can be reduced without diminishing plan quality. Specifically, we investigated the feasibility of reducing mean heart doses (MHD), and the volume of left atrial wall (LAW) receiving doses in excess of 63Gy (V_{LAW63}).

Method: 20 NSCLC patients were re-planned following IDEAL-CRT protocol[1] using VMAT. We identified new target levels for MHD and V_{LAW63} (Table 1). Patients were then re-planned, more highly prioritising heart and LAW dose constraints, and determining the extent to which heart and LAW irradiation could be reduced while still meeting the IDEAL-CRT target dose coverage levels and dose constraints.

Results: After IDEAL-CRT planning, 8 patients met the ambitious level for V_{LAW63}; however after prioritising constraints on LA Wall irradiation the ambitious level could be achieved for 19/20 patients. Similarly, after IDEAL-CRT planning the ambitious level for MHD was met for only 3 patients, and 5 failed to meet the basic level; but after prioritising reductions in MHD, the ambitious level was achieved in 8 patients and none failed to meet the basic level.

Conclusion: By setting more demanding heart dose constraints, MHD and LAW doses can be substantially reduced while continuing to meet the target coverage and normal tissue constraints of the IDEAL-CRT protocol, potentially improving survival.

Table 1a

	V_{LAW63} Constraint				
	Constraint Level	Ambitious	Moderate	Basic	Failed
		0%	≤2.2%	≤20%	>20%
	Prescribed Dose (Gy) Median [range]				
IDEAL Baseline	68.8 [63, 73]	n=8	n=8	n=4	n=0
Tighter V_{LAW63} planning	68.8 [63, 73}	n=19	n=1	n=0	n=0

Table 1b

	Mean Heart Dose Constraint				
	Constraint Level	**Ambitious**	**Moderate**	**Basic**	**Failed**
		≤5Gy	≤11Gy	≤20Gy	>20Gy
	Prescribed Dose (Gy) Median [range]				
IDEAL Baseline	68.8 [63, 73]	n=3	n=9	n=3	n=5
Tighter MHD planning	68.8 [63, 73}	n=8	n=8	n=4	n=0

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P064 Rare, medium or well done? Practising skin care in interventional radiology

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Background: The capabilities of Interventional Radiology (IR) to treat is continuously expanding, naturally increasing the technical complexities of procedures undertaken and is one of the reasons why IR is an area of radiology which is considered to be at risk of resulting in a skin radiation dose exceeding 5Gy Air Kerma (AK). This recommended trigger point carries advice for further action post procedure due to possible deterministic injury. In reality there is widespread variability within local hospital policies. The trust at the focus of this poster did not have a standardised pathway for high dose procedures within its IR departments. Cardiology based interventional procedures however have a high radiation dose pathway set at 5Gy AK and 500Gycm2 DAP for total amount of radiation delivered to the patient.

Purpose: The aim of the poster is to outline the importance of measuring practice against the standard, illustrate which IR procedures result in the highest radiation dose levels and the importance of recognising cumulative dose and its position within

procedural planning, the relationship of peak skin AK (radiation dose received to a single area of skin) in comparison to accumulative AK is portrayed through dosewatch data.

Summary: The poster includes the methodology, results and conclusions of the audit on high dose interventional and cardiology procedures with a copy of the high dose pathway that is being introduced. The pathway has been designed to support future IR procedures, detailing specific processes and resources to be utilised within radiation dose management.

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P065 Imaging in the diagnosis of a unicuspid aortic valve and Gerbode defect

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Background: Unicuspid aortic valve (UAV) is a rare congenital malformation with an incidence of 0.02% in the adult population[1]. A 21-year-old male medical student discovered an incidental cardiac murmur on self-examination. He was investigated with echocardiogram that demonstrated mild aortic regurgitation thought secondary to a congenital bicuspid aortic valve. This was monitored over the course of 14 years. At 35, on routine follow up the echocardiogram showed an anomaly. He had a cardiac MRI which demonstrated a unicommissural unicuspid aortic valve and concentric left ventricular hypertrophy. As he had severe aortic stenosis with moderate aortic regurgitation it was decided to offer open-heart surgery. The native aortic valve was replaced with a 25mm non-stented bioprosthetic valve. On 3 month follow up, an acquired Gerbode defect was demonstrated on echocardiogram. This is a rare left ventricle to right atrial shunt and represents <1% of all heart defects[2].

Purpose: To highlight the importance of radiological imaging in the diagnosis of this rare condition and of its rare complications. To demonstrate the importance of vigilant surveillance in patients with suspected UAV. To review the literature on the potential adverse effects of delayed UAV treatment, and of the possible post-surgical complications.

Summary: UAV is a rare congenital malformation, mainly confused with bicuspid aortic valve and that presents with aortic valve insufficiency. This case demonstrates radiological diagnosis in an asymptomatic adult with no previous known congenital heart defect, and who remained haemodynamically stable for several years prior to surgical intervention.

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P066 The impact of motion management techniques on clinical outcomes in early stage non-small cell lung cancer patients undergoing stereotactic ablative radiotherapy: A critical review of the literature

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Background: Stereotactic ablative radiotherapy (SABR) has taken a vital role in the management of early stage non-small cell lung cancer (NSCLC) in the UK (Yahya et al., 2018). Considering SABR's distinguishing features, motion management techniques (MMTs) are crucial (Goldsmith and Gaya, 2012). Despite the increasing prevalence of MMTs reported in literature (Cole et al., 2014), there is paucity reporting clinical outcomes of patients based on differing MMTs. This work aimed to assess the outcomes of studies involving SABR for NSCLC based on MMT utilised, namely tracking, gating, motion encompassing methods such as internal target volume (ITV), or combination of techniques which includes using ITV and another form of MMT.

Methods: A literature search was undertaken relating to outcomes in SABR for early stage NSCLC, specifically local control (LC), overall survival (OS) and toxicities. The search period included January 2009 to March 2018. Search parameters were filtered using the terms trials, outcome and English. The resulting articles were selected after assessing for relevance, leaving 29 papers.

Results: Data extraction demonstrated comparisons of clinical outcomes for the MMTs, a sample of which can be seen in table 1. Furthermore, variations among the included studies were noted, seen in table 2.

Table 1: An example of MMT comparison based on local control and overall survival			
MMT	No. of studies with existing data	Range	Median
Local control - 24 months			
Tracking	13	74-98%	84%
Combination	3	84-86%	85%
ITV	3	92-98%	96.4%
Overall survival - 24 months			
Tracking	9	60-82%	75%
Combination	5	52-78%	65%
ITV	4	55-75%	64.5%

Table 2: Differences found in studies	
Dose	34Gy/1# to 60Gy/8#
Patients	21-500 participants
Follow-up	12-60 months with all studies including up to 24 months of LC and OS

Conclusion: The evidence highlighted several preliminary recommendations. In this sample of three MMTs at one follow-up in time, median LC was highest in ITV and equivalent for the other studies but a larger variation for tracking compared to the combination studies. This suggests MMTs may be a contributing factor for clinical outcomes.

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P067 A comparison of soft tissue and bone to verify treatment position for lung cancer patients receiving radical radiotherapy

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Introduction: As the complexity of radiotherapy treatments increase, more on treatment imaging is being routinely in clinical practice. Studies vary in which anatomical landmark to match to in lung cancer treatment to ensure treatment accuracy. Prior to transitioning from bone matching using two-dimensional kilovoltage (kV) imaging to 3D soft tissue matching using Cone Beam CTs(CBCTs), we retrospectively assessed the optimum landmark for image-matching purposes.

Method: Five radiographers conducted automatic and manual matches to bone, carina and tumour in 88 CBCTs of 20 patients. For each of the 2600 matches, couch shifts were recorded in the anterior/posterior, left/right and superior/inferior directions. Tumour coverage was graded using target volume margins. The level of agreement between automatic and manual matches and the percentage of set-up errors out of tolerance (5mm) were calculated. CBCT feasibility was assessed by examining inter observer reliability, reporting difficult matches and comparing timings of CBCTs with kV images.

Results: There was a significant improvement in target coverage when matching to tumour, instead of bone or carina ($P<0.001$). However, Bland-Altman analysis demonstrated tumour matching had the lowest automatic and manual agreement. Tumour matching detected the highest proportion of set-up errors (26.1%), then carina (19.05%) and bone (18.41%). All methods demonstrated good or excellent inter-observer reliability (intraclass correlation 0.871-0.957). Problematic matches occurred in 20% and timings were comparable with kV imaging.

Conclusion: This study supports CBCT imaging and soft tissue matching to tumour as routine clinical practice in radical lung radiotherapy, with visual inspection of the tumour to ensure target coverage.

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P068 Lung cancer - stage of disease at diagnosis

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Background: The stage of cancer at diagnosis is an important prognostic factor. International population-based studies suggest that differences in stage at presentation may explain some of the survival variation for several cancers[1].

We looked at all new lung cancer diagnoses over a five-month period at a UK teaching hospital to determine the stage of disease at diagnosis and whether first presentation as an inpatient or outpatient influences the stage of disease at time of diagnosis.
Methods: A retrospective study from May to September 2018. A list of patients was generated from the MDT co-ordinator for all new diagnoses of lung cancer within this timeframe.
Our exclusion criteria:

- Not a new primary diagnosis of lung cancer
- Patients from outside-of-area.

Results: 74 patients were identified. 34 patients were excluded and 40 patients were analysed. There were 80% outpatients in the cohort. 62.5% patients had T3-4 disease, 67.5% had nodal disease and 42.5% had metastatic disease at diagnosis. Compared with the outpatient group, all of the inpatient group presented with T3-4 disease, 100% and 53.1% respectively. Inpatients were also more likely to have metastatic disease, 62.5% and 37.5% respectively.
Conclusion: The majority of lung cancers were diagnosed at a late stage. Patients diagnosed as an inpatient are far more likely to have higher stage disease. Further research and improvement of the diagnostic pathway to allow for the detection of lung cancers at an earlier stage is on-going with studies into the effectiveness of lung cancer screening[2].

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P069 An example of Boerhaave's syndrome

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Background: Oesophageal rupture is a rupture of the oesophageal wall. Iatrogenic causes account for approximately 56% of oesophageal perforations, usually due to medical instrumentation such as an endoscopy or para-oesophageal surgery (Marx et al 2010). In contrast, the term Boerhaave syndrome is reserved for the 10% of oesophageal perforations which occur due to vomiting (eMedicine 2018). This condition is frequently self-limiting but may have serious sequelae if undiagnosed. Signs on conventional radiography of the chest include pneumomediastinum and pneumopericardium. These appearances should trigger further imaging to identify the location of the rupture and any complications.
Purpose: To illustrate the typical appearances on conventional chest radiography, relate these to other imaging modalities and inform management options and differential diagnoses.
Summary: 33 year old patient presented to the Emergency Department with chest pain following prolonged vomiting. Conventional chest image on initial presentation showed pnuemopericardium and surgical emphysema. Patient was recalled for CT scan of the chest which confirmed free gas in the mediastinum, pericardium and soft tissues, but failed to identify an oesophageal rupture. Contrast swallow examination was also normal. The patient was discharged after antibiotic treatment and observation with Out Patient follow-up for endoscopy. Appropriate annotated images will be displayed. Brief discussion of differential diagnoses and treatment.

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P070 Imaging in Idiopathic Pulmonary Fibrosis (IPF) - review of the revised international guidelines and management implications

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Background: IPF is the most common form of interstitial lung disease (ILD) encountered in routine clinical practice. Accurate diagnosis requires an MDT approach and is critical to facilitate correct management in this era of anti-fibrotic therapies to slow the course of IPF. The histologic pattern of IPF is Usual Interstitial Pneumonia (UIP). The radiologist has an important role and in 2018, new guidance from the Fleishner society and an international group including the European Respiratory Society (ERS) expanded the HRCT classification of UIP from the prior 3 categories to 4 categories.
Purpose: To describe the imaging appearances of IPF in the context of the recently revised international guidelines. This educational exhibit will enable radiologists to accurately apply the new guidelines in interpretation of HRCT and understand the implications in diagnosis and management. The important role of the multidisciplinary team (MDT) will be discussed.
Summary: With cases from our referral centre for ILD we will illustrate the 4 categories in the new HRCT classification of UIP. Cases of typical UIP, probable UIP, indeterminate for UIP and atypical for UIP where alternative diagnoses should be considered will be presented. Key imaging features of all categories will be presented. The importance of the MDT will be discussed allowing clinical, laboratory and radiologic correlation, increasing diagnostic confidence. We will also illustrate cases where ultimately biopsy was necessary for diagnosis.

P071 **Imaging in lung cancer staging- a review of Tumour Node Metastasis (TNM) 8 and treatment implications**

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Background: Lung cancer is the most common cancer worldwide and the leading cause of cancer death in the UK. The TNM staging 8th edition has been created based on statistical analysis of over 100,000 patients and has re-classified lung cancer stages based on prognostic data. Staging plays a crucial role in describing the extent of a lung cancer and this together with patient specific factors aids the multi-disciplinary team (MDT) in formulating a management plan suited to the patient. Important changes which have been made include a greater influence of tumour size on staging, the influences of tumour extent and local invasion and recognition of distinctions between solitary or multiple sites of extrathoracic metastatic disease. It is important for radiologists and to be aware of these changes.

Purpose: To describe the changes made to TNM classification of lung cancer in accordance with the recently changed international guidelines. This exhibit will enable radiologists to understand the broadened staging categories and implications on treatment. We will discuss the impact this has had on lung cancer management at our thoracic centre.

Summary: Cases from our thoracic centre will be reviewed, key features distinguishing between different staging subtypes will be highlighted as well as potential pitfalls. We will describe memory aids with the aim of helping trainees in recalling some of the different staging subtypes and these will be correlated with images.

P072 **Seeing through the fog - a review of adenocarcinoma spectrum lesions in the lung and their staging according to TNM 8**

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Background: Lung cancer remains a leading cause of cancer death in the UK and adenocarcinomas remain the most common histologic subtype. In 2011, replacing the old term bronchoalveolar carcinoma (BAC) a new classification of adenocarcinoma introduced new terminology and diagnostic criteria. In the 2018 lung NTM 8 the spectrum of lung adenocarcinoma lesions was introduced into formal TNM staging for the first time.

Purpose: This educational poster will use cases from our thoracic centre with radiologic-pathologic correlation to illustrate the spectrum of adenocarcinoma lesions in the lung, from pure ground glass nodules to part solid and ultimately sold lesions. Use of the new TNM 8 staging system will be demonstrated to enable radiologists to correctly stage these lesions.

Summary: This poster will clearly outline the progression of adenocarcinoma spectrum lesions from premalignant atypical adenomatous hyperplasia through to the early malignant lesion minimally invasive adenocarcinoma and on to invasive disease. We will outline how to apply the new TNM 8 staging system and how this informs the lung cancer multidisciplinary team in management and follow up of these lesions. Important features that the radiologist must be aware of in the follow up of these lesions including increasing solid component will be highlighted.

P073 **The use of imaging as a predictor of malignant solitary fibrous tumours of the pleura**

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We present an 85 year old woman, non-smoker and no previous exposure to asbestos, complaining of back pain. Computed tomography (CT) scan showed an incidental finding of soft tissue mass measuring 5.3 × 6.4 cm, posteromedially at the right lung base. There was evidence of post-contrast enhancement and tumour necrosis with erosion into T10 vertebra and fracture of 10th rib. Magnetic resonance imaging (MRI) confirmed this, revealing a homogeneous mass on T1- weighted imaging and heterogeneity on T2-weighted images. The mass extended into the neural foramina and spinal canal.

The patient subsequently underwent an 18F-FDG PET/CT scan showing a soft tissue mass with high FDG uptake (SUV max 13.3). No significant hilar or mediastinal lymphadenopathy or other increased metabolic activity noted. Histopathology showed cores of fibrotic tissues infiltrated by sheets of spindled tumours cells with moderate pleomorphism and up to 3-4 mitotic figures seen per 10 high per fields. Foci of haemorrhage and necrosis were evident. On immunostaining, the tumour cells were positive for vimentin CD34 and BCL 2, confirming malignant solitary fibrous tumour. SFTP is a rare mesenchymal tumour, accounting for 5% of pleural tumours of which 12-33% are malignant.

Histological differentiation between benign and malignant tumours is difficult due to its heterogeneity and large size. Therefore, diagnosis is confirmed histologically, post-surgical resection. Literature review suggests the use of single imaging modality is limited. Multimodal imaging including CT, MRI and PET/CT is required for a radiological diagnosis of malignant SFTP.

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P074 Systematic approach to reviewing chest X-rays for nasogastric tube placement

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Nasogastric tube feeding is common practice and thousands of nasogastric tubes are inserted daily without incident. Feeding into the lung through a misplaced nasogastric tube is a "Never Event". The National Patient Safety Agency (NPSA) suggests X-ray image interpretation could be a major factor. A systematic and logical review pattern used consistently can reduce the likelihood of "Never Events". A nasogastric tube identified to be in a lung should be removed immediately to ensure the best outcome for the patient. The poster will include a systematic approach review of chest radiographs for the purpose of evaluating nasogastric tube placement, along with high quality images to demonstrate appropriately placed tubes and misplaced tubes.

P075 The role of FFR in coronary artery CT

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Current guidelines recommend non-invasive imaging as the first line test in stable coronary artery disease. This has led to the increasing role of cardiac CT. Limitations of this test are the ability to determine between ischaemic and non-ischaemic lesions. However recent advances in FFR (fractional flow reserve from Heartflow) allow an individual 3d model of patients coronary arteries derived from CT coronary angiography and highlight any lesion specific ischemia. There are high levels of diagnostic accuracy and is supported by NICE Guidance.

The role of FFR in assessment of functional significance enables accurate selection of the patients who will benefit from revascularisation and invasive coronary artery intervention. The poster aims to highlight the use of FFR via case reviews of cardiac lesions diagnosed on CTCA and subsequent patient management.

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P076 Delivering radiotherapy in DIBH to a lymphoma patient in a thermoplastic BDS - a case report

James Barber; George Mikhaeel; Jessica Brady; Benson Leung; Rubina Begum
Guy's and St Thomas' NHS Foundation Trust

Background: A 35 year old male was referred for radiotherapy to a Classical Hodgkins Lymphoma including cervical level III, IV and V, the SCF and the anterior mediastinum. The treatment area extended to the inferior extent of the mediastinum. Standard protocol was to treat in a full 5-point thermoplastic BDS. Dose constraints for the heart and lungs couldn't be met using the butterfly technique in free breath. Therefore, a technique for delivering DIBH in a mask was required.

Method: Current practice was to treat all DIBH mediastinal lymphomas with arms raised, but this approach would not give adequate immobilisation of the cervical area. As local practice is to use AlignRT (SGRT) to verify DIBH this precluded the use of a full head and shoulder BDS as this would obscure too much of the patient contour. To allow optimal immobilisation while still allowing SGRT to verify DIBH, a head only BDS in conjunction with shoulder depressors was used. This minimised the risk of pitch in the head and variance in the position of the shoulders when entering and exiting DIBH, while still allowing AlignRT to detect sufficient patient contour to verify breath-hold.

Results: Re-planning the patient using the butterfly technique in DIBH allowed dose constraints to be met. Mean heart dose dropped from 21.359Gy to 10.568Gy and Lung-PTV mean dose dropped from 14.556Gy to 8.939Gy.

Conclusion: Following successful treatment this technique has been used successfully in 5 further cases, allowing radiotherapy to be safely delivered to long volumes.

P077 An audit to investigate the possible advantages of treating lymphoma stomach patients in DIBH or EEBH to reduce heart dose

James Barber; George Mikhaeel; Jessica Brady; Benson Leung
Guy's and St Thomas' NHS Foundation Trust

Background: Standard protocol for treating lymphoma stomach patients is to treat in free breath. For GI primary lesions, treatment in end exhalation phase, either gated or breath-hold, or using abdominal compression, are widely thought to be beneficial. However, for the younger cohort of patients seen in lymphoma treatments, cardiac dose is of greater concern.

Method: A baseline data collection was carried out retrospectively looking at abdominal 4DCT scans. This evaluated the distance between the superior extent of the stomach and the inferior extent of the heart in the inhalation and exhalation phases to give an indication as to whether DIBH or EEBH would beneficial in minimising heart dose.
Results: Of the 20 patients evaluated, 85% showed a greater distance from stomach to heart in inhalation and 5% an equal distance. While a consideration in interpreting this data is that the patients analysed had not consistently followed any fasting protocol, this correlation is still strong enough to favour use of DIBH to reduce cardiac dose in these patients, especially factoring in that this distance is likely to increase further in deep inspiration hold from a natural inhalation.
Conclusion: This has provided the evidence to go forwards piloting treating this cohort in DIBH. A second retrospective data collection was carried out to show mean heart doses in lymphoma patients treated in free breath. This will be prospectively compared to patients planned in DIBH to definitively show if cardiac dose is reduced.

GI UPPER AND LOWER / HEP

P078 Pictorial review: Imaging features of extra-abdominal desmoid tumours at presentation and following treatment

Geraldine Dean; Tim Hall; Anika Choraria; Kannan Rajesparan; Elly Pilavachi; Elly Pilavachi
University College Hospital

Background: Extra-abdominal desmoid tumours (DT) are monoclonal proliferations of fibroblasts that are locally aggressive with unpredictable clinical behaviour. These tumours are difficult to treat medically and surgically. Although definitive diagnosis remains histopathological, DTs have characteristic imaging features that aid diagnosis and response assessment.
Purpose: To present multi-modality imaging features of extra abdominal DTs and post-treatment changes. The learning outcomes will include 1) Familiarity with the radiological appearances of extra abdominal DTs 2) Appreciation of imaging features following treatment.
Summary: This educational pictorial review will present a variety of extra abdominal DT images from various modalities in a tertiary centre. We will outline the main imaging features that aid diagnosis and assessment of treatment response.

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P079 Clinical audit of rectal cancer patient referrals for Papillon contact brachytherapy

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Background: Papillon contact X-ray brachytherapy (CXB) is an alternative to surgery for rectal cancer(NICE, 2015). Although it has seen a resurgence in the UK in recent years (Myint, 2017) there are currently no national guidelines guiding referrals for treatment. This study audited patients who were referred for and treated with CXB over a 6 year period against guidelines derived from a critical review of the evidence.
Methods: Patient demographics, tumour characteristics, and outcome data were gathered for 31 patients referred for CXB. A critical review of the evidence identified consensus referral criteria and outcome data against which to audit patients.
Results: Referral criteria were derived from six published studies of patients unfit for surgery or stoma-averse. All referred patients had a visible tumour or scar with a tumour size under 3cm sited less than 12cm from the anal verge. Nodal status varied (N0-2) but there was no metastatic disease present. The audited cohort demonstrated equivalence of median age, performance status, and tumour stage. Initial clinical complete response, local recurrence, and occurrence of distant metastases were also comparable. The overall survival rate of 83.9% exceeded the published results.
Conclusion: Similarity of cohort demographics enabled comparison of outcome data which confirmed the validity of referral and treatment protocols. Although the limited evidence base and retrospective nature of the audit limits the strength of the findings, this work should guide future referrals until evidence from ongoing studies becomes available and contribute to development of robust national2015)

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