Received:
12 January 2015

Revised:
12 February 2015

Accepted:
19 February 2015

doi: 10.1259/bjr.20150037

Cite this article as:

Shah A, Botchu R, Ashford RU, Rennie WJ. Diagnostic triage for sarcoma: an effective model for reducing referrals to the sarcoma multidisciplinary team. *Br J Radiol* 2015;88:20150037.

FULL PAPER

Diagnostic triage for sarcoma: an effective model for reducing referrals to the sarcoma multidisciplinary team

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Objective: Soft-tissue lesions are common and often benign. Owing to the rarity of soft-tissue sarcomas (STSs), evidence has shown that patients are increasingly referred urgently onto the 2-week wait pathway, which may have a detrimental impact on the management of patients with a proven STS. Imaging plays a vital role in lesion characterization and can be used to triage referrals to reduce the caseload of a sarcoma multidisciplinary team (MDT). In our institution, we established a sarcoma diagnostic triage meeting (SDTM). This study aimed to determine the effectiveness of the SDTM in reducing non-sarcomatous referrals to the main sarcoma MDT.

Methods: A retrospective review of the SDTM minutes from July 2011 to June 2012 was performed. Data collected for each case included details of referrer, referral modality and referral outcome.

Results: 165 cases were reviewed. 58% of referrals underwent a core biopsy or surgical excision with 85% benign pathology, the commonest being lipoma. 15% of referrals were sarcomatous lesions and were referred onwards to the main MDT.

Conclusion: A total of 82% of the patients referred urgently with a suspicious soft-tissue mass was managed by the SDTM and hence not referred onwards to the East Midlands Sarcoma Service MDT. A diagnostic triage is effective in reducing the caseload burden of the main MDT and allowing it to be more effective.

Advances in knowledge: Referrals based on imaging can be prioritized by diagnostic triage. Diagnostic triage established in our institution reduced 82% of MDT referrals allowing a more focused MDT discussion on patients with a proven sarcoma.

Soft-tissue sarcomas (STSs) account for approximately 1% of all adult primary tumours. In 2010, there were 3272 new cases of STS (all subtypes combined) in the UK.¹ In 1997, "The new National Health Service: modern, dependable", a government White Paper stated that all patients with a suspected cancer would see a specialist within 2 weeks of being referred urgently.² The 2006 National Institute for Health and Care Excellence (NICE) Improving Outcomes Guidance stated that patients with STS should be managed by a multidisciplinary team (MDT).³ Most soft-tissue tumours (STTs) are benign but often cannot be reliably distinguished from malignant ones with clinical judgment alone. Imaging plays a vital role in characterizing lesions, and MR can provide a high degree of sensitivity and specificity in characterization.^{4,5}

NICE established criteria for a 2-week wait (2WW) referral for urgent specialist assessment (Table 1). Our institution is part of the regional East Midlands Sarcoma Service (EMSS). The service has two diagnostic centres based at the

University Hospitals of Leicester (south) and Nottingham City Hospitals (north), UK. The EMSS is responsible for a population of 4 million people, managing approximately 150 STS cases per year.⁶ The EMSS has established referral pathways to the EMSS MDT for both general practitioners (GPs) and secondary care clinicians in our region for patients with a suspected or proven STS.

The number of referrals for suspected STS is increasing, and that the rate of increase of 2WW referrals is increasing at a greater rate than for routine referrals.⁷ It has been reported that the incidence rate of STSs increased significantly by 26% between 1997 and 2007.⁸ This is likely to have a negative impact on the treatment of patients with proven sarcoma because of the redirection of finite MDT resources to the large number of patients with non-sarcomatous pathology.⁹

NICE guidelines state that MDT discussions should be focused on newly diagnosed patients, patients following

Table 1. National Institute for Health and Care Excellence clinical/imaging criteria for urgent 2-week wait referral³

Size >5 cm
Soft-tissue mass increasing in size
Soft-tissue mass deep to the deep fascia
Pain attributable to the soft-tissue mass

tumour resection or patients with local recurrence. An anecdotal note was made in our centre of a large number of non-sarcomatous referrals to the EMSS MDT. Owing to time constraints and increased workload of the MDT, a decision was made in 2010 to set up and establish a sarcoma diagnostic triage meeting (SDTM) in Leicester, UK. Members include a sarcoma [musculoskeletal (MSK)] radiologist, an orthopaedic sarcoma surgeon, a specialist sarcoma pathologist and the MDT co-ordinator. All members are core members of the EMSS MDT. New referrals to the south centre with prior imaging were reviewed and diagnostic decisions were made. Only biopsy-proven STSs or World Health Organization intermediate pathologies were then referred onwards to the EMSS MDT. The aim of this study was to determine the effectiveness of the SDTM in reducing the number of non-sarcomatous referrals to the EMSS MDT.

METHODS AND MATERIALS

A retrospective review of the University Hospitals of Leicester's SDTM minutes between July 2011 and June 2012 was performed. The data collected for each case included details of the referrer, referral modality, outcome and appropriateness of the referral. All histology reports were obtained from the histology database for those patients who underwent a biopsy/excision. Referrals were excluded if they were referred outside of the review dates, had a known STS or were reviewed for follow-up. Cases that were discussed on multiple occasions were counted once only. A referral was deemed appropriate if the lesion had imaging features that met any one of the urgent referral criteria as set by NICE (Table 1); if the lesion was biopsied/excised; or if an onward referral directly to the supraregional sarcoma centre was made. A consultant MSK radiologist (WJR), with 9 years' experience, had the final decision regarding the appropriateness of a referral. Outcomes were classified into groups that underwent a biopsy/excision, those that were discharged, those that were referred for routine clinical or imaging follow-up or that were referred or as "other" (e.g. referral to another MDT).

RESULTS

Over a 1-year period, a total of 217 cases were discussed in the SDTM, of which, 52 did not meet the inclusion criteria leaving a total of 165 patients.

Referral source

Of the 165 referrals, 79% ($n = 131$) were directly from the in-house radiology department. Of these, the majority of referrers were consultant radiologists (70%; $n = 92$) and sonographers (27%; $n = 35$). Other referrers included allied local district general hospitals (DGHs) (14%), hospital clinicians (<1%),

reporting radiographers (<1%), one radiology resident and one physiotherapist. In two cases, the referral source could not be identified.

Referral modality

Of the 165 referrals, 160 (97%) were based on imaging alone. Two cases were referred from local DGHs with imaging and histology. Three cases were referred to the EMSS MDT after the local clinical team had organized a biopsy, with two of these referrals being prior to the availability of the histological report. Ultrasound was the most common modality of imaging that prompted a referral (48%; $n = 76$), with MRI (33%; $n = 53$) as the second commonest modality. Other modalities included plain film (12%) and CT (7%).

Referral outcome

The two histological referrals from local DGHs were positive for a STS. One of the three internal biopsy referrals was positive for a STS, with the remaining two cases histologically confirmed as non-sarcomatous lesions (non-Hodgkin's lymphoma and breast fibromatosis). Just over half of the remaining referrals underwent a core biopsy or definitive surgical excision (58%; $n = 92/160$). Other outcomes included onward referral to the

Table 2. Examples of inappropriate referrals to the East Midlands Sarcoma Service multidisciplinary (MDT) team between July 2011 and June 2012

Osteochondral defect
Non-aggressive features on ultrasound
Enchondroma
Lymph nodes
Osteomyelitis
Hernia
Geode
Bicipital bursitis
Ulnar neuropathy
Fracture
Calcific myonecrosis
Referral of known incompletely excised fibromatosis
Referrer cancelled MDT referral
Onward referral to the lung MDT
Onward referral to the breast MDT
Onward referral to the colorectal MDT
Onward referral to the primary of unknown origin MDT
Onward referral to the orthopaedic hand surgeons
Onward referral to the endocrine tumour MDT
Onward referral to the tuberculosis services
Onward vascular referral
Onward referral to the haematology MDT
Wrong MDT referral

Figure 1. Referral outcomes of the 162 patients referred to the East Midlands Sarcoma Service (EMSS) between July 2011 and June 2012. MDT, multidisciplinary team.

supraregional tertiary bone sarcoma centre (5%; $n = 8/162$), discharge from the 2WW service back to the referrer (16%; $n = 26/162$), referral for clinical/imaging follow-up (7%; $n = 11/162$) and “other” (12%; $20/162$), for example, onward referral to another MDT owing to incorrect MDT coding (Table 2). There were five (3%) cases where the outcome was not known at the time of the study. Referral outcomes are summarized in Figure 1.

Of the lesions in which a tissue diagnosis was obtained, either by excision or core biopsy (Figure 2), 85% ($n = 78/92$) were non-sarcomatous (Table 3) with lipoma being the single most common pathology (29%; $n = 27/92$). STSs accounted for a fifth (15%; $14/92$) of the biopsies with the commonest histological subtype being myxofibrosarcoma (3) and rhabdomyosarcoma (2). Other sarcomatous histological subtypes are shown in Table 4.

Referral appropriateness

It was deemed necessary to histologically determine the nature of the lesion, thus, all biopsied/excised lesions, in addition to the three histologically proven STS referrals, were appropriately referred. This equates to 58% ($n = 92/160$) of the referrals to the EMSS MDT being appropriate. A further 5% ($n = 8/165$) were referred onwards directly to the local regional bone sarcoma

centre. Unknown outcomes accounted for 3% ($n = 5/160$). The remaining 35% ($n = 57/165$) should not have been referred specifically onto the 2WW pathway. This is owing to a combination of referral of lesions that did not meet one of the features of the NICE criteria for urgent referral, lesions that could have been referred routinely or referral to the wrong subspeciality.

A total of 82% ($n = 135/165$) (not including 5 unknown cases) of the patients who were referred urgently with a suspicious soft-tissue mass were managed by the SDTM and hence not referred onwards to the EMSS MDT.

DISCUSSION

The NICE “Improving outcomes for people with sarcoma” guidance highlights the need for the referral and management of all suspected STSs by a specialized STS MDT. With increasing referral rates, it is important to effectively manage referrals to ensure that only appropriate referrals are discussed in the MDT. Hence, we established a SDTM to prioritize referrals, with prior imaging, with the aim of reducing discussion of non-sarcomatous cases at the main MDT. Our results demonstrated 87% of the total cases referred to the MDT were managed by the SDTM and not referred onwards to the EMSS MDT, which confirmed our

Figure 2. Histology of the 92 biopsied/excised lesions for suspected soft-tissue sarcoma between July 2011 and June 2012. *Other histology given in Table 3.

Table 3. Non-sarcomatous histology from lesions biopsied/excised that were referred to the East Midlands Sarcoma Service during July 2011–June 2012

Fracture and reactive synovium
Endometriosis
Fibrosis
Angiolipoma
Myopericytoma
Arteriovenous malformation/haemangioma
Myxoma
Neurofibroma
Osteoid osteoma
Schwannoma
Ganglion
Fibromatosis
Fat necrosis
Giant cell tumour
Glomus tumour
Soft-tissue chondroma
Organizing haematoma
Infected rheumatoid nodule
Hibernoma
Non-Hodgkin's lymphoma
Aneurysmal bone cyst
Reactive
Epidermoid cyst
Fasciitis
Adenocarcinoma (lung) metastasis
Non-specific/benign

hypothesis that a diagnostic triage service was effective in reducing the number of benign lesions discussed in the main STS MDT.

The SDTM consists of the experienced MSK radiologist, sarcoma surgeon, sarcoma pathologist and the MDT co-ordinator, and half of the core members who make up the EMSS MDT. The reason for having these three clinicians in the SDTM is because this was deemed to be the minimum number required to safely approach assessing these referrals and deciding further management whilst keeping costs to a minimum. The alternative in reducing the number of non-sarcomatous referrals and ensuring only STS-proven cases are discussed in the MDT would be to biopsy all cases referred into the service, which is neither practical nor true patient-centred care. Thus, establishing a SDTM was considered most patient centric and safe practice in the provision of a cancer service and with three clinicians rather than a decision by a single operator such as an experienced MSK radiologist alone. Evidence has shown that surgical management

of a STS by a specialist sarcoma surgeon is significantly better than by a non-specialist.^{10,11} NICE guidelines state “There is consistent observational evidence that a histopathological diagnosis of sarcoma is often changed on review by an expert pathologist” when compared with a generalist pathologist. Likewise, a similar observation has been noted comparing a sarcoma specialist radiologist vs a general radiologist.³ Furthermore, the average cost to run a MDT has been reported as over £800,000, with De Ieso *et al*¹² concluding that some MDTs cost the equivalent of 50 Band 7 nurses or 20 consultants.¹³ Hence, taking these factors into consideration, it is imperative to make the MDT as efficient as possible, with the caseload number being an important determinant in the efficacy.

The SDTM meets for half an hour after the main MDT, and all new referrals with prior imaging are reviewed. Depending on the imaging features, referrals are grouped into benign, indeterminate or suspicious. If the imaging features are benign, the patient is removed from the 2WW pathway and either discharged back to the referrer or, if required, a routine appointment is made with the sarcoma surgeon for clinical or imaging follow up. Indeterminate ultrasound referrals performed by inexperienced operators have a repeat ultrasound performed by the specialist MSK radiologist. Suspicious lesions have an urgent MRI arranged, if not already performed, and, if appropriate, an urgent biopsy. For both indeterminate and suspicious referrals, the patient is rediscussed in the SDTM following complete

Table 4. Histological subtypes of the sarcomatous lesions biopsied/excised at the University Hospitals of Leicester, including three biopsied lesions referred to the multidisciplinary team (MDT) between July 2011 and June 2012

Histology	Total
Myxofibrosarcoma	3
Rhabdomyosarcoma Pleomorphic rhabdomyosarcoma Alveolar rhabdomyosarcoma	2
Undifferentiated sarcoma NOS	2
Dedifferentiated liposarcoma	1
Synovial sarcoma NOS	1
Leiomyosarcoma	1
Pseudomyxogenic (epithelioid sarcoma-like) haemangioendothelioma	1
Adult fibrosarcoma	1
Extraskeletal myxoid chondrosarcoma	1
Pleomorphic hyalinizing angiectatic tumour	1
Biopsied lesions referred to the East Midlands Sarcoma Service MDT	
Myxofibrosarcoma	1
Dermatofibrosarcoma protuberans	1
Leiomyosarcoma	1

NOS, not otherwise specified.

imaging $\pm$ histological review. Histologically confirmed sarcomatous lesions are referred onwards to the EMSS MDT (Figure 3).

The National Health Service (NHS) Cancer Plan was introduced in 2000, revised by NICE in 2005 and include guidelines for the rapid assessment and referral of cases of suspected malignancy within 2 weeks from referral.¹⁴ Pencavel et al⁷ have demonstrated the rate of increase of 2WW referrals is increasing faster than routine referrals without increase in the detection of STS. A possible explanation for this may be due to provision of open access ultrasound and MRI for GPs. This was true in our institution as the most common imaging modality to trigger a referral was ultrasound (48%). Open access to MRI is restricted in our region, and GPs can only easily have access to ultrasound, hence the main mode of initial imaging referral. Furthermore, ultrasound is a cheap easily accessible modality whereby simple lesions can be excluded. Obviously, any doubtful lesions or atypia would warrant MRI. Soft-tissue masses tend to be imaged prior to a specialist clinical examination, and the majority of referrals are thus based on imaging, as seen in our study, with 78% of referrals from our in-house radiology department. Although the EMSS has produced guidelines and pathways that can be accessed by primary and secondary

healthcare providers, the pathway was not robust enough to prevent the significant increase in referral rate seen in our institution. Radiographs performed for GP referrals are sometimes over interpreted as sarcomas and subsequent referral to the MDT (Figure 4). As seen in our institution, studies have shown that imaging plays a vital role in the evaluation of soft-tissue lumps and can be an extremely useful in decreasing benign referral rates if interpreted appropriately. Ultrasound is the primary screening tool for the evaluation of soft-tissue lesions with MRI generally reserved for the characterization of indeterminate or suspicious lesions. Ultrasound has been shown to be an effective triage tool and in conjunction with MRI, most STTs can be characterized with a high degree of sensitivity and specificity as benign, indeterminate or malignant.^{4,5,15} However, imaging, particularly ultrasound, can also result in an increased referral rate if performed by inexperienced operators and in unclear clinical pathways, as is demonstrated in our article. For example, small lipomas were referred based on ultrasound scans performed by any qualified provider (AQP), despite clear NICE guidance (Figure 5). Vanhoenacker et al¹⁶ recently reported that a second “expert” opinion increases the accuracy in the diagnosis of STT on MRI with fewer false-positive diagnoses. This adds further evidence to having a triage service run by speciality

Figure 3. Flow chart demonstrating the patient pathway once imaging-based referral to the sarcoma multidisciplinary team (MDT) is made. ^aTypical pathway if initial imaging modality is ultrasound; if MRI is the initial modality with suspicious features then the patient has a biopsy arranged. If the MRI is clearly benign then the patient is discharged from the 2-week wait (2WW) pathway. +, indeterminate/suspicious features; EMSS, East Midlands Sarcoma Service; MSK, musculoskeletal; SDTM, sarcoma diagnostic triage meeting; STS, soft-tissue sarcoma; USS, ultrasound sonography.

Figure 4. Anteroposterior radiograph of the right knee in a 28-year-old female referred for pain over the lateral joint line and locking following a fall, demonstrating an osteochondral defect (arrow), referred to as a chondroblastoma to the sarcoma diagnostic triage meeting.

radiologists providing “expert” opinion to manage MDT referrals, which are often from referrers inexperienced with diagnosing a STS. Figure 6 demonstrates an example where an MRI of a patient

Figure 5. Long axis ultrasound of the upper posterior thigh demonstrating a small subcutaneous lipoma, referred to as a sarcoma, reclassified at the sarcoma diagnostic triage meeting.

Figure 6. Axial T_2 weighted spin echo. MRI in a 63-year-old male presenting with medial knee pain and a swelling, referred to as a sarcoma to the sarcoma diagnostic triage meeting which was reclassified as a pes anserinus bursa (arrow).

being investigated for a soft-tissue swelling around the knee was interpreted as a STS despite being in a characteristic bursal site. Based on our results, we would suggest that this form of diagnostic triage meeting would be useful in other “heavily subscribed” MDTs such as hepatobiliary and lung.

Of the 160 referrals based on imaging, 58% ultimately underwent either a definitive surgical excision or biopsy. Of all the lesions with an established tissue diagnosis, 85% were non-sarcomatous, with lipoma being the commonest benign pathology. These lesions were biopsied as imaging features were not entirely typical for a simple lipoma. These results are comparable with those of Rowbotham *et al*¹⁷ in which 112 patients were studied and a benign final diagnosis was found in 85%, with lipoma being the most common diagnosis.

A total of 35% of referrals were deemed inappropriate for a number of reasons that included referral to the wrong MDT or lesions that did not require urgent 2WW referral (as per NICE urgent referral criteria) and could have been routinely referred. A number of referrals were for pathology that did not fall under the remit of the sarcoma service such as lymphadenopathy for possible tuberculosis, bicipital bursitis and fracture. The main imaging modality in our series was ultrasound, which in our institution and with AQPs is mainly performed by sonographers, which is becoming increasingly common across the NHS. The nature of multiple sites, community-based ultrasound and weekend lists makes direct supervision of these lists by an experienced MSK radiologist nearly impossible. A potential solution could be instant access to the referral criteria in all ultrasound rooms as an aide memoir. However, as imaging is increasingly being performed in the community and by AQPs, making provision for continued education and developing and

monitoring local systems for MDT referral will be challenging. Continual education programmes for general radiologists and sonographers could also help reduce unnecessary referrals.¹⁸ However, we acknowledge that this is a highly specialized area, and if there is a suspicion of a STS, medical practitioners should not hesitate to seek specialist opinion. By having a SDTM, non-sarcomatous referrals can be dealt with without overburdening the main sarcoma MDT. We recommend a basic imaging set from referring hospitals of ultrasound for soft-tissue lesions, followed by a non-contrast MR in two planes of T_1 spin echo and short tau inversion recovery imaging, prior to referral to a SDTM.

We acknowledge there are some limitations to this study. This is a retrospective study performed in a single institution, although we feel that the results observed in this study can be applicable to centres across the country. Every centre is likely to be experiencing a significant rise in their referral rates putting pressures on an already stretched service and therefore the results of this

study should be further assessed with multicentre results. Also, we only accessed the radiology information system and the SDTM minutes to gather patient data with some information not being available, however, all pathology and imaging results were accessed. Although beyond the scope of this study, it would be useful to look at the imaging/clinical features of the STS-positive patients and correlate these with the NICE criteria for urgent referral and compare the results with the histologically proven non-sarcomatous lesions. The aim of this article was not to refute or validate the NICE criteria.

We have demonstrated an effective model for reducing STS MDT referrals. With the use of a diagnostic triage meeting, a total of 82% of the total 2WW referrals were not referred onwards to the EMSS MDT. By reducing the caseload of the main MDT, more time can be spent, and thereby more attention focused on proven cases of STSs with the aim of ultimately improving outcomes for the patient.

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