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The surgical management of soft tissue tumours arising in the abdominal wall

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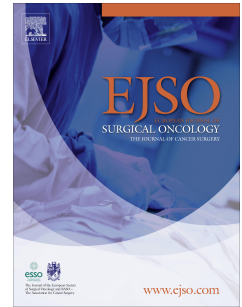
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Title page

Title: The surgical management of soft tissue tumours arising in the abdominal wall

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conference, London 2009. Abstract: Pencavel T, Strauss D, Thomas J, Hayes

A. Abdominal Wall soft-tissue tumours: a large single-centre experience.

EJSO 2009 (Nov);35(11):1212

Abstract**Background:**

Soft-tissue tumours can occur at almost any site, including the abdominal wall and represent a biologically diverse group of benign and malignant tumours.

Methods:

A prospectively-kept database was searched to identify all patients with tumours resected that involved the abdominal wall. The histological diagnosis, complication rates and local recurrence rates were reported. Kaplan-Meier analysis of prognostic factors was determined for patients with primary abdominal wall sarcomas.

Results:

Ninety-two patients underwent resection for tumours involving the abdominal wall. Desmoid tumours (n=30) and primary soft-tissue sarcomas (n=25) were the most common pathologies. Of 92 patients undergoing resection 87 required reconstruction of the abdominal wall defect with polypropylene mesh but only 2 patients required reconstruction of the overlying skin. There were no immediate surgical complications in patients who underwent isolated abdominal wall reconstruction and the long term incision hernia rate was 4%. Kaplan-Meier analysis for patients with primary abdominal wall sarcomas showed that local recurrence was higher in tumours > 10cm (p=0.0024) and in high grade tumours (p=0.0021). Disease-specific survival was worst in high

grade tumours ($p=0.0010$) and tumours $> 10\text{cm}$ ($p=0.0042$). Desmoid tumours did not recur in any patient after abdominal wall resection, irrespective of microscopic margins.

Conclusions:

Tumours involving the abdominal wall exhibit a wide range of pathologies. Abdominal wall reconstruction can be achieved in the vast majority of cases with mesh reconstruction alone with little surgical morbidity. Sarcomas carry a significant risk of local recurrence. Abdominal wall fibromatosis carries a better prognosis than fibromatosis arising in the extremities.

Introduction

Soft-tissue tumours include a wide spectrum of pathologies, ranging from benign to high grade malignancies. Soft-tissue tumours can occur anywhere, but most often arise in the extremities.¹ When sarcomas at all sites are considered there is a high incidence of local recurrence (25%) and a five-year survival between 50% and 60%.² Local recurrence and disease-specific survival are closely related to tumour grade, size, depth, site and incomplete surgical resection margins.³⁻⁶

Abdominal wall sarcomas account for between 1 – 5% of all soft-tissue sarcomas⁷. Similar surgical principles apply to sarcomas in the abdominal wall namely complete surgical excision with negative histological margins. Fibromatosis or abdominal wall desmoids are benign, slow-growing tumours of myofibroblast origin with a propensity for local aggressive behaviour but with a lack of metastatic potential. In the extremities, fibromatosis has a reputation for local recurrence that can occur regardless of margin status⁸. The aetiological link to familial adenomatous polyposis (FAP) has been well established. Other risk factors include oestrogen exposure and abdominal wall trauma⁹. Primary abdominal wall sarcomas and abdominal wall desmoid tumours are the most common abdominal wall tumours, and preoperative histology is essential to distinguish them from less common pathologies which have similar clinical presentations. Endometriosis can occur in the abdominal wall as an implantation phenomenon¹⁰. The abdominal wall can further be the site of metastatic carcinoma, either as an implantation¹¹ or by haematogenous spread. Other benign soft tissue tumours including intramuscular lipomas,

schwannomas, haemangiomas can also rarely occur in the abdominal wall and cause local symptoms and concern. The purpose of this study is to report on the pathological spectrum of tumours resected at a single institute and to discuss the outcome after surgical resection and abdominal wall reconstruction in this diverse group of tumours.

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Patients and Methods

Patients with soft-tissue tumours resected from the abdominal wall from January 2000 until January 2009 were identified from a prospectively-kept database. The pathological and clinical records of these patients were reviewed.

The abdominal wall was defined as the region between the costal margins and the inguinal ligaments with the lateral aspect of the paravertebral muscles defining the lateral borders. Macroscopic margins were ascertained by the operating surgeon confirming either complete surgical excision or residual tumour. Microscopic margins were assessed at histopathology examination. Patients that were deemed inoperable or who declined surgery were not included in this study. Patient variables include age, presenting symptoms, history of pregnancy and sex. Histology was reported by a specialist sarcoma pathologist. Pathological variables include diagnosis, size, microscopic margins, tumour subtype and grade. Operative outcomes documented include length of hospital stay, postoperative morbidity, ability to obtain macroscopic clearance and adjacent visceral resections, method of abdominal wall reconstruction and late complications. The specific endpoints for patients with desmoids tumours were local recurrence and endpoints for sarcomas were local recurrence and disease-specific survival. Time to local recurrence and disease-specific survival was calculated from date of surgery to clinical or radiological confirmation of end-point. Intra-abdominal and peritoneal recurrence in patients where the peritoneum constituted the deep margin, were classified as local recurrence. Deaths resulting from disease were treated as an end-point for disease-specific survival.

Statistical analysis

Local recurrence and disease-specific survival was estimated using the method of Kaplan and Meier¹². Univariate influences of prognostic factors on study end-points was analysed using log rank test. Local recurrence and disease-specific survival was only calculated for soft-tissue sarcomas. No multivariate analysis was carried out owing to the moderate size of this cohort. A p-value of less than 0.05 was considered statistically significant.

Results

Pathology and diagnosis

During the period January 2000 to Jan 2009, 92 patients underwent resection of tumours involving the abdominal wall. The patient demographics and pathological spectrum for the whole cohort is shown in Table 1. Pain was an infrequent presenting feature for all pathologies other than endometriosis, with most patients presenting with an asymptomatic abdominal mass.

The sex distribution was essentially equal for all pathologies other than abdominal wall desmoids and endometriosis where there was a strong female association. Of the 28 female patients with desmoids, 25 patients presented after a recent pregnancy. None of the patients with abdominal wall desmoids had familial adenomatous polyposis

The histopathological subtypes and grade of the 25 primary abdominal wall sarcomas are shown in Table 2. The other benign tumours (n=6) undergoing surgical resection included schwannomas, haemangiomas, intramuscular lipomas and a non-specific inflammatory mass.

A diagnostic preoperative core needle biopsy was available in 90% (83/92) patients, the remaining patients had conclusive preoperative imaging or known metastatic malignancy such as metastatic melanoma. All patients undergoing surgical resection underwent cross-sectional preoperative imaging either by CT or MR scanning (Figure 3a,3b).

Surgical outcome and complications

In total, 92 patients underwent 93 resections of abdominal wall tumours; one patient underwent a re-resection of a recurrent sarcoma within the study period. In 87 of the 93 operations (94%), a mesh reconstruction of the abdominal wall was required and 5 patients with small benign tumours did not require mesh reconstruction. The median length of stay for the whole cohort was 5 days with a range of 1 – 32 days.

In all but 2 of these cases there was no requirement for associated skin reconstruction and primary closure of the skin could be obtained directly over the mesh. In two cases primary skin closure could not be achieved and a pedicled myocutaneous flap was required. Additional structures that required resection included inguinal ligament (8 patients), inferior rib and diaphragmatic insertion (7 patients), inguinal or iliac node dissections (5 patients), bowel resections (4 patients), dome of bladder (5 patients), spermatic cord and testis (3 patients).

Of the 92 patients, 38 underwent resection of the abdominal wall involved by sarcoma. Twenty-five patients had primary abdominal wall sarcomas, 10 patients were referred with recurrent sarcomas of the abdominal wall that has been resected elsewhere before and 3 patients had metastatic sarcoma deposits involving the abdominal wall. There were an equal amount of men and women (19/38) ranging in age from 22 to 86 years (median 54 years). All patients required mesh reconstruction of the abdominal wall. Median length of hospital stay for this group of patients was 8 days (range 4 – 32 days).

Immediate postoperative complications developed in 6/92 patients (6.5%). All complications occurred in patients with abdominal wall sarcomas who

underwent visceral resections. Two patients developed postoperative small bowel obstruction which resolved on conservative treatment. One patient developed a small bowel enterocutaneous fistula and one patient developed a urinary fistula. Two further patients developed an infected seroma that required operative drainage and antibiotics. Long-term complications related to the mesh reconstruction developed in 6/38 sarcoma patients (16%). Four patients developed incisional hernias, and 2 patients complained of pain or discomfort relating to the mesh.

During the study period, 30 patients underwent resection of an abdominal wall desmoid tumour. Mesh reconstruction was required in 29/30 patients. No patient required visceral resections but one patient required resection of the inguinal ligament. The median hospital stay was 5 days (range 2 – 9 days). No patient developed postoperative complications and one patient developed an incisional hernia during follow-up. Five patients complained of pain or discomfort relating to the mesh during follow-up.

Although the outcome analysis presented in this paper has focussed on primary abdominal wall sarcoma, the 92 patients in the series also contained a population of patients undergoing resection for other, pathologically distinct, tumours involving the abdominal wall. This included seven patients, all female, who underwent resection of abdominal wall endometriosis. All seven patients had previous caesarean sections. Four patients presented with a painless palpable mass and 3 patients complained of a cyclic painful mass. Six of the seven patients required abdominal wall reconstruction with mesh. Length of stay for this group of patients ranged between 1 - 5 days. None of these patients developed a postoperative complications or local recurrence.

One patient underwent resection for an advanced primary skin squamous cell carcinoma of the abdominal wall and ten patients underwent resection for other secondary malignancies affecting the abdominal wall; 4 patients had isolated metastatic carcinoma lesions after a prolonged disease-free interval, 4 patients had symptomatic metastatic melanoma nodules involving the abdominal wall and 2 patients had implantation lesions involving the abdominal wall after previous intra-abdominal resections (gallbladder carcinoma – port site, colon carcinoma – drain site.) All 11 patients required mesh reconstruction and no immediate postoperative complications occurred in this group.

Local recurrence and long-term outcome

For the 38 patients with abdominal wall sarcomas, in order to define a more biological homogenous group, analysis has been focused on patients with a primary abdominal wall sarcoma, whose median follow-up was 21 months, ranging from 1.4 months to 89.0 months. The median overall survival for this group was 29 months. The median size of primary abdominal wall sarcoma was 15cm (range 3 - 27cm). Microscopic clear resections (R0) were accomplished in 14/25 patients, macroscopic clear resection but with involved microscopic margins (R1) in 9/25 patients and incomplete macroscopic resection in 1 patient. Microscopic margin involvement could not be assessed in 1 patient. The relatively high rate of involved margins is explained by the surgical boundaries of excision, with the deep margin defined by the peritoneum and contiguous organ resection only performed if direct invasion

was seen pre- or intra-operatively. Thus the most frequently involved margin was the deep margin, which was involved in 9 cases. Other margins were limited by bony structures. Local recurrences developed in 9/23 patients (39%) that had a macroscopic complete resection of the primary abdominal wall sarcoma group, after a median time of 4 months (range 1.3 – 22.3 months).

Analysis using Kaplan-Meier survival plots for local recurrence indicated that recurrence was significantly associated with tumour size (higher recurrence rates for tumours >10cm, $P= 0.0024$), grade (higher recurrence rate in high grade tumours, $P = 0.0021$). Microscopically clear margins were associated with improved disease-free survival ($P=0.03$) and approached, but did not attain, significance for local recurrence ($P=0.08$). Seven patients (7/25) developed systemic metastasis, 5 of these 7 died of their disease and two underwent metastasectomies and is still alive. All patients who developed systemic metastases had tumours greater than 10cm. There was a worse disease-specific survival in higher grade ($p= 0.010$) and tumours > 10cm ($P= 0.042$). At the end of the study, 11 patients had died of sarcoma-related causes, 3 patients were alive with local or systemic recurrence and 11 patients were disease-free at last follow up.

For patients with abdominal wall desmoid tumours the median tumour size was 8 cm (range 3 - 20 cm). Microscopic clear margins (R0) were confirmed in 15/30 patients and 15 patients had microscopic involved margins (R1). No patient developed local recurrence during follow-up. Median follow-up was 39.2 months with a range from 7 – 107 months. Nine patients went on to have

further pregnancies after resection of abdominal wall desmoids, either by normal vaginal delivery or caesarean section and none developed mesh-related complications or recurrence of desmoid tumours.

For the 7 patients with primary or metastatic carcinoma involving the abdominal wall, all underwent an R0 resection. At the end of the study, 3 of these 7 patients had died from metastatic disease 17, 21 and 52 months after their surgery and 4 patients were alive 1 – 16 months after resection without evidence of local or systemic disease. However of the patients who underwent resection of symptomatic metastatic melanoma nodules involving the abdominal wall, three of the four patients died within 6 months after surgery.

Discussion

Tumours involving the abdominal wall include a heterogeneous group of pathologies with a wide array of biological behaviour. Abdominal wall tumours can be divided into primary and secondary lesions. Primary lesions include sarcomas, desmoid tumours and other benign entities such as schwannomas, intramuscular lipomas or haemangiomas. Secondary lesions can be local recurrence or metastatic lesion (sarcoma, carcinoma or melanoma) or an implantation phenomenon such as endometriosis or port site, drain site or wound site implantation after resection of an intra-abdominal malignancy. The possibility of a secondary lesion will often arise from the history and examination of the patient.

A preoperative histological diagnosis of the abdominal wall tumour is essential. Core-needle biopsy is safe and accurate to obtain a histological

diagnosis.¹³ Appropriate imaging is essential to define the anatomical position of a tumour and its relation to surrounding structures.

Surgical approach is governed by the preoperative histological diagnosis. A more conservative approach can be adopted for benign conditions and for local control in patients with metastatic disease, while a wide full-thickness abdominal wall resection taking an approximately 2cm margin of normal tissue, is the objective for sarcomas and desmoid tumours. After resection of the full-thickness abdominal wall including the peritoneum, the greater omentum is sutured to the margins of the defect to prevent contact of mesh with bowel that can become adhered to bowel or may erode into the bowel in the future. The abdominal wall defect is then reconstructed with double layers of polypropylene mesh sutured to the margin of the abdominal wall defect. The remaining skin is usually sufficient to close without tension.

The most common primary tumour found in the abdominal wall in this study was desmoid tumour. Histologically they are composed of spindle-shaped cells in a collagenous matrix, but lack the nuclear and cytoplasmic features of malignant tumours⁸. Molecular studies have confirmed that these lesions are monoclonal neoplasms and not the product of an intense inflammatory response¹⁴. Fibromatosis of the limbs and limb girdle exhibit locally aggressive behaviour, infiltrating surrounding structures and have a high local recurrence rate after complete surgical resection ranging from 24% to 77%¹⁵⁻¹⁹. Abdominal wall desmoid tumours differ markedly from limb fibromatosis and intra-abdominal desmoid tumours. They mostly occur in female patients and usually develop during or soon after pregnancy⁹. In marked contrast to

limb or limb girdle fibromatosis, desmoid tumours isolated to the abdominal wall very rarely recur after surgical excision^{8,15,16}. In this study, no patients recurred after surgical excision. The behaviour of desmoid tumours is enigmatic because their recurrence pattern is not related to resection margins¹⁵. Half of the patients in this study had microscopic positive margins, but at the median follow-up of 39.2 months in this group, no patient has locally recurred after resection of an abdominal wall desmoid tumour. Furthermore, according to size, symptoms and patient preference these tumours could be treated conservatively²⁰. The functional outcome in most patients was excellent with all patients returning to full physical activity. Only one patient developed an incisional hernia in this group of patients.

Twenty-five patients underwent resection of a primary abdominal wall sarcoma, the goal of surgery being wide excision to achieve negative margins. Most tumours resected reached the peritoneum and required full-thickness resection of the abdominal wall. Reconstruction of the abdominal wall can be accomplished with prosthetic mesh with normal functional outcome in most cases. Due to the tissue-expanding effect of the sarcoma, enough skin is usually available to close the skin primarily, even after an ellipse of skin has been resected with the tumour. Where the anticipated defect is large because of tumour infiltration of a significant skin area, closure of the defect with a pedicled or free myocutaneous flap may be necessary. In cases where the tumour is situated in close proximity to bony structures (ribs, pubis, iliac crest) or the inguinal ligament, these structures should be resected in continuity to ensure adequate tumour clearance. If the abdominal wall

sarcoma involves intra-abdominal viscera, they should be resected in continuity with utmost care to prevent contamination of the operative field. Resection of involved organs does put patients at a higher postoperative risk for septic complications as demonstrated in this study.

The notorious biological behaviour of sarcomas is unfortunately their predisposition for local recurrence¹. Local recurrences developed after a median of 4 months (range 1.3 – 22.3 months) in 9 of 23 (39%) patients who had a macroscopic complete resection of the primary abdominal wall sarcoma group. Stojadinovic et al⁽⁷⁾ reported local recurrence rate of 31% in their series of primary abdominal wall sarcomas, when local and intra-abdominal recurrences are combined. Local recurrence was significantly associated with tumour size (> 10cm) and higher tumour grade. Only one patient received preoperative radiotherapy, and 3 patients received postoperative radiotherapy. Evidence from prospective randomised trials has demonstrated that radiotherapy improves local control in extremity sarcomas^{5,21,22}. Radiotherapy can be used in abdominal wall sarcomas but its use is limited by the radiosensitivity of surrounding structures especially small bowel, liver and kidneys. Further studies are necessary to examine treatment planning with conformal therapies such as intensity-modulated radiation therapy in an attempt to avoid toxicities and decrease the high incidence of local recurrence²³. No prospective randomised trials exist specifically looking at the advantage of radiotherapy in primary abdominal wall sarcomas. Taking into account the positive effect the use of radiotherapy in limb sarcomas has on

the incidence of local recurrence, the more liberal use of radiotherapy in abdominal wall sarcomas has to be considered.

Multiple studies found that tumour grade and size are important independent factors in prognosis^{4,6}. The median disease-specific survival for patients with primary abdominal wall sarcomas in this study was 29 months. There was a worse disease-specific survival in high-grade tumours and large tumours (> 10cm). Due to the inherent chemo-resistance of sarcomas, only one patient received chemotherapy in an adjuvant fashion.

Seven patients underwent resection of abdominal wall endometriosis, all in relation with previous caesarean section scars. Endometrial cells are spilled at time of caesarean section and implant within the abdominal wound.¹⁰ The reported pathognomonic symptom of pain associated with the mass during menstrual cycle is present in only approximately 57% of patients¹⁰ and in this study 3 of the 7 patients reported cyclic pain associated with the mass. The standard treatment is complete surgical excision with negative margins. In a large review of this condition¹⁰, a local recurrence rate after resection of 4.3% was noted. A rare but well-described complication of abdominal wall endometriosis is malignant transformation to clear cell carcinoma, carcinosarcoma or adenocarcinoma²⁴⁻²⁶.

Conclusion

Soft-tissue tumours of the abdominal wall exhibit a wide range of pathologies despite similar clinical presentation. Preoperative histological diagnosis is mandatory to plan appropriate surgical resection and to not compromise patient outcome. This can easily and accurately be accomplished by core-needle biopsy. Surgical resection should be planned according to preoperative histology and cross-section imaging. Abdominal wall sarcomas carry a significant risk of local recurrence especially for large, high grade tumours. Tumour size and grade also are independent factors related to disease-specific survival. Abdominal wall desmoid tumours carry a better prognosis than fibromatosis arising in the extremities. The biological behaviour of this disease is unpredictable and the relation between surgical margins and local recurrence remain undefined. Abdominal wall resection with prosthetic mesh can be performed with minimal morbidity and leads to satisfactory functional outcome in the majority of patients.

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Table 1

Pathology	Total cases	Male: Female	Median age (years)	Pain as presenting symptom
Desmoid tumour	30	2:28	35	2/30
Primary soft tissue sarcoma	25	15:10	55	6/25
Recurrent soft tissue sarcoma	10	6:4	58	0
Metastatic soft tissue sarcoma	3	0:3	47	0
Endometriosis	7	0:7	37	3/7
Carcinoma	7	2:5	60	0
Metastatic malignant melanoma	4	1:3	61	4/4
Other benign tumour	6	1:1	43	0
Total	92	27:65	43	15/92

Table 1. Patient demographics and pathological spectrum for the whole cohort of patients with abdominal wall tumours.

Table 2

Pathology for primary sarcomas of the abdominal wall	n = 25
Pleomorphic sarcoma	7
Spindle cell sarcoma	3
Sarcoma NOS	2
Synovial sarcoma	2
Epithelioid sarcoma	2
Malignant peripheral nerve sheath tumour	2
Fibrosarcoma	1
Chondrosarcoma	1
Leiomyosarcoma	1
Myxofibrosarcoma	1
Pleomorphic rhabdomyosarcoma	1
Soft tissue osteosarcoma	1
Solitary fibrous tumour	1
Tumour grade	
Grade 1	8
Grade 2	5
Grade 3	12

Table 2. Histopathological subtypes and tumour grade of the 25 primary abdominal wall sarcomas

Fig 1a. Local recurrence of primary abdominal wall sarcoma comparing tumours size < 10cm to tumours > 10cm ($p = 0.0024$).

Fig 1b. Local recurrence of primary abdominal wall sarcoma comparing tumour grade 1 to tumour grade 2/3 ($p = 0.0021$).

Fig 2a. Disease-specific survival in 25 patients with primary abdominal wall sarcomas comparing tumours < 10cm and tumours > 10cm in size ($p = 0.0042$).

Fig 2b. Disease-specific survival in 25 patients with primary abdominal wall sarcomas comparing tumour grade 1 and tumour grade 2/3 ($p = 0.0010$).

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Figure 3a

Figure 3b

Figure 3a,b. CT scans of a large abdominal wall desmoid tumour (Figure 3a) and a large abdominal wall sarcoma (Figure 3b). Both diagnoses were made preoperatively by clinically guided percutaneous core biopsy

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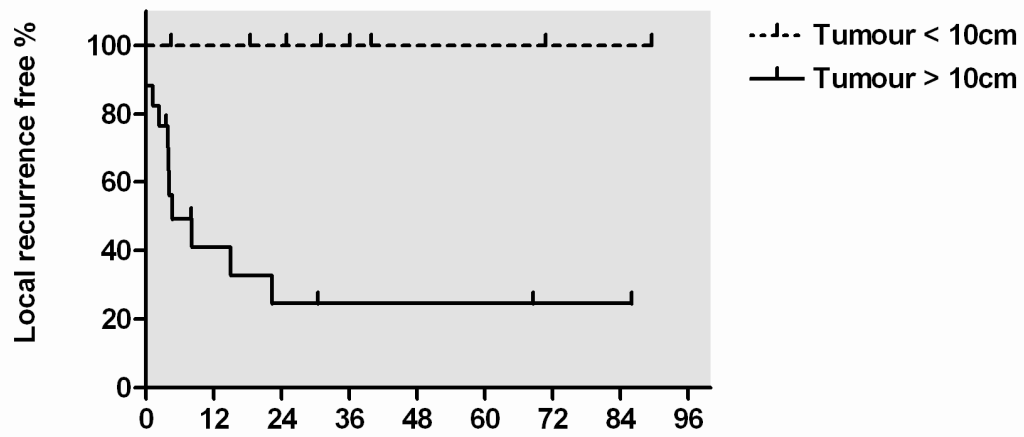
Conflict of Interest:

The authors are not aware of any conflict of interest in relation to this manuscript.

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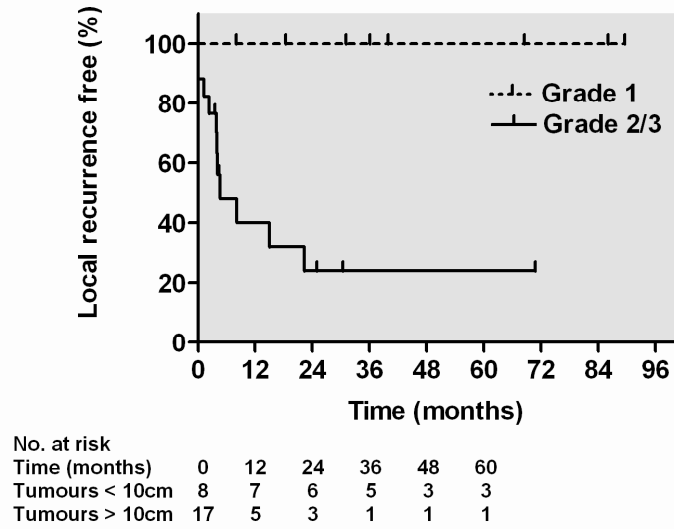
Local recurrence related to tumour size

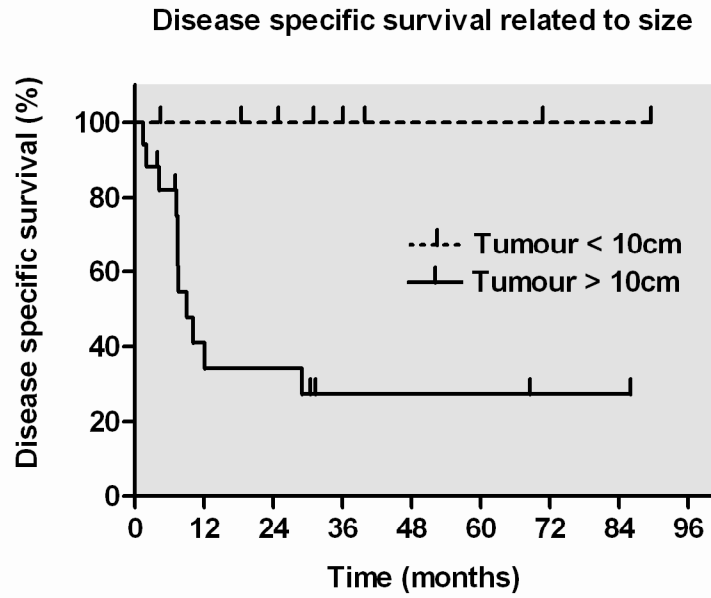


No. at risk		0	12	24	36	48	60
Time (months)		0	12	24	36	48	60
Tumours < 10cm		8	7	6	4	2	2
Tumours > 10cm		17	6	4	3	2	2

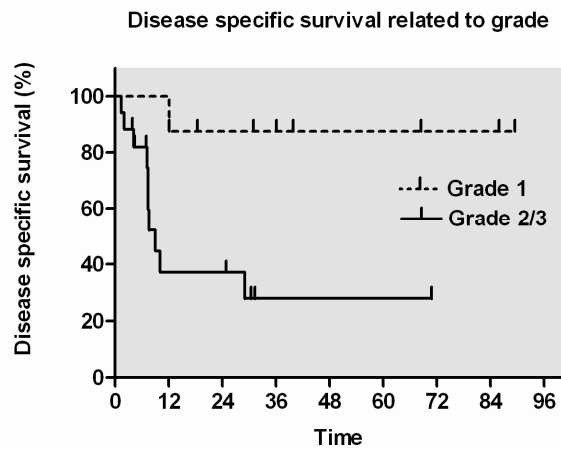
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Local recurrence related to grade

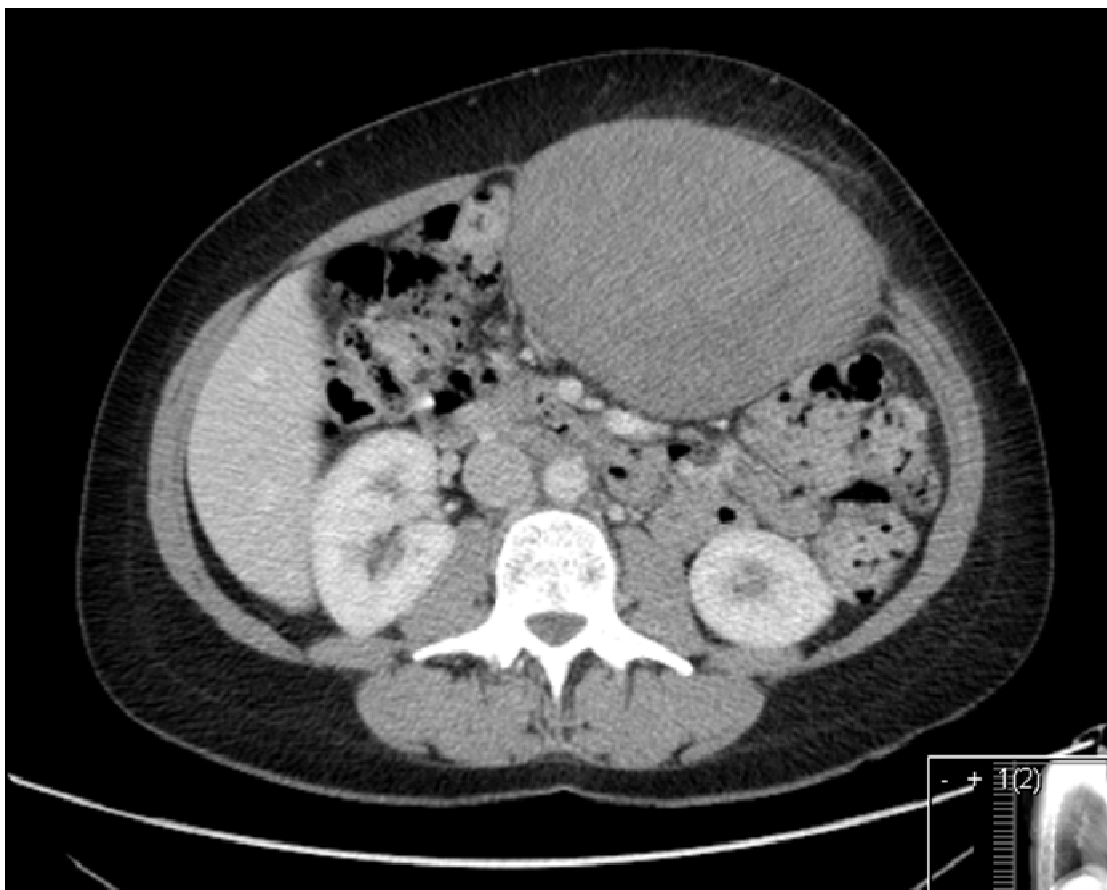




No. at risk						
Time (months)	0	12	24	36	48	60
Tumours < 10cm	8	7	6	4	3	2
Tumours > 10cm	17	6	5	2	2	2



No. at risk	Time					
Time (months)	0	12	24	36	48	60
Tumours < 10cm	8	7	6	5	3	3
Tumours > 10cm	17	5	5	1	1	1



ACCEPTED



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