Original Article | Journal of Bone and Soft Tissue Tumors | 2020 January-April; 6(1): 5-8

Factors Predicting Massive Blood Loss in Patients Undergoing Pelvic Resection: A Tertiary Referral Center Experience from North India

Devansh Goyal[1], Venkatesan Sampath Kumar[1], Roshan Banjara[1], Abdul Majeed[1], R Namith[1], Shah Alam Khan[1]

Abstract

Background: Pelvic resections are challenging procedures with significant risk of morbidity, especially massive blood loss. Risk factors for massive blood loss are understudied due to the rarity of such procedures.

Materials and Methods: A cross-sectional study was performed on pelvic resections performed between January 2018 and October 2019. Intraoperative and perioperative data were collected from prospectively collected database and hospital medical records. Patients were divided into two groups– Group 1 with intraoperative blood loss <2 L and Group 2 with blood loss 2 L or more. Demographic data, tumor characteristics, surgical procedure, and perioperative outcomes were studied between the two groups. Patients in whom only soft-tissue resections were performed and those who did not have complete data were excluded from the study.

Results: Of the 27 patients identified, 2 had soft-tissue recurrence resections only and 4 had incomplete data and were excluded from the study. Of the remaining 21 patients, 8 were classified into Group 1 and 13 into Group 2. On studying the various characteristics, tumor type, tumor volume, type of pelvic resection, and duration of procedure were significantly different between the two groups. Although wound complications, 30-day mortality, and read missions were higher in Group 2, this difference was not statistically significant.

Conclusion: Massive blood loss was more common in chondrosarcoma patients, with tumor volume more than 300 cc and the duration of procedure more than 4 h with resection involving the acetabulum and pubis (Type I/II/III and Type I/II/III/IV).

Keywords: Blood loss, Pelvic resections, Perioperative morbidity, Pelvic tumor surgery, Tumor volume.

Introduction

Neoplastic lesions of pelvis are rare and they can be either primary bone or soft-tissue tumors or secondary neoplastic lesions such as metastasis. The most frequently seen pelvic bone sarcoma is chondrosarcoma followed by osteosarcoma [1].

Primary pelvis bone sarcomas usually have a worse prognosis compared to their appendicular counterparts [2]. This is because a vast majority of these tumors present very late as the tumor continues to grow within the true pelvis before the patient notices the swelling. Hindquarter amputation used to be the choice of treatment till the early 1980s when there were no reliable adjuvant treatment options [3]. However, with the emergence of better pre-operative imaging, surgical techniques, and adjuvant and neoadjuvant therapies, limb salvage has become feasible today.

Internal hemipelvectomies are subdivided accordingly to modified Enneking and Dunham classification as Type I, iliac resection; Type II, acetabular resection; Type III, ischiopubic resection; and Type IV, resection of sacroiliac joint and H, if resection of femoral head occurs [4]. Internal hemipelvectomy is an appropriate surgical option when the oncological margins can be obtained, although long-term survival and functional outcomes are still not well established in the literature.

Pelvic resections are technically demanding in view of the precarious anatomy with close proximity to various neurovascular structures and intrapelvic organs. Hence, majority of the pelvic resections are performed in tertiary referral centers where the surgical team has sufficient experience, expertise, and multidisciplinary support to handle the perioperative challenges.

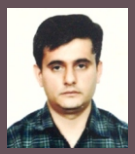
The high perioperative morbidity may be attributed to prolonged surgical times, high blood loss, large dissections compromising the viability of skin and muscle flaps, and formation of dead space that leads to collections, leading to surgical site infections. Anticipating complications are the key to prevent them from happening. Massive blood loss in pelvic tumors is a dreaded intraoperative complication which is potentially life threatening if not addressed in a timely and efficient manner. Kawai et al. [5] did a retrospective study, reviewing the records of 1047 consecutive cases to examine the extent of blood loss and the transfusion

[1]Department of Orthopaedics, All India Institute of Medical Sciences, New Delhi, India.

Address of Correspondence
Dr. Venkatesan Sampath Kumar,
Department of Orthopaedics, All India Institute of Medical Sciences, Ansari Nagar, New Delhi - 110 029, India.
E-mail: venkatortho4@gmail.com


Dr. Devansh Goyal


Dr. Venkatesan Sampath Kumar


Dr. Roshan Banjara


Dr. Abdul Majeed


Dr. R Namith


Dr. Shah Alam Khan

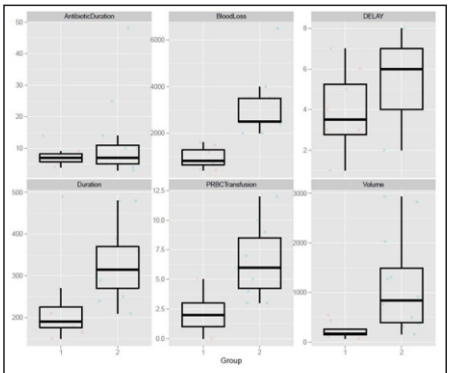


Figure 1: Box plot comparing various characteristics between Group 1 and Group 2.

Figure 2: Post-operative case of chondrosarcoma right hemipelvis following Type I/II/III pelvic resection (Group 2) with extensive wound dehiscence and infection.

Figure 3: Post-operative case of Ewing's sarcoma right hemipelvis following Type I/II pelvic resection (Group 1) showing healthy wound.

requirement associated with various kinds of musculoskeletal tumor surgeries and found that patients underwent wide resections for malignant bone tumors, particularly of the pelvis and sacrum, had the highest transfusion requirement. Satcher et al. [6] reported that in 15 patients with pelvic primary malignant tumor resections and autoclaved autografting reconstructions, the mean blood loss was 7061 cc (range: 500–35,000 cc).Most studies so far have concentrated on the complications such as wound infection and dehiscence, implant/reconstruction failure, or systemic complications while blood loss has been studied only as apart of results.

The aim of our study was to evaluate the factors that may predict the chances of excessive blood loss in patients undergoing pelvic resection for sarcomas and assess perioperative morbidity in such patients.

Materials and Methods

A cross-sectional study was performed on all pelvic tumor procedures undertaken between January 2018 and October 2019. We reviewed our prospectively collected database to identify 27 pelvic tumor cases, of which 2 were soft-tissue recurrence excisions and 4 did not have complete data and were excluded from the study. The patients who did not have complete data include three chondrosarcomas and one osteosarcoma. Finally, we had 21 patients for our analysis. There were 8 females and 13 males with a mean age of 26 ± 16.5 years and median age being 22 years (13–39 years).

We considered tumor type, American Society of Anesthesiologists (ASA) grade, tumor volume, type of pelvic resection, and duration of surgery as factors that may affect the intraoperative blood loss. Blood loss of 2000 ml or more was considered significant which is approximately 40% of estimated blood volume and is considered as Class IV hemorrhagic shock [7], thus classifying patients into Group 1 with blood loss <2000 ml (8 cases) and Group 2 with blood loss≥2000ml (13 cases). We also analyzed outcomes such as the need for intensive care unit (ICU) admissions, number of packed red blood cells transfusions given, wound complications, duration of intravenous antibiotics, 30-day readmission, need for the second surgery, and 30-day mortality between the two groups.

Diagnosis was based on clinical and imaging findings and was confirmed on histopathological analysis in all cases. Those who underwent biopsy elsewhere had their slides/block reviewed at our institute. All patients underwent thorough oncological assessment and staging by plain radiographs, magnetic resonance imaging (MRI), and whole-body scintigraphy by positron emission tomography-computed tomography scan as per the institute's protocol before surgery. Only one patient had metastatic disease at the time of surgery. None of the cases underwent pre-operative angioembolization. The treatment decisions were established by a multidisciplinary team involving surgeons, radiologists, medical oncologists, and pathologists. All the surgical procedures were performed following the principles of musculoskeletal oncology and margins were evaluated by Enneking's method [8].The type of resection was subdivided according to the modified Enneking and Dunham classification as Type I, iliac resection; Type II, acetabular resection; Type III, ischiopubic resection; and Type IV, resection of the sacroiliac joint and H, if resection of the femoral head occurs [4]. In view of small sample size, the procedures were categorized into three groups such that Group A included Type I, Type I/II,andType I/II/IV resections. Group B included Type II/III resections and Group C included Type I/II/III and Type

Table 1: Comparison between the groups on pre-operative characteristics

Characteristics	Group 1 (blood loss <2000ml),*n* =8	Group 2 (blood loss ≥2000ml),*n* =13	*P*-value
Age (median, IQR) (in years)	12 (7.7–13.3)	35 (24–40)	0.002
Received neoadjuvant chemotherapy (%)	8 (100)	3(23.1)	0.001
Metastasis (%)	0	1(7.7)	1
Tumor type (%)			0.001
Ewing's sarcoma	8(100)	3(23.1)	
Chondrosarcoma	0	8(61.5)	
Leiomyosarcoma	0	1(7.7)	
MPNST	0	1(7.7)	
Tumor volume(median, IQR) (in cc)	172.4(146.1–259.4)	841.6(387.1–1490.2)	0.005
ASA grade			0.505
Grade 1 (%)	8 (100)	11(84.2)	
Grade 2	0	2(15.4)	
Procedure (%)			0.035
Group A	6(75)	2(16.7)	
Group B	0	4(33.3)	
Group C	2(25)	6(50.0)	

IQR: Interquartile range, ASA: American Society of Anesthesiologists, MPNST: Malignant peripheral nerve sheath tumor

Table 2: Comparison between the groups on intra-and post-operative characteristics

Characteristics	Group 1 (blood loss <2000ml),*n* =8	Group 2 (blood loss ≥2000ml),*n* =13	*P*-value
Number of packed red blood cells transfused	2.0(1–3)	6.0(4.2–8.5)	0.002
Blood loss (median, IQR)(ml)	800.0(637.5–1275.0)	2500.0(2500.0–3500.0)	0.0001
Duration of surgery (median, IQR) (min)	190.0(176.2–225.0)	315.0(270.0–370.0)	0.01
ICU admission (%)	4 (50.0)	11 (91.7)	0.1
Duration of IV antibiotics (median, IQR) (in days)	7.0 (5.7–8.2)	7.0(5.0–11.0)	0.01
30-dayreadmission (%)	0 (0)	3 (25)	0.2
Wound complications (%)	1 (12.5)	4 (30.8)	0.6
Reoperation (%)	1 (12.5)	5 (38.5)	0.4
30-day mortality (%)	0 (0)	2 (15.4)	0.5

IQR: Interquartile range, ICU: Intensive care unit

I/II/III/IV resections.

The blood loss considered is the estimated intraoperative blood loss. The blood loss was estimated by anesthesiologists and surgeons intraoperatively. It comprised the volume of blood in suction after deducting the normal saline used for lavage and estimated volume of blood soaked by the surgical mops and gauze estimated by Gauze Visual Analog [9]. The tumor volume was calculated using the available MRI as described by Göbel et al. [10]. Using the formula: ([π/6] × length × width × depth).The duration of surgery was calculated in minutes, which was inclusive of the anesthesia time.

Statistical analysis was performed using R statistical software version 3.6.1. For continuous data, Student's t-test was used if data followed a normal distribution and Wilcoxon rank-sum test was used for non-parametric data. Where continuous data have followed a non-normal distribution, we have reported the median and inert quartile range instead of the mean and standard deviation. For ratios, we used the Chi-squared test while Fisher's exact test was used if expected frequency in any cell was <5.

Results

Of the 21 patients analyzed, 8 patients with blood loss <2 L were classified as Group 1 and rest 13 patients into Group 2. The median (range) blood loss in Group 1 was 800ml (400–1600ml) while that in Group 2 was 2500ml (2000–6500ml). The demographic and tumor characteristics of the two groups are compared in Table 1. Tumor type in Group 1 was Ewing's sarcoma in all patients (n=8), compared to Group 2, which had chondrosarcoma in 8 cases (61.5%), Ewing's sarcoma in 3 cases(23.1%), leiomyosarcoma in 1 case(7.7%),andmalignant peripheral nerve sheath tumor in 1 case(7.7%), making a significant difference(P = 0.001) in the composition of the two groups. All cases in Group 1 (n=8) had received neoadjuvant chemotherapy compared to 3 cases (23.1%) of Group 2 which was significant (P=0.001). The overall tumor volume ranged from 70.5cc to 2935cc, with a median volume of 415.5cc (175.7–1003.5cc). The median volume in Group 1 was 172.4cc (145.1–259.4cc) compared to 841.6cc (387.1–1490.2cc) in Group 2. Thus, a higher tumor volume was associated with higher blood loss (P=0.005). About 75% (n=6) of cases in Group 1 underwent Group A (Type I, Type I/II,andType I/II/IV resections) resections, while 50% (n=6) of cases in Group 2 underwent Group C (Type I/II/III and Type I/II/III/IV resections) resections, thereby concluding that Type I/II/III and Type I/II/III/IV resections were associated with a higher blood loss (P=0.035). Median duration of surgery in Group 1 was 190.0 min (176.2–225.0 min). Median duration of surgery in Group 2 was 315 min (270.0–370.0 min). Thus, longer surgical times were associated with higher blood loss (P=0.01).

The presence of metastatic disease at the time of surgery and ASA grade was not found to affect or predict blood loss. Patients with a higher blood loss were found to have higher transfusion requirements (P=0.002) and also required longer duration of IV antibiotics (P=0.01) (Table 2). No significant difference was found between the two groups in terms of need for ICU admission, wound complications, 30-day readmission, 30-day mortality, and need for the second surgery. However, these events were more common in Group 2 compared to Group 1.

Discussion

Massive blood loss is defined as a loss of >50% of blood volume in 3 hor the entire blood volume in 24 h[7]. Massive blood loss during surgery can lead to on table mortality which is considered as the most dreaded complication. In our study, we found that massive blood loss was significantly more common in chondrosarcomas in comparison to Ewing's sarcomas. This is probably because there are no adjuvant treatment options available for chondrosarcomas that may aid in reduction of the tumor volume before surgery [11].

Large tumor volume makes surgical resection difficult and potentially leads to increased bleeding. In a retrospective analysis of 137 pelvic resections, Tang et al. found that the mean duration of surgery was 233.72 ± 90.33 min[12]. In most reports of primary or metastatic pelvic tumors, the average operation time was 3–6 h and sometimes even more than 10 h [13, 14, 15]. As one would expect, the larger tumor volumes and longer surgery durations were found to be associated with higher blood loss.

The important finding in our study was that the median difference between the two groups was larger than what we expected, as depicted in (Fig.1). For the duration of surgery, when the cutoff limit is chosen at 4 h (240 min), we found that 87.5% (n=7) of the Group 1 cases were below the cutoff range in comparison to Group 2 where all cases (n=13) were above this cutoff. Similarly, for a cutoff limit of 300 cc, 75% of cases (n=6) of Group 1 were below the limit in comparison to Group 2 where 92% of cases (n=12) had tumor volumes exceeding the cutoff limit. Hence, we may say that in patients, when pre-operative tumor volume is more than 300 cc, pelvis resection planned involves Type I/II/III or Type I/II/III/IV and duration of surgery exceeds 4 h, high volume of blood loss is common. Our findings were similar to those reported by Tang et al. in their study, where they concluded that tumor volume >400cc and surgery duration >200 min were independent risk factors of significant blood loss intraoperatively [12].

Although ICU admissions, wound complications (Fig. 2), 30-day readmission, and 30-daymortality were lesser in Group 1 compared to Group 2, these differences did not achieve statistical significance in our study. This is probably due to the small sample size of our study. We would recommend larger studies, preferably multicentric studies to validate these further.

The limitation of our study was that we were able to look at the perioperative outcomes alone. It will be interesting to look at the long-term outcomes of these patients to understand if surgery had benefited them in improving their longevity. We would recommend long-term follow-up studies in pelvic tumor patients with large tumor volumes and massive intraoperative blood loss.

Conclusion

However, our study findings are relevant in perioperative management of these difficult conditions. Surgeons should anticipate massive blood loss in chondrosarcoma patients, with tumor volume >300cc, involving pubis and acetabulum where the long duration of surgery (>4 h) is expected.

References

1. AbuduA, GrimerRJ, CannonSR, CarterSR, SneathRS. Reconstruction of the hemipelvis after the excision of malignant tumours. Complications and functional outcome of prostheses.J Bone Joint Surg Br1997;79:773-9.

2. WurtzLD, PeabodyTD, SimonMA. Delay in the diagnosis and treatment of primary bone sarcoma of the pelvis.J Bone Joint Surg Am1999;81:317-25.

3. CarterSR, EastwoodDM, GrimerRJ, SneathRS. Hindquarter amputation for tumours of the musculoskeletal system.J Bone Joint Surg Br1990;72:490-3.

4. EnnekingWF, DunhamWK. Resection and reconstruction for primary neoplasms involving the innominate bone.J Bone Joint Surg Am1978;60:731-46.

5. KawaiA, KadotaH, YamaguchiU, MorimotoY, OzakiT, BeppuY. Blood loss and transfusion associated with musculoskeletal tumor surgery.J Surg Oncol2005;92:52-8.

6. SatcherRL Jr., O'DonnellRJ, JohnstonJO. Reconstruction of the pelvis after resection of tumors about the acetabulum.Clin OrthopRelat Res2003;409:209-17.

7. GutierrezG, ReinesHD, Wulf-GutierrezME. Clinical review: Hemorrhagic shock.Crit Care2004;8:373-81.

8. EnnekingWF, SpanierSS, GoodmanMA. A system for the surgical staging of musculoskeletal sarcoma.Clin OrthopRelat Res1980;153:106-20.

9. AliAlgadiem E, AleisaAA, AlsubaieHI, BuhlaiqahNR, AlgadeebJB, AlsneiniHA. Blood loss estimation using gauze visual analogue.Trauma Mon2016;21:e34131.

10. GöbelV, JürgensH, EtspülerG, KemperdickH, JungblutRM, StienenU, et al. Prognostic significance of tumor volume in localized Ewing's sarcoma of bone in children and adolescents.J Cancer Res Clin Oncol1987;113:187-91.

11. RiedelRF, LarrierN, DoddL, KirschD, MartinezS, BrigmanBE. The clinical management of chondrosarcoma.Curr Treat Options Oncol2009;10:94-106.

12. TangX, GuoW, YangR, TangS, JiT. Evaluation of blood loss during limb salvage surgery for pelvic tumours.Int Orthop2009;33:751-6.

13. AljassirF, BeadelGP, TurcotteRE, GriffinAM, BellRS, WunderJS, et al. Outcome after pelvic sarcoma resection reconstructed with saddle prosthesis.Clin OrthopRelat Res2005;438:36-41.

14. BeneveniaJ, CyranFP, BiermannJS, PattersonFR, LeesonMC. Treatment of advanced metastatic lesions of the acetabulum using the saddle prosthesis.Clin OrthopRelat Res2004;426:23-31.

15. VenaVE, HsuJ, RosierRN, O'KeefeRJ. Pelvic reconstruction for severe periacetabular metastatic disease.Clin OrthopRelat Res1999;362:171-80.

Conflict of Interest: NIL
Source of Support: NIL

How to Cite this Article

Goyal D, Kumar VS, Banjara R, Majeed A, Namith R, Khan SA | Factors Predicting Massive Blood Loss in Patients Undergoing Pelvic Resection: A Tertiary Referral Center Experience from North India | Journal of Bone and Soft Tissue Tumors | January-April 2020; 6(1): 5-8.