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Case Study

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Sarcoma in pregnancy: radiation risks-dilemmas and choices: a case study

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Abstract

Introduction: Sarcomas occurring during pregnancy are rare and they present significant challenges in clinical management, to optimise, investigations and treatment choices to ensure both maternal and foetal well-being.

Case: A 32-year-old G1P0 female presented with a rapidly growing swelling in her right axilla. Ultrasound-guided core needle biopsy revealed a high-grade pleomorphic malignant tumour. The dilemmas and choices weighing the risks of staging studies, risks of contrast-enhanced scans, surgery during pregnancy and pre- and post-operative radiotherapy to both the mother and foetus are discussed in this case report

Discussion: Decision of unenhanced whole-body MRI was chosen for staging studies to mitigate radiation and contrast risks to the foetus and mother. Imaging studies revealed a 10 cm tumour in the right axilla, displacing the subclavian neurovascular structures but without evidence of metastatic disease. Concerns about pre-operative radiotherapy including proton beam radiotherapy, given risk of tumour progression and surgical challenges post-radiation therapy, a consensus decision was reached to proceed with surgical resection followed by delivery of the baby and post-operative radiotherapy. Successful limb-preserving sarcoma surgery was performed at 26 weeks of gestation. She gave birth to a healthy female child at 38 weeks of gestation, and she is receiving post-operative radiotherapy.

Recommendation: Sarcomas diagnosed during pregnancy are rare and delicate balance is required for optimising oncologic outcomes and minimising risks to the mother and the foetus. Decision-making involving multiple specialties and multidisciplinary teams, a treatment plan was formulated that prioritised the safety of the patient and her baby.

Introduction

Sarcomas are heterogeneous in nature and represent a group of malignant tumours. There are over 100 subtypes of soft-tissue sarcomas. Cancer occurs in about 1 in 1,000 pregnancies, and sarcomas constitute a rare subset of these malignancies.[1] Sarcomas are less than 1% of all cancers, hence extremely uncommon during pregnancy. Clinical management is complex because it involves tenuously balancing optimal oncologic treatment of the mother while minimising risks to the developing foetus.[2]

High-grade pleomorphic sarcomas represent an especially aggressive subtype of sarcomas, characterised by marked cellular atypia and high mitotic activity and often mandate prompt and decisive management strategies.[3] The diagnostic approach to sarcomas in pregnancy is limited because foetal exposure to ionising radiation and teratogenic drugs should be avoided as much as possible. MRI scan is preferred over CT scan due to the absence of ionising radiation and a better soft-tissue contrast, which is important for the detailed assessment of soft-tissue sarcomas.[4]

The general therapeutic strategy for managing sarcomas in pregnancy includes a multidisciplinary approach and treatment can be a combination of surgical resection, radiotherapy and sometimes addition of chemotherapy. Surgery forms the cornerstone of treatment. However, timing and extent have to be planned according to the stage of pregnancy and foetal viability.[5]

This case highlights the intricacies involved in the multidisciplinary management of a high-grade pleomorphic malignant tumour in a pregnant patient in optimising maternal and foetal outcomes.

Case presentation

This 31-year-old woman, G1P0, was seen at 20 weeks of gestation with a two-month history of swelling in the right axilla. Preliminary examination showed a 6 cm tumour of the right axilla and an imaging study with ultrasound showed that the tumour had internal vascularity, raising the possibility of a malignancy. Ultrasound-guided core needle biopsy revealed a high-grade pleomorphic malignant tumour. The differential diagnoses included heterologous malignant phyllodes tumour, metaplastic carcinoma and pleomorphic liposarcoma.

The patient was referred to the Regional Sarcoma Service for further assessment. A whole-body MRI scan for staging, including an axillary MRI, confirmed a large lobulated mass with areas of fat and haemorrhage in close proximity to brachial neurovascular structures (Figures 1 and 2). Contrast-enhanced scans for local imaging and staging studies were deferred due to unknown risks to the foetus.[7]

The case was discussed at two additional large cancer centre multidisciplinary teams (MDT) meetings, with oncology, obstetrics, orthopaedics and vascular surgery inputs. The option of medical termination of pregnancy to facilitate sarcoma treatment was considered but ultimately deferred on the patient's preference. Initially, the plan was to proceed with proton beam radiotherapy, delivery of the baby and subsequent surgical resection, but due to the rapid progression of the tumour and repeat MRI imaging, this decision was revised in favour of surgical resection first, followed by radiotherapy. The dilemmas and choices in relation to radiation dose, radiotherapy and planning of surgery are presented in Table 1. The timeline of key events in the management of this case is summarised in Table 2.

At 26 weeks of gestation, the patient underwent limb-preserving sarcoma resection through a transverse axillary incision, preserving the axillary neurovascular structures. This was a complex operation with dissection in close proximity to critical neurovascular structures, including the brachial plexus, and it was successfully carried out by a team of Orthopaedic, Vascular and Thoracic surgeons, with the obstetric team on standby, in case of pre-mature labour.

The patient recovered well postoperatively, without any complications. She was kept under close observation by both the surgical and obstetric teams, with plans to proceed to deliver the baby around 37–38 weeks of gestation, followed by adjuvant radiotherapy.

There was primary wound healing, with no neurological deficit or significant seroma formation. The tumour was completely excised and histopathological examination confirmed a high-grade epithelioid pleomorphic liposarcoma, with close resection margins as anticipated due to the proximity to the critical neurovascular structures. Further management included coordination with the obstetrics and clinical oncology teams with regard to planning for timely delivery and initiation of radiotherapy. A healthy female baby was delivered at 38 weeks. The patient is currently having a post-operative radiotherapy course of 60 Gray delivered in 30 fractions (in two Phases:50Gy in 25 fractions, followed by 10Gy in 5 fractions to the high-risk volume), to reduce the risk of local recurrence.[6] Radiotherapy planning images (Figures 3–6) show the planned dose, volume and the extent of radiotherapy field

Breastfeeding from either breast, while having radiotherapy to the axilla is considered to be safe.[10]

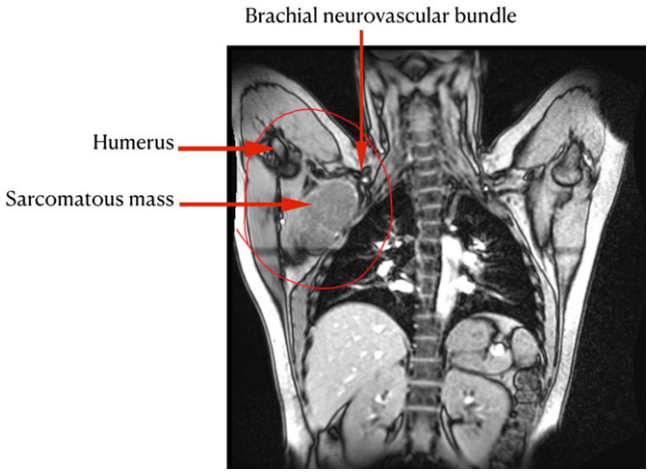

Figure 1. T1 weighted MRI image showing right axillary sarcoma, in close proximity to axillary neuromuscular structures and chest wall.

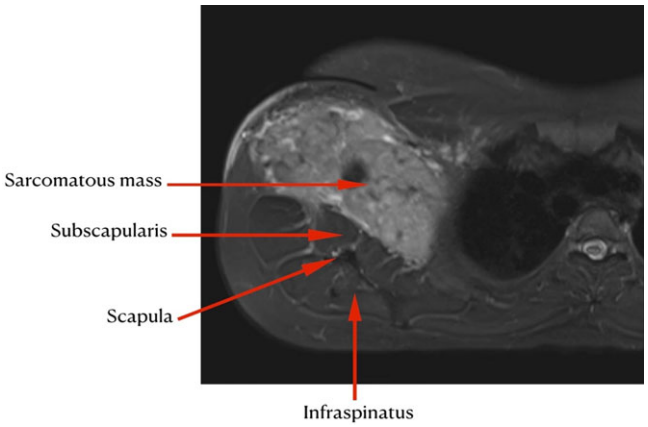

Figure 2. Axial MRI depicting the complexity and extent of the axillary sarcoma. Radiotherapy Planning Images.

Discussion

This case underscores the complexities of managing high-grade sarcomas during pregnancy, where the timing of interventions must balance oncologic control with foetal viability. Treatment may vary depending on the type of sarcoma, stage, gestation age and health status of the mother. The preference for a primary imaging modality using MRI is due to careful concern and diligence for foetal safety while attaining vitally important diagnostic information. Avoiding ionising radiation, contrast agents and minimising risks through ultrasound-guided biopsy are examples of the personalised approach necessary needed in managing such complex cases.[6] This is especially the case in the first trimester.[7]

The case was discussed in multiple MDT meetings, involving oncology, obstetrics, orthopaedics and vascular surgery teams. Initially, the plan was to proceed with pre-operative proton beam radiotherapy, followed by the delivery of the baby, and subsequent surgical resection. During pregnancy, conventional external beam radiotherapy should be avoided if there is incidental irradiation to the uterus with potential risks to the developing foetus, including growth restriction, malformations and even foetal death,

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Table 1. Dilemmas and choices in the management of high-grade soft tissue sarcoma during pregnancy

Dilemma	Choice
Use of contrast for imaging	Non-contrast imaging[4,7]
Staging-CT Chest Abdomen Pelvis	Whole-Body MRI without contrast[4,7]
Pre-operative radiotherapy for high-grade STS	Deferred (Role for proton beam RT) Postoperative RT chosen[6,9]
Medical Termination of pregnancy to facilitate sarcoma treatment	Avoided (patient choice)
Radical vs limb salvage surgery	Limb salvage surgery at 26 weeks of gestation (anytime during the second trimester) [5,6,8]
Timing of planned delivery	37 weeks of gestation (possible after 26 weeks); optimal delivery time to facilitate RT[6,8]
Risk of breastfeeding while having RT to breast area	Advice to use either breast for feeding[10]

Table 2. Timeline of key events in the management of soft tissue sarcoma during pregnancy

Timeline	Events
Early March 2024/ **20 Weeks Gestation**	Presentation and Investigations started
Late April 2024/ **26 Weeks Gestation**	Limb preserving sarcoma surgery
Early July 2024/ **38 Weeks Gestation**	Delivery

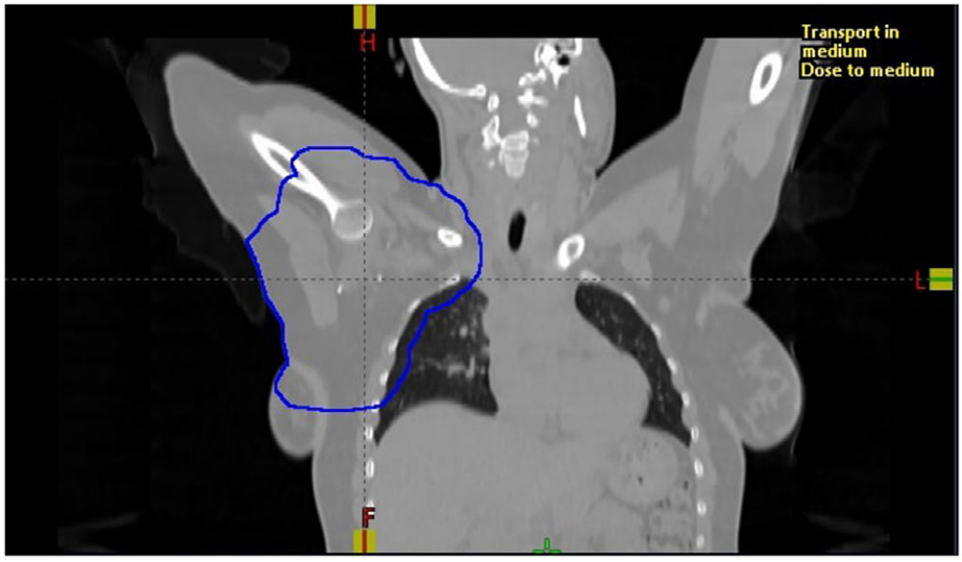

Figure 3. Phase 1 PTV (Planned Treatment Volume)=2300cm3; will receive 50Gy in 25 fraction.

depending on the dose and timing of exposure.[6] National Institute for Health and Care Excellence (NICE) guidelines do not provide a specific maximum radiation dose for pregnant patients. However, they stress the importance of minimising foetal exposure. If radiotherapy is unavoidable, the dose to the foetus should ideally be kept below 0.1 Gy (10 mGy), as exposure beyond this level increases the risk of foetal harm, including growth retardation, malformations and neurodevelopmental issues.[6,7] High-grade pleomorphic liposarcoma radiotherapy requires high doses of radiation, usually in the range of 50–70 Gy, depending on size, location and margins of the tumour. This dose is given in fractions of 1.8–2 Gy over several weeks. Such doses to the uterus, during pregnancy, entail a great hazard to the foetus, mainly during the second trimester when there is neurodevelopment. Distance from the radiotherapy treatment volume determines the foetal dose. Therefore guidelines generally recommend deferring radiotherapy postpartum when feasible to avoid these risks.[6,7] The benefits of deferring treatment allowed the pregnancy to progress without the added risks of radiation, while surgery provided a primary means of tumour control.

In this case, proton beam radiotherapy was initially planned but was reconsidered when the tumour's rapid progression indicated the need for more immediate surgical intervention. Adjuvant radiotherapy was planned post-delivery to address any residual

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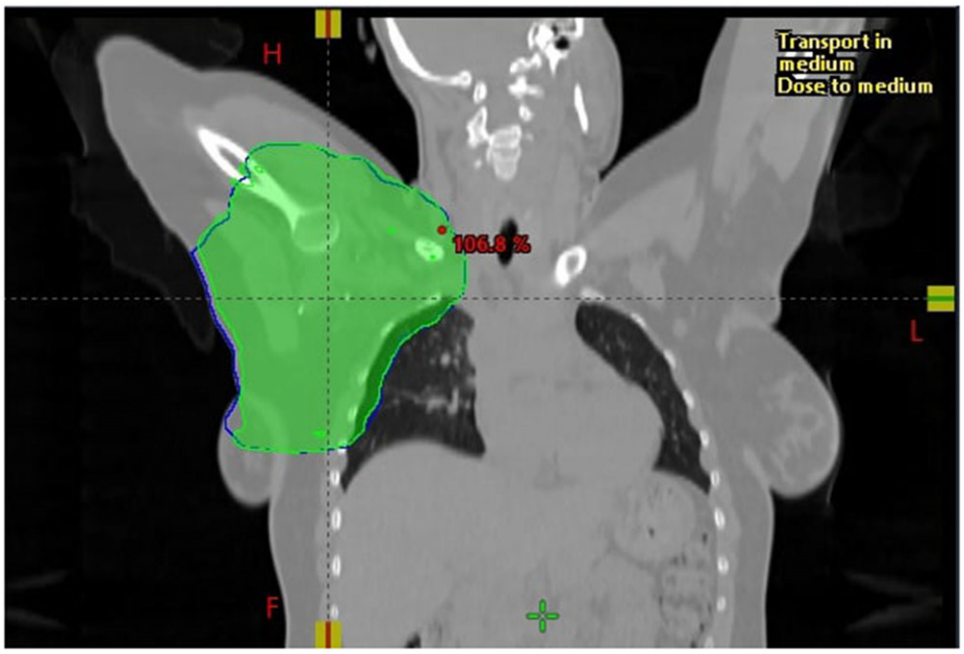

Figure 4. Phase 1 Planned Treatment Volume with 95% Dose (green); 50 Gy in 25 fractions.

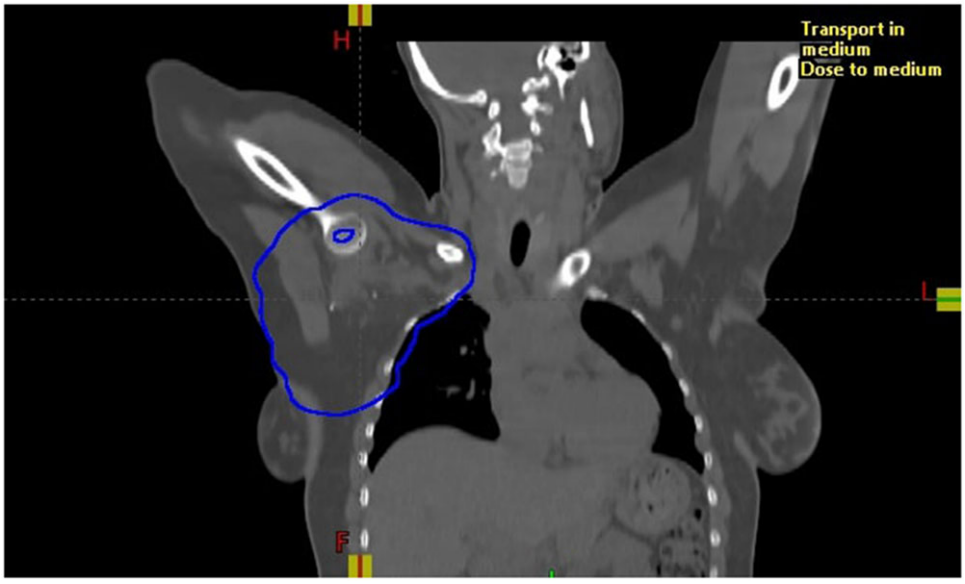

Figure 5. Phase 2 Planned Treatment Volume: 1300cm3 and is a smaller volume than Phase 1. This treatment volume will receive a boost of 10Gy in 10 fractions on top of the 50Gy in 25 fractions; and will therefore in total receive 60Gy in 30 fractions.

microscopic disease. Radiotherapy after surgery is typically utilised to reduce the risk of local recurrence. The timing post-delivery allows for safe administration of radiotherapy, without the risk to the developing foetus.

Surgery is often the treatment of choice for localised sarcomas and can be performed during pregnancy, with the timing being critical. Surgery is generally planned for the second trimester when the risks of miscarriage and preterm labour are lower compared to the first and third trimesters.[6] In this case, at 26 weeks gestation, given the close resection margins, adjuvant radiotherapy was planned post-delivery to address any residual microscopic disease. Radiotherapy after surgery is typically utilised to reduce the risk of local recurrence, especially in cases where surgical margins are close or positive. The timing post-delivery allows for safe administration without the risk to the newborn.

Recommendation

Sarcoma diagnosis during pregnancy is very rare, and there are no standardised care pathways or guidelines to help with the management of pregnant patients with a soft-tissue sarcoma. Our case study highlights the challenges and choices in mitigating radiation risks and optimising management. Individualised treatment plans with the help of multidisciplinary teams' input are essential for the appropriate management.

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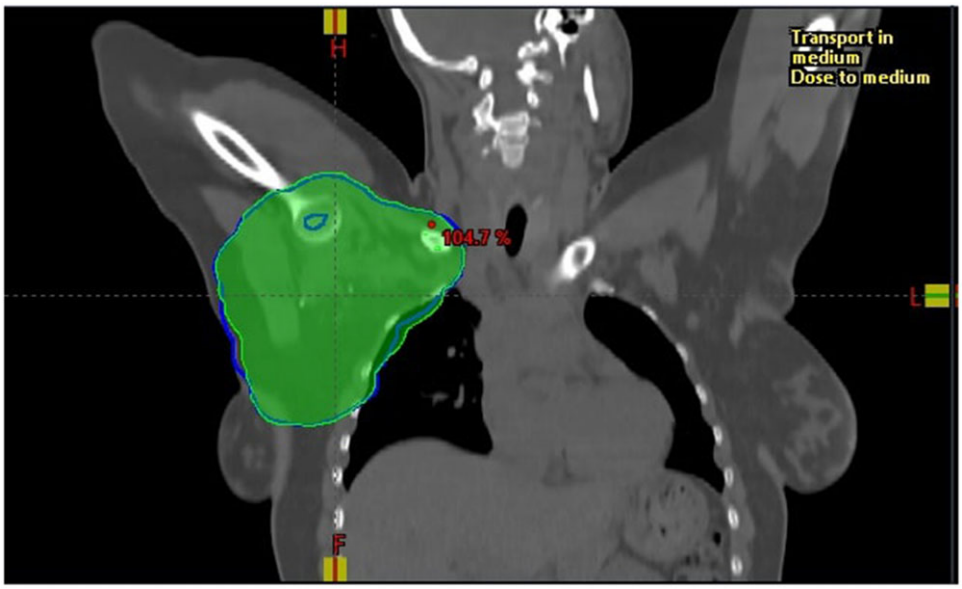

Figure 6. Phase 2 Planned Treatment Volume with 95% dose 10Gy in 5 fractions.

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