

**CASE REPORT**

# **Bleeding Battle In Soft Tissue Sarcoma Surgery: A Review Of Perioperative Considerations And Management**

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## **ABSTRACT**

Bleeding is a common expected complication during surgery, but more so in advanced sarcoma resection surgery owing to the tumour's angiogenesis. As surgery is potentially curative for primary nonmetastatic extremity soft tissue sarcoma – hence surgery is necessitated. In this case, we have a patient with significant bleeding intraoperatively requiring several methods and techniques to control the hemorrhage. The management of bleeding involves multiple assessment and strategies to ensure appropriate care for the patients. The management is perioperative involving all stages: preoperative risk identification and optimization to intraoperative surgical options and techniques to postoperative care. The objective of this review is to establish a guideline on factors and options that surgeons should be aware, going into surgery from preoperative to postoperative management when bleeding ensues. Latest updates and recent evidence help ensure improved clinical management for sarcoma patients undergoing surgery.

## **INTRODUCTION**

Bleeding in advanced sarcoma surgery is common, especially involving hematological malignancies (1). Hemorrhage is a major concern as it is a leading cause for intra-operative cardiac arrest (2). Pre-cardiac arrest signs ranging from hypotension, hypoxemia and tachycardia may present prior to progression to a full cardiac arrest. Early detection of these signs is crucial. A “state of emergency” should be immediately declared upon recognition of these signs and measures taken to avert further deterioration and possible mortality.

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Apart from hematological malignancy being a risk factor for bleeding, florid angiogenesis from the malignant process also substantiates the probability of hemorrhage (4). Studies focusing on anti-angiogenic therapies to shrink vascular supply or reduce bleeding have surfaced to address this morbid condition (3). In addition to these novel methods to manage hemorrhage, the importance of proper risk-stratification and peri-operative planning is pertinent. In this article, we review various strategies that were employed to tackle hemorrhage in relation to a patient who had undergone soft tissue sarcoma surgery.

## CASE REPORT

A 35-year old gentleman presented complaining of a gradually increasing right thigh mass of one year duration with an absent history of infection, family history of malignancy or constitutional symptoms. Clinically, the right thigh mass measured 35cm x 45cm with surface telangiectasia, fixed within the adductor compartment on both planes with pinchable overlying skin. Neurovascular status of the right lower limb was normal. Systemically, the cardiorespiratory and abdominal examination was unremarkable.



Figure 1: Clinical image showing a right thigh swelling over the medial compartment with surface telangiectasia. Markings seen illustrate the dimensions of the lesion

MRI images of the right lower limb revealed a tumour encapsulating the profunda vessels and abutting the superficial femoral vasculature. The tru-cut biopsy was suggestive of a malignant soft-tissue tumour (Epitheloid Hemangioendothelioma).

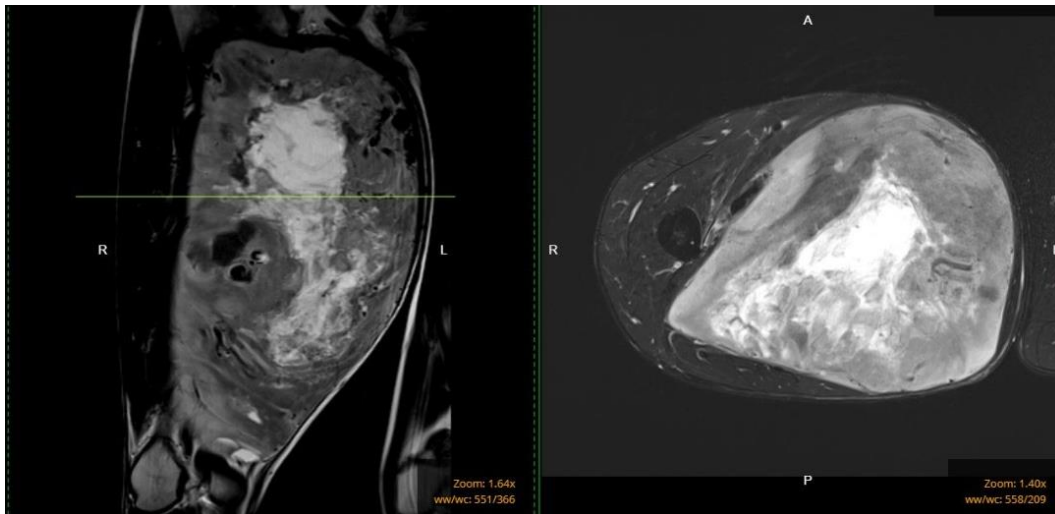


Figure 2: T2 weighted MRI images of the right thigh in axial and sagittal view (tumour cut: around the widest circumference) Sagittal (a) and Axial (b) images depict a hyperintense lesion within the adductor compartment with ill defined margins encapsulating the profunda vessels and abutting the superficial femoral vasculature

Preoperative strategies and planning were discussed prior and subsequently a wide resection of the tumour was done. Intra-operatively, the distal portion of the tumour mass was well encapsulated within the pseudotumour, however the proximal portion had adhesions and was found to encroach beyond the tumour capsule with close proximity to the common femoral and obturator vessels. The nature of surgery was rather vascular due to the friable nature of the engorged veins surrounding the lesion. Unfortunately, due to its proximity to the lesion, the common femoral vein was nicked during dissection and required ligation to obviate hemorrhage. Venous grafting was initially considered but was aborted, as the patient was haemodynamically compromised. Anesthetist had employed hemodynamic resuscitation via blood product transfusion.

Post-operatively the patient was observed within the intensive care unit. The patient progressed well in the ward and was found to have an intact neurovascular status of the limb on subsequent reassessment. The ensuing intra-operative histo-pathological report revealed that the lesion resected was a malignant peripheral nerve sheath tumour.

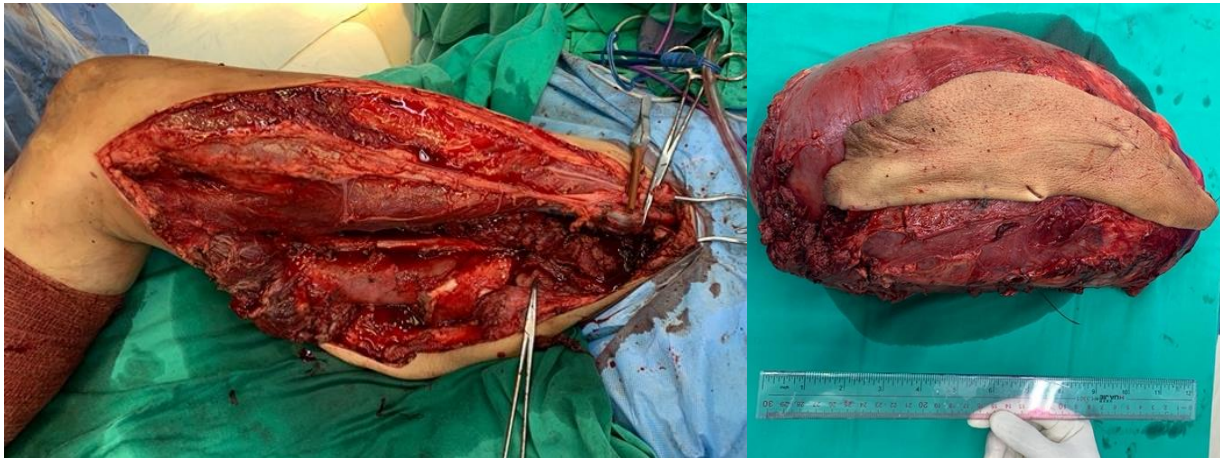


Figure 3: a) Floor of the medial right thigh after resection of the tumour. b) Resected tumour en-mass with residual elliptical skin, measuring about 30cm x 20cm.

## Discussion

This case classically illustrates the challenges faced during a battle to achieve hemostasis during a soft-tissue sarcoma surgery. Without adequate and meticulous planning, it would be catastrophic to say the least and may result in mortality. We review the strategies that were employed in each aspect of this case to ensure a victorious outcome in the battle against hemorrhage in this case.

### a) Pre-operative assessment and preparation

At presentation, a thorough history was obtained and complete physical examination performed. History with emphasis on underlying blood dyscrasias, vessel pathologies, use of anti-coagulants or traditional preparations must be taken (7). History of prior surgeries should be assessed to elicit if there were any bleeding complications and steps taken to manage it.

With regards to pre-operative investigations, standard pre-operative laboratory investigations including platelet counts should be taken. A routine coagulation profile is not recommended as it is a poor predictive value for bleeding (8). A referral to a hematologist would be advised if indicated. Should the patient be on anti-coagulants, an assessment should be conducted to evaluate the risk of thrombosis should the anti-coagulants need to be withheld before surgery.

Examples of these bleeding assessment tools include:

- International Society on Thrombosis and Haemostasis bleeding assessment tools (9).
- Vicenza bleeding score (10).
- Pediatrics bleeding questionnaire (11).
- Or any customized hospital assessing tool by individual institutions

**b) Neo-adjuvant Radiotherapy**

Studies had shown based on retrospective data that RT is highly effective in haemorrhagic control for bleeding skin carcinoma and intrabdominal carcinomas in palliation, long or short regimes demonstrating equal hemostatic effect (32). However, there was no clear literature on the effect of pre-op RT on intraoperative bleeding. Surgeries are planned 5-6 weeks post completion of the neo-adjuvant RT routinely (33). No pre-operative radiotherapy was ordered for this case.

**Intra-operative Surgical strategies****a) Positioning**

Positioning plays a role in reducing intraoperative blood loss. Particularly in prone positioning like in lumbar surgery – whereby the clearance of inferior vena cava obstructing venous clearance need to be made sure. Not applicable in this case, however for oncology patients in supine position, slight tilting of the operative table and elevation of the surgical site or extremities facilitate venous drainage and reduces venous pressures (8).

**b) Tourniquet**

Tourniquets are widely used in orthopedic surgery as means to reduce intraoperative blood loss and clearer surgical field. However, usage of the tourniquet is however not applicable in this case too as the surgical site is the entirety of the right thigh. Therefore, the decision dictating the use of tourniquet are visibility of surgical field and surgical site (12). Contraindications of its application are in presence of wound at site and underlying peripheral vascular diseases. Disadvantages of its application are post-operative pain, impaired underlying muscle function and risk of thromboembolic events (13). However, it's a simple and effective means for reducing bleeding intraoperatively.

**c) Antifibrinolytics**

Fibrinolysis is a physiological process that takes place within the body that functions to limit clot formation following trauma or surgery (14). These antifibrinolytic agents are widely used to combat bleeding perioperatively. They regulate the extend of fibrin formation and vascular obstruction resulting in thrombin generation, platelets adhesion with cross linkage and fibrin formation (15). Two mainstay agents are the synthetic lysine analogs tranexamic acid and epsilon aminocaproic acid via displacement of the lysine binding site of plasminogen from fibrin inhibiting the activation (14). Tranexamic acid 500mg IV stat dose was given for this patient. Aprotinin is an alternative option, a broad-spectrum protease inhibitor that reversibly inhibits trypsin, kallikrein, elastase and being the most

potent antifibrinolytic agent (16). These agents can be administered intraoperatively when bleeding is noted to be heavy by attending anesthetist.

#### d) Diathermy

It's common practice in oncology surgery where dissections are done with either a bipolar or monopolar. These are key tools to reduce soft tissue bleeding during surgery as compared to sharp dissections (7). There are a number of new bipolar sealing system devices in the market and which report less damage to soft tissues and more efficient coagulations as compared to the classical ones. Examples of these electrosurgical devices used are Ligasure™ and Aquamantys™ (Medtronic, USA), and Harmonic™ shears (Johnson & Johnson, USA). All probes and devices come in various sizes.

##### Aquamantys™

The Aquamantys™ system a single use portable handheld device which is a radiofrequency generator system with an attached saline pump irrigation tip. Combination of the radiofrequency system with the saline provides a faster tissue hemostatic sealing (17). With the incorporation with saline, studies had shown that tissues sample via Aquamantys had shown coagulation with minimal charring as compared to the conventional diathermies (17).



Figure 4: a) Medtronic Aquamantys™ console controls with probe. b) Aquamantys™ dual tip end probe with irrigating system

##### Ligasure™

Ligasure is an electrothermal bipolar vessel sealer that's functions by denaturation of elastin and collagen of the tissue including the encapsulated vessels and creating a seal (18). The device comes in two sizes: the small or large jawed ones depending on the surgical needs. A study was conducted in the Ortho Oncology division of Albert Einstein College of Medicine from 2010 to 2016 comparing 142 patients who

underwent sarcoma surgeries with use of conventional diathermy alone (n=91) versus Ligasure (n=51) (19). Results had shown significant reduction in bleeding: (19)

- Reduction in intraoperative blood loss (p = 0.02)
- Reduced transfusion volume (p = 0.04)
- Reduced mean hemoglobin reduction (p = 0.03)

No significant complication had been reported that had been attributed from the usage of Ligasure™ in that study.



Figure 5: a) Ligasure™ console system controls b) Small and large jawed Ligasure™ handheld diathermy clippers.



Figure 6: Ligasure™ large jawed diathermy system on soft tissue dissection.

Both of these devices (Aquamantys and Ligasure) were used during surgery in this case.

**e) Topical or sclerosants**

These options include fibrin sealants [fibrinogen and thrombin], gelatin - thrombin matrices and oxidized cellulose that can be applied onto bleeding tissues during surgery for hemostatic control (8). They either mechanically (direct) or chemically augment (indirectly) the coagulation cascade. Fibrin sealants/glue promotes tissue approximation that tamponades the bleeder. The thrombin and gelatin matrix is granular in nature, that ease conformity to the puncture wound shape, as there will be about 10-20% swelling in contact with blood (20).

Polyethelene Glycol Hydrogels (PEG) or Poloxamer 407 co-polymer can also be administered via a syringe directly into the vasculature or into the bleeding orifices. It's a polyethelene glycol base substance that polymerizes at the application site and is auto degraded in a month after application (20). It causes minimal inflammation or allergic reactions but with superior hemostatic effect (20). In this case we encountered bleeding due to vessel friability. We managed to use some excess skin, sutured onto the bleeding area to provide a tamponade to stop the bleeding.

**f) Anesthetic strategies**

The attending anesthetist plays an equally important role co-managing bleeding complications. One method is by permissive hypotension, by reducing intraoperative mean arterial pressure between 50-65 mmHg with pharmacological agents (8). The anesthetist needs to balance the risk of bleeding over the risk of multiple organ insult secondary to hypoperfusion (21). A central neuroaxial anesthesia (epidural or combined spinal epidural anesthesia – as oncology surgery are long hours) is preferable over general anesthesia alone for this purpose. It can also be achieved with a combination of regional with general anesthesia (22). Regional blockade results in blockage of preganglionic sympathetic impulses, vasodilatation and hypotension resulting in decreasing intraoperative blood loss or transfusion required (23).

Patients core body temperature also plays a role in blood coagulability. Reversible complications from hypothermia are dysfunctioning platelet, coagulation cascade and temperature labile enzymes (24). Hypothermia is defined as core body temperature that is below 36°C caused by variety of factors from reduced metabolism, use of cold parental administrations and environmental factors. Hypothermia can also lead to increased rate of infections and cardiovascular events in patients (25). Hence the anesthetists are routinely vigilant, looking into avoiding hypothermia in patients during surgery.



Positive pressure ventilation with minimal usage of PEEP (Positive End Expiratory Pressure) and low tidal volumes had also been shown to reduce blood loss as it promotes venous return (26).

### **Post-operative care**

After the completion of the surgery with skin closure, the wound is dressed with antibiotic cream or gel and a sealed dressing is applied. Before sealed plaster is applied, wound should not be oozing blood. Compression bandage or garments are applied to compress the residual bleeding at the area and inspection of the wound done 2 days later. The degree of bleeding can't be assessed via hematocrit alone as there is a constant loss of both plasma and RBC (27).

Vitals signs should be monitored as it prognosticates the ongoing fluid resuscitation requirements. Many factors do make it hard to have a proper detection of fluid status, the concomitant anemia, tachycardia from pain or systemic response – hence a higher clinical intuition and suspicion of the condition is vital (27). With ongoing blood transfusion according to protocol algorithm, hematocrit levels, vital sign monitoring, ECG, urine output and clinical suspicion: patient should be on continuous meticulous observations – looking for signs of desaturation, aspiration, tachycardia and hypotension (27). Patients after a significantly vascular surgery who show a drop in hematocrit are routinely monitored in the ICU until hemodynamically stable before they are transferred to the general wards.

To prevent worsening of coagulopathy, hypothermia should be avoided even post operatively with strict monitoring of the coagulation profile, emergent administration of fresh frozen plasma, platelets or vitamin K as necessary (27). Anytime during the post operative period till the time of wound inspection – presence of dressing soaked with blood suggests an ongoing bleed. Firstly, one need to localize the bleeding source then control of hemorrhage with either additional tamponade or ligation of bleeders with or without local anesthesia depending on depth of the wound.

Once patient is hemodynamically stable, gradual mobilization in the sequence of sitting propped up, standing and then to ambulation with assistance can be done in stages. When there are no active bleeds and patient is hemodynamically stable, patient's own anticoagulants can be restarted according to their optimal timing protocols - e.g. - Dabigatran 4 hours postoperatively and Rivaroxaban 12 hours post op (28).

## CONCLUSION

Surgical excision is still the mainstay treatment for soft tissue sarcomas, along with adjuvant radiotherapy and to some extent chemotherapy for some. The role of surgery aims to cure a primary non metastatic extremity soft tissue sarcomas with or without adjuvant radiotherapy (29). Prognosis is relatively worse when metastasis had taken place, but still depends on the histopathology of the tumour. Time plays a role; hence it is beneficial for early resection of tumour – earlier reduction of tumour load and reduced chance for metastasis. Hence going into surgery resembles a battlefield scenario, a clear strategy and exit plan must be in place prior.

Complications in surgery are unpredictable and should be swiftly handled and managed. Bleeding is a commonly expected complication for most surgeries, but in oncology surgery the handling of pathological tissue can have an unexpected bloodier outcome – tumours generates angiogenic-neovascularization. Some patients require pre-operative RT prior to surgery resulting in endothelial damage over the vasculature, triggering easy friability leading to a more challenging hemostatic control. Therefore, a thorough pre-operative assessment is important.

Hemostasis complications does not seize after tumour resection alone. In the post-operative period, patient's immobility, early physiotherapy and rehabilitation should be initiated at an optimal timing to weigh out surgical site bleeding versus stiffness and morbidity. With proper planning and meticulous surgical techniques, intraoperative bleeding risk can be reduced significantly.

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