Original Article

A retrospective analysis of massive blood transfusion and post-operative complications in patients undergoing supra-major orthopaedic oncosurgeries

Address for correspondence:
Dr. Atul Kulkarni, Department of Anaesthesiology, Critical Care and Pain, Tata Memorial Hospital, Dr E Borges Road, Parel (E), Mumbai - 400 012, Maharashtra, India.
E-mail: kaivalyaak@yahoo.co.in

Access this article online

Website: www.ijaweb.org

DOI: 10.4103/0019-5049.179465

Quick response code

Ankit Gupta, Atul Kulkarni

Department of Anaesthesiology, Critical Care and Pain, Tata Memorial Hospital, Mumbai, Maharashtra, India

ABSTRACT

Background and Aims: Anaesthetic management of patients undergoing supra-major orthopaedic oncosurgeries is challenging. We wanted to evaluate the effects of pre-operative co-morbid conditions, intraoperative blood loss and transfusion, haemodynamic instability on post-operative complications and hospital outcomes in patients after such surgeries. **Methods:** We collected data from the patient files, anaesthesia records and the electronic medical records about pre-operative morbidities, intraoperative management, complications, blood loss, fluid therapy and blood products transfused. We also collected data on post-operative complications, intensive care unit (ICU) and hospital length of stay (LOS) and status at discharge. Data were summarised using percentages for categorical data and mean and median for continuous data. **Results:** The mean blood loss was 4567.44 ml (range 1200–16,000 ml); 95% of all patients received blood transfusion. Twenty patients needed massive blood transfusion. Fresh frozen plasma was needed in 17 patients while 1 patient needed single donor platelets. Haemodynamic instability was present in 38 patients, of which 8 needed continuous vasopressor infusion. Nineteen patients were ventilated post-operatively. Coagulopathy occurred in 22 patients while thrombocytopaenia was seen in 6 patients. The median ICU LOS was 3 (1–6) days, and median hospital stay was 17 (6–53) days. All patients were discharged alive. **Conclusion:** Supra-major orthopaedic oncosurgeries are associated with massive intraoperative blood loss and transfusion. Common complications include anaemia, coagulopathy and hyperbilirubinaemia and prolonged ICU stay. Meticulous care, anticipating the complications with timely treatment can lead to excellent outcomes.

Key words: Massive blood transfusion, orthopaedic surgery, post-operative complications

INTRODUCTION

Surgery remains mainstay for treatment of tumours of the pelvis and sacrum such as chondrosarcomas, osteogenic sarcomas, giant cell tumours and sacral chordomas. The surgeries include internal and external hemipelvectomies and sacral chordoma excision. These are supra-major oncosurgeries because they involve extensive radical resection over a prolonged period and pose a challenge to the anaesthesiologists due to many factors. The tumours being vascular cause massive blood loss and need massive transfusion which can cause complications. Prolonged surgery leads to hypothermia and fluid and electrolyte imbalance. Pre-operative adjuvant cancer therapy causes systemic comorbidities. Patients are operated in unusual positions with frequent position changes with the potential for injury to the patient. The tumours often involve adjacent structures such as bowel and bladder needing excision of multiple organs

How to cite this article: Gupta A, Kulkarni A. A retrospective analysis of massive blood transfusion and post-operative complications in patients undergoing supra-major orthopaedic oncosurgeries. Indian J Anaesth 2016;60:270-5.

and multi-disciplinary co-ordination. Involvement and handling of nerves can potentially lead to post-operative neuropathic pain.

Blood loss during pelvic surgery can be rapid and sometimes uncontrollable and needs careful replacement with crystalloids, colloids and blood and blood products. Complications of rapid blood transfusion include hypothermia, dilutional coagulopathy, dilutional thrombocytopaenia, metabolic acidosis, electrolyte abnormalities, citrate toxicity, transfusion-related acute lung injury (TRALI), transfusion associated circulatory overload and allergic reactions.[1,2] In cancer patients, the use of allogenic blood itself poses several hazards to the patients making them vulnerable to post-operative infections, graft-versus-host disease, post-transfusion purpura through mechanisms such as transfusion-mediated immune modulation and microchimerism.[2]

We conducted this retrospective review of patients who had undergone surgery for resection of tumours of the pelvis and sacrum. Our aim was to document the post-operative complications caused by intraoperative massive blood loss and its replacement and to see if these complications affected intensive care unit (ICU) and hospital outcomes.

METHODS

This study was carried out as a retrospective audit of patients who underwent supra-major surgeries for resection of tumours of the pelvis and sacrum in our institution, a tertiary cancer referral centre, from January 2007 to December 2010. Since this was a retrospective study with no direct patient contact, waiver of consent was obtained from the Institutional Ethics Committee. A list of patients who had undergone surgeries for resection of tumours of the pelvis and sacrum from January 2007 to December 2010 (43 patients) was obtained from the database of the Department of Bone and Soft Tissue Surgery. This was cross-checked with the operating room register for that period. Data were collected by analysing the patient's case record files deposited in the medical record department. Data were also obtained from the electronic medical record system and the anaesthesia records.

We collected data on demographics, pre-operative co-morbid conditions, adjuvant therapy received for cancer and investigations. Intraoperative information was recorded about anaesthesia technique, patient position, invasive hemodynamic monitoring, total blood loss, fluids infused, blood products transfused, investigations sent. We also noted intraoperative complications such as haemodynamic instability (defined as fall in systolic blood pressure below 90 mm Hg or 30% from baseline for more than 10 min), need for vasopressor support to treat hypotension and need for post-operative mechanical ventilation.

Post-operative data were collected regarding need and duration of mechanical ventilation, investigations for the first 3 days. We also noted post-operative complications such as anaemia (haemoglobin <8 g/dl), thrombocytopaenia (platelet count below 75,000/dl), coagulopathy (international normalised ratio [INR] more than 1.5), liver dysfunction (bilirubin more than 2 mg/dl or liver enzymes more than twice baseline) and renal dysfunction (rise in creatinine to more than 50% of baseline) till the 3rd post-operative day (POD). Pulmonary complications (need for mechanical ventilation beyond 12 h after surgery) were also noted. Data about post-operative pain relief were also noted. We recorded total duration of recovery room and ICU stay and status at discharge.

Data were entered into and analysed using statistical software SPSS version 18.0 (IBM, USA). Data were summarised using percentages for categorical data and mean/median for continuous data.

RESULTS

During the study period, data from 43 patients were analysed. Their characteristics are shown in Table 1. The pre-operative investigations were normal. Of the 43 patients, the most common tumours were chondrosarcoma (16) followed by giant cell tumour (11), osteosarcoma (8), sacral tumour (5), primitive neuroectodermal tumour of pelvis (2) and pelvic enchondroma (1). Various types of resections were performed as required for these. Thirty-seven patients underwent specific hemipelvectomies while five had sacral tumour excision. In one patient, pubic rami curettage and excision were performed.

All patients received general anaesthesia with endotracheal intubation and controlled ventilation. Epidural analgesia was instituted in 34 out of 43 patients. It was placed, when the patient was awake, in the T11-12 or T12-L1 interspaces. A central

venous catheter was inserted in 16 out of 43 patients, all via the right internal jugular vein. Invasive blood pressure monitoring via a radial artery catheter was started in 29 out of 43 patients; hypotensive anaesthesia was not used in any of the patients. Thirty-five out of 43 patients were operated in floppy lateral position (patient is placed in lateral position, the upper arm is fixed, but the waist is not fixed so that the surgeon can tilt the pelvis in either direction); three patients needed position change during surgery. No anti-fibrinolytic was used in any of the patients.

Table 2 shows the blood loss and replacement fluids. Twenty (46.5%) patients required massive transfusion (replacement of one entire blood volume within 24 h, or >50% of blood volume in 4 h). Blood and blood products were transfused in 41 (95.3%) patients. Only 1 patient required single donor platelets. None of the patients required random donor platelets or cryoprecipitate. The median urine output at the end of the procedure was 973 ml (400–2200 ml). Twenty patients (46.5%) had complete blood count and coagulation profile done during the surgery. Thirty-eight patients (88.3%) had haemodynamic instability at some time intra-operatively. Eight patients were hypertensives who were stable before the blood loss started. Of the 38 patients with haemodynamic instability, 27 patients (62.8%) were managed with boluses of mephentermine while 8 patients (18.6%) needed continuous infusion of vasopressors (adrenaline [5], noradrenaline [3]) for a median period of 8 h (3–20 h). Nineteen patients (44.2%) were not reversed and shifted to ICU for elective ventilation. Median duration of post-operative ventilation was 1 day (2–48 h). None of the ventilated patients showed evidence of TRALI.

Table 1: Patient characteristics

Characteristics	*n*
Age in years (mean, range)	35.8 (10-68)
Weight (mean, range) kg	55 (32-90)
Male:female ratio	12:31
ASA physical status I/II	35/8
Pre-operative chemotherapy (yes:no)	12:31
Pre-operative radiotherapy (yes:no)	4:39
Both chemotherapy and radiotherapy	2
Hypertension (yes:no)	8:35

ASA – American Society of Anesthesiologists

Table 2: Intraoperative fluids infused and blood and blood products transfused

Blood loss, fluids and blood products transfused	Amount lost/amount infused
Blood loss (mean, range)	4567 ml/1200-16,000 ml
Crystalloids (mean, range)	4435 ml/2000-9000 ml
Colloids (mean, range)	1210 ml/250-3500 ml
Whole blood units (mean, range)	3.5/1-20 units
Packed cells units (mean, range)	4/2-12 units
Fresh frozen plasma units (mean, range)	4.1/2-12 units

The platelet count in the post-operative period showed a clinically significant fall till the 2nd POD, and then it started normalising from the 3rd POD although this was not statistically significant. The prothrombin time and INR showed a similar pattern of derangement, with both values significantly rising in the first 2 PODs and returning close to the baseline values by the 3rd POD [Table 3]. Bilirubin showed a pattern similar to that of the coagulation parameters. The total serum proteins however continued to remain low throughout the first 3 PODs.

Post-operative pain in 30 patients was managed with continuous epidural infusion of local anaesthetic with opioid. The infusion was commenced in the ICU or recovery room once the patient had become haemodynamically stable. The remaining nine patients who had general anaesthesia alone were given intravenous morphine via a patient-controlled analgesia pump which was supplemented by regular paracetamol. Four patients in the series were

Table 3: Trend of haematological and other investigations (mean, range)

Parameter	Pre-operative	Immediate post-operative	POD 1	POD 2	POD 3	*P*
Haemoglobin (g/dl)	11.7 (8-16)	9.2 (6.9-15)	9.9 (6.1-14.7)	10.4 (8-14.7)	10.5 (8.14.3)	0.6
Platelets (x10^3/mm^3)	288 (73-612)	141 (26-213)	154 (57-331)	186 (43-517)	200 (96-511)	0.68
INR	1.08 (0.88-1.29)	1.51 (1.04-2.62)	1.34 (0.88-2.24)	1.24 (0.8-1.7)	1.22 (0.8-1.6)	0.59
APTT (sec)	29.1 (23.4-35.4)	30.3 (19.6-47)	29.8 (19.6-48.3)	28.3 (18.5-48)	28.33 (18-39)	0.7
Albumin (g/dl)	4.09 (2-5)	3.23 (1.6-4.3)	3.2 (1.6-4.3)	Not done	Not done	0.72
Bilirubin (mg/dl)	0.61 (0.13-1.67)	1.7 (0.9-11.51)	0.86 (0.19-4.29)	Not done	Not done	0.56
SGOT (IU/lt)	32 (11-110)	48 (11-115)	42.1 (11-99)	Not done	Not done	0.54
SGPT (IU/lt)	28 (9-105)	33 (8-86)	33.4 (11-102)	Not done	Not done	0.7
Creatinine (mg/dl)	0.8 (0.5-1.4)	0.7 (0.4-1.4)	0.78 (0.4-1.4)	0.78 (0.4-1.3)	0.6 (0.5-1.2)	0.7

POD – Post-operative day; INR – International normalised ratio; APTT – Activated partial thromboplastin time; SGOT – Serum glutamic oxaloacetic transaminase; SGPT – Serum glutamic pyruvic transaminase

managed with epidural infusion initially but shifted to intravenous morphine via a patient-controlled analgesia pump in view of complaint of tingling, numbness of one lower limb (3 patients) or both lower limbs (1 patient). The post-operative pain relief was satisfactory in almost all the patients. The mean pain score on day 0 on rest was 3.72 out of 10 (3–5) and pain score on movement was 5.48 out of 10 (4–7). Pain scores decreased over the next 3 days with a mean post-operative pain score on day 3 on rest and movement were 1.13 (1–3) and 2.4 (2–3), respectively. Table 4 shows the overall post-operative complications.

With appropriate blood product replacement, epidural catheters of patients were removed in average of 4 days without any associated complications.

The median duration of ICU/recovery room stay was 3 (1–6) days. Most patients (38) were started on low molecular weight heparin on the 2nd POD as per institute's protocol. The median duration of post-operative hospital stay was 17 (6–53) days. All patients were alive at hospital discharge.

DISCUSSION

In this retrospective analysis of data of patients undergoing supra-major orthopaedic oncosurgeries, we found high morbidity but no mortality. Many of our patients had received pre-operative chemotherapy and radiotherapy. The effects of pre-operative treatments such as chemotherapy and radiation therapy affect the patient's physiological status and increase perioperative risk by affecting major organs. Radiotherapy causes local fibrosis which can increase perioperative blood loss. These surgeries are prolonged, involve extensive resection and often result in significant blood loss. Many patients may develop post-operative multi-organ dysfunction due to intraoperative massive transfusion, hypo-perfusion due to hypotension and need for vasopressors. This may lead to extended ICU and hospital stay and increased costs for the patients. Post-operative pain can be severe and adequate pain management is essential; however, the potential for coagulopathy, neurological complications (mainly medico-legal concerns) and chances of intraoperative hypotension can impact the decision to use epidural analgesia. Thirty-four of our patients (79.06%) received epidural analgesia. The decision to use epidural catheters in cases of sacral or pelvic tumour resections must carefully balance the risks and benefits. In our institute, all patients undergoing supra-major surgeries are given general anaesthesia and epidural anaesthesia. If massive blood loss is anticipated, then central venous and arterial catheters are also inserted. The blood loss is calculated by weighing the mops and drapes and by measuring the amount collected in the suction bottles. Epidural analgesia can provide hypotension leading to a better surgical field and decreased blood loss; it decreases systemic opioid requirements, prevents venous stasis and allows good pain relief in the post-operative period, thereby permitting early mobilisation. However, the risks include the following – the site of insertion of the catheter may encroach on the surgical field, the hypotension due to intraoperative blood loss may be exaggerated due to sympathetic blockade, the diagnosis of post-operative neurological complications may be difficult and if post-operative coagulopathy occurs, removal of the catheter may be delayed.

Table 4: Post-operative complications

Complications	Number of patients with complications
Haematological	
Anaemia	12
Coagulopathy	22
Thrombocytopaenia	06
Liver dysfunction	9
Renal dysfunction	0
Cardiac dysfunction	0
Haemodynamic instability requiring continuous vasopressor infusion	8
Respiratory dysfunction	
Mechanical ventilation >12 h	18
Pneumonia	0
Neurological complications	
Cerebrovascular accident	0
Peripheral nerve injury (transient)	4
In-hospital death	0
No complications	20

(43 patients had more than one complication)

Pre-operatively, seven patients (16.2%) had anaemia (haemoglobin <10 g/dl) and two patients (4.65%) had low white cell counts due to chemotherapy. None of the anaemic patients received pre-operative transfusion because they belonged to American Society of Anesthesiologists physical status I and were asymptomatic. There were no abnormalities in the pre-operative coagulation, liver function or renal function tests.

Arterial catheters for invasive arterial monitoring were inserted in 29 (67.4%) patients; central venous catheters were inserted in 16 (37.2%). The arterial lines were predominantly used because they provide

accurate, continuous arterial pressure measurement; particularly during periods of hypotension. Frequent blood sampling for blood gas measurements are possible along with other investigations. Central venous catheters are long which increase the resistance to the flow of fluid; therefore, they are not very useful for rapid fluid administration.

Thirty-five patients (81.3%) were operated in the floppy lateral position; 3 patients needed position changes during surgery. As a consequence of these positions and changes in position, the patient is potentially at the risk of nerve compression. Therefore, those areas which are compressed should be checked at each position change. In addition, position changes increase the risk of disconnection of the breathing circuit or invasive lines. None of the patients in this study had compression-related injuries or complications related to position change.

The mean blood loss in our study was 4567 (1200–16,000) ml and 20 patients needed massive blood transfusion. Transfusion was required in almost all (41) patients. These findings are similar to other studies reporting perioperative management of patients undergoing supra-major orthopaedic surgeries.[3-5] Thirty-eight patients (88%) had some form of haemodynamic instability. This was managed mainly using intravenous fluids while 27 patients (62.79%) required intermittent boluses of vasopressors (mephentermine) and 8 patients (18.6%) needing continuous vasopressor infusion. None of the previous studies reported need for vasopressor therapy.[3-5] Most of our patients had high intraoperative requirement of fluid and blood products. To manage the high flow rates of blood required, specialised rapid transfusion equipment (Level 1® Fast Flow Fluid Warmer Sims Portex, UK) was used.

Major blood loss in pelvic and sacral tumour resections is an anticipated complication. Mean blood loss during sacral resections is reported at 3495.22 ± 2814.78 (100–16300) ml.[3] As per the authors, blood loss during surgery for pelvic tumours was mainly influenced by the location of the tumour, the tumour volume and the operation time. Satcher *et al*. reported that in 15 patients with pelvic primary malignant tumour resections and autoclaved autografting reconstructions, the mean blood loss was 7061 (500–35,000) ml.[4] In another study of 24 malignant pelvic bone tumours treated by local excision and allograft reconstruction, the average blood loss during the hospital stay was 4359 ± 2800 (1000–11,300) ml.[5] A large amount of blood loss was also found in reconstruction with prostheses for pelvic tumours. The average blood loss of 4793 (1500–12,000) ml was reported by Guo *et al*.[6] In one study of nine patients undergoing total sacrectomies, the mean blood loss was 6.3 (4.5–17) L.[7] In another report, three sacral tumour resections were performed with blood loss of 9250, 7500 and 9600 ml.[8] In another study of 29 patients who underwent partial or total sacrectomies, the median blood loss was 3.9 L and the maximum blood loss was 37 L.[9] Nineteen patients (44.18%) in this series remained electively intubated following surgery. The reasons for this included massive blood transfusion, ongoing bleeding, coagulopathy and acid-base imbalance. The median duration of ventilation was 1 day with no patient needing ventilation for more than 2 days. In a similar study by Molnar *et al*., 31 out of 49 patients (63.26%) were ventilated post-operatively.[10] This means that anaesthesiologists involved in the management of such patients should anticipate and plan for the possibility of need for post-operative ventilation, and patients should be counselled regarding the same.

The most common post-operative complications were haematological such as coagulopathy (51.6%), anaemia (27.9%) and thrombocytopaenia (13.9%). These were managed by supportive treatment and the coagulation returned to normal within 48 h after surgery. Molnar *et al*. also found that post-operative coagulopathy was corrected by the 1st POD after appropriate transfusion of fresh frozen plasma, cryoprecipitate and platelets.[10] Nine (20.93%) of our patients had hyperbilirubinaemia which was probably related to the use of blood and blood products. This was managed conservatively. Eight patients (18.6%) needed vasopressor infusions for 1–2 PODs. In 43 patients, 54% developed a total of 79 complications, with some patients developing more than one complication. These complication rates were similar to those (43%) described by Molnar *et al*.[10]

Supplementary paracetamol was given to 9 patients on a regular basis, but non-steroidal anti-inflammatory agents were avoided due to the problems of coagulopathy. Four patients complained of tingling, numbness of one lower limb (3 patients) or both lower limbs (1 patient). These complications were transient and recovered after stopping the epidural local anaesthetic, confirming that they were not because of patient positioning, surgery or bony metastases. There were no other complications related to the use of neuraxial analgesia. All epidural catheters were removed

after the POD 3 when the platelets and coagulation had returned to normal. Molnar *et al*. reported peripheral nerve lesions in 6 of 49 patients (12.24%) all of which were related to the surgery.[10] In their series, 41 out of 49 patients had epidural catheters. They were all given continuous infusion of ropivacaine and fentanyl. None of the patients had any side effect related to the use of the epidural catheter.

We have a massive transfusion protocol for dealing with intraoperative massive blood loss in our hospital, and the patients were managed as per the protocol. The data from this study can be used to formulate maximum surgical blood ordering schedule (MSBOS) for patients undergoing supra-major surgeries in our hospital as this data tell us about the blood loss that is likely to occur in these types of surgeries. MSBOS decreases the cross-matching workload of the blood bank. It also will lead to better use of existing blood and prevent blood getting outdated and wasted.[11] This data can also be useful in future to anticipate post-operative morbidity and counselling patients and family.

The literature on perioperative management of supra-major orthopaedic surgeries with massive blood loss and their outcomes is scarce. There are no previous published Indian data of this type. The limitation of our study is that it is retrospective in nature and hence some of the important data such as arterial blood gases, serum electrolytes and arterial lactate values were not available to us.

The median duration of ICU and hospital length of stay (LOS) was longer than usual in our patients as compared to our other patients (ICU LOS 1.2 days [2 h–2.1 days]); however, all patients were discharged alive from hospital.

CONCLUSION

Supra-major orthopaedic surgeries are associated with massive intraoperative blood loss and transfusion. Complications such as anaemia, coagulopathy and hyperbilirubinaemia lead to prolonged ICU stay. Meticulous attention to all aspects of care, anticipating complications and their timely treatment can lead to excellent outcomes with minimal perioperative morbidity and mortality.

Acknowledgement

Dr. Ajay Puri, Professor and Head, Division of Surgical Oncology, Tata Memorial Hospital, Dr. E Borges Road, Parel (E), Mumbai - 400 012, Maharashtra, India.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Sihler KC, Napolitano LM. Complications of massive transfusion. Chest 2010;137:209-20.
2. Hendrickson JE, Hillyer CD. Noninfectious serious hazards of transfusion. Anesth Analg 2009;108:759-69.
3. Tang X, Guo W, Yang R, Tang S, Ji T. Evaluation of blood loss during limb salvage surgery for pelvic tumours. Int Orthop 2009;33:751-6.
4. Satcher RL Jr, O'Donnell RJ, Johnston JO. Reconstruction of the pelvis after resection of tumors about the acetabulum. Clin Orthop Relat Res 2003;409:209-17.
5. Delloye C, Banse X, Brichard B, Docquier PL, Cornu O. Pelvic reconstruction with a structural pelvic allograft after resection of a malignant bone tumor. J Bone Joint Surg Am 2007;89:579-87.
6. Guo W, Li D, Tang X, Yang Y, Ji T. Reconstruction with modular hemi pelvic prostheses for periacetabular tumor. Clin Orthop Relat Res 2007;461:180-8.
7. Wuisman P, Lieshout O, Sugihara S, van Dijk M. Total sacrectomy and reconstruction: Oncologic and functional outcome. Clin Orthop Relat Res 2000;381:192-203.
8. Doita M, Harada T, Iguchi T, Sumi M, Sha H, Yoshiya S, *et al.* Total sacrectomy and reconstruction for sacral tumors. Spine (Phila Pa 1976) 2003;28:E296-301.
9. Fourney DR, Rhines LD, Hentschel SJ, Skibber JM, Wolinsky JP, Weber KL, *et al.* En bloc resection of primary sacral tumors: Classification of surgical approaches and outcome. J Neurosurg Spine 2005;3:111-22.
10. Molnar R, Emery G, Choong PF. Anaesthesia for hemipelvectomy – A series of 49 cases. Anaesth Intensive Care 2007;35:536-43.
11. Iyer SS, Shah J. Red blood cell transfusion strategies and maximum surgical blood ordering schedule. Indian J Anaesth 2014;58:581-9.