Modalities of Blood Sparing in Orthopedic and Trauma Surgery at the Centre Hospitalier Universitaire La Renaissance in Chad

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KEYWORDS
Blood-saving strategies; orthopedic and trauma surgery and CHU La renaissance.

ABSTRACT
Objective: To determine intraoperative blood-sparing strategies in major orthopedic and trauma surgery at CHU-R.
Patients and methods: This was a cross-sectional, descriptive study conducted over a thirteen (13)-month period from November 2022 to December 2023 in the operating theatre. All patients who had given their consent for major orthopaedic or traumatological surgery were included in the study. Variables were sociodemographic, clinical, paraclinical, therapeutic and evolutionary.
Results: A total of 105 patients were enrolled, 76.2% of them male, with a sex ratio of 3.1. The mean age was 55 years, with predominance in the [21-25] and [51-55] age groups, 11.40% (n=12) and 12.40% (n=13). Two-thirds (71.40%) of surgeries were trauma surgeries. PTH and Gamma nailing were respectively the most common types of major orthopedic (42%) and traumatological (41%) surgery. Haemostasis disorders were detected in 21.90% of cases (TP≤.70 and APTT<24) and 82% of patients had intraoperative blood loss ≥1000 including 28% between 1501 and 2000ml. Tranexamic acid was used in 57 patients (54.29%) and 15.24% of patients who did not receive tranexamic acid had blood loss ≥ 1000ml. The use of an electric scalpel and tourniquet helped reduce intraoperative blood loss (5.80% versus 63%). Other strategies such as anesthesia and surgical techniques did not show a significant difference in intraoperative blood loss. Clinical tolerance of anemia was 86.67%. Five patients were transfused intraoperatively.
Conclusion: this study is part of the evaluation of blood-sparing practices in orthopaedic and traumatological surgery. ATX had demonstrated significant efficacy in intraoperative blood conservation.

1. Introduction

The blood-sparing modality known as Patient Blood Management (PBM) was first used in 2005 by Professor James Isbister, an Australian haematologist, who realized that the focus of transfusion medicine needed to shift from blood products to patients[1]. It's a patient-centered, multi-modal, multi-disciplinary strategy to minimize the use of blood products and improve patient outcomes[2]. It is a proactive approach to improving the quality and safety of care, recommended by the Sociétés Savantes and the WHO. One of the aims of this approach is to reduce bleeding in surgical patients, in order to avoid as far as possible the need for homologous blood transfusion in the context of regulated surgery and qualified hemorrhagic or potentially hemorrhagic procedures[3]. These surgeries, involving arthroplasties of the spine and lower limbs, result in enormous blood loss. The vascular structure of the bone makes it more difficult to achieve surgical hemostasis. The clinical implementation of this strategy rests on 3 pillars: optimization of the patient's blood mass, minimization of blood loss and optimization of the patient's tolerance to anemia[4].

In countries with limited resources, the problems posed by blood transfusion in general are infrastructure, the different techniques used, donors and factors such as cultural obstacles, customs and even beliefs[5]. Indeed, a study carried out in Cameroon in 2015 confirmed that out of 73,000 units of blood available, over 90% came from family replacement donors and only 1% from voluntary and regular donors[6]. In Chad, as in other countries, the same problem arises in terms of voluntary blood donors, making it necessary to resort to family donors even in emergency situations. According to the 2017 World Health Organization report, the blood donation rate in Chad is 5.4 per 1,000 inhabitants including family blood donation or compensation donation[7]. At present, patient blood-sparing practices in our healthcare facilities remain marginal, linked to individual initiatives, and often very heterogeneous from one establishment to another. They also lack interdisciplinary and multi-professional coordination. In spite of all these difficulties of access to blood products, this study takes place in a context where the prevalence of ballistic trauma due to armed confrontations, brawls, public road and traffic accidents

and the prevalence of degenerative hip arthropathies are constantly increasing in our Chadian populations.

2. Patients and Methods

This was an observational, cross-sectional, descriptive epidemiological study that took place in the anesthesia-intensive care department of CHU la Renaissance for a 13-month period from November 2022 to December 2023.

The study included all patients who had given their consent for major orthopedic or traumatological surgery, such as: emergency or scheduled THP surgery, PTG surgery and centromedullary nailing surgery (Gamma, Targon and universal nails). Patients undergoing any major surgery other than traumatology or orthopedics (neurosurgery), orthopedic surgery or minor traumatology, and any patient who had not given consent to be included in our sample, were excluded.

Data were collected on observation charts from anesthesia records, both preoperatively and intraoperatively. Socio-demographic, clinical, therapeutic and evolutionary data were collected. The following variables were studied in particular:

- Bleeding risk management (PT/ aPTT, platelets and discontinuation of drugs inducing haemostasis disorders and maintenance of normothermia);
- Surgical technique (electric scalpel, pneumatic tourniquet, surgeon's dexterity),
- Medication technique to limit blood effusion (use of tranexamic acid). ATX is used perioperatively at a dose of 1g 15 minutes before the incision intraoperatively, and sometimes at 8 hours postoperatively on a prolonged basis;
- Anesthesia techniques (General anesthesia, spinal anesthesia, and controlled hypotension, normothermia);
- We chose to measure the amount of intraoperative blood loss by the sum of the amount of blood aspirated into the aspiration jar.
- Weighing compresses. Although inaccuracies may have occurred, we used this approach as it is a more practical tool. As an experiment, we weighed both dry and blood-soaked compresses, and dry and soaked abdominal drapes. A dry 10cm x 10cm woven compress blade weighs 3.7g, and a blood-soaked blade weighs 13.5g. A dry abdominal pad blade weighs 19.6g, and when soaked in blood, it weighs 69.1g.

The data were entered in Excel and analyzed using EPI-INFO software. Quantitative and qualitative variables were studied using the Chi2 or T-student test.

Photo 1: Weighing a dry compress and a blood-soaked compress

Photo 2: Weighing a dry abdominal compress and a blood-soaked abdominal compress on the balance.

3. Results

A total of 105 patients meeting the criteria were collected, 76.2% of them male with a sex ratio of 3.1. The mean age was 55 years with [standard deviation 3.227] and the [21-25] and [51-55] age groups accounted for 11.40% (n=12) and 12.40% (n=13) respectively. ASA1 represented 66.80% of patients with no particular history, and the most common comorbidity was arterial hypertension (14.30%) (figure1). The main indication for surgery was trauma (71.40%) (figure2). PTH insertion and centromedullary nailing with Gamma nails were the most common types of orthopaedic (42%) and major traumatological (41%) surgery respectively (figure 3). Hemorrhagic risk management: all patients underwent a hemostasis check-up. Hemostasis disorders (platelets, PT, APTT) and discontinuation of bleeding-risk drugs were performed by 21.90% and 18.10% respectively (table 3). Thrombocytopenia was present in 3.8% of cases (platelets <150,000). Preoperative anemia (hemoglobin level ≤12g/dl) was present in 43.81% of patients (figure 4).

Concerning intraoperative blood loss, 17.1% (n=18) of patients out of 60, anesthetized under GA, i.e. 17.1% had an intraoperative blood loss ≥ 1000ml, while only 4.8% (n=5) out of 45 operated under RA, (tables1). Of 105 operated patients, 02 cases (1.9%) had a temperature ≤ 36oc, 99 cases (39.04%) had temperatures between 36 and 37.5°C of which 68 (63.9%) presented blood loss was ≥ 500ml (table 2). The electric scalpel was used in 84.90% of cases, and combined with the pneumatic tourniquet in 15.50%. Blood loss was greater (≥1000ml) in the group of patients in whom only the electric scalpel was used (63% versus 5.80%) (table3).

It was noted that 57 patients (54.29%) had received tranexamic acid (ATX) medication, and 15.24% of the 48 patients who had not, had blood loss in excess of 1000 ml (table 4). Tranexamic acid significantly reduced intraoperative blood loss. Of 57 patients who received tranexamic acid, 28% had retained postoperative Hb levels ≥ 10 g/dl; whereas 42% of the 48 patients who did not receive it, had hemoglobin levels down to between 07 and 9g/dl (Figure 5). Recourse to blood transfusion was 13.33% of patients (n=14), including 3 preoperatively, 5 preoperatively, 6 patients intra- and postoperatively (Table 5).

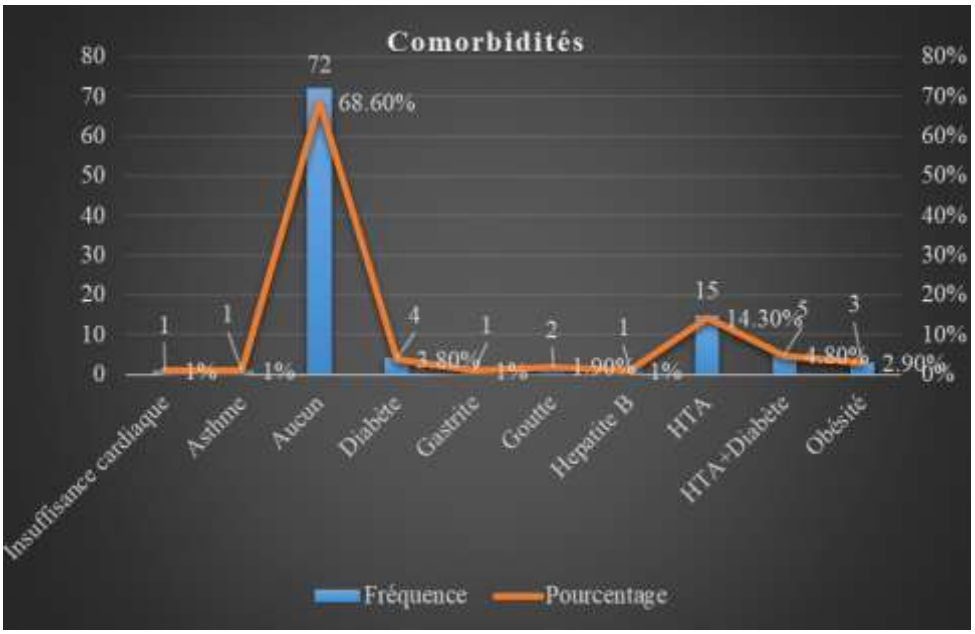

Figure 1. Distribution of patients according to medical history or comorbidities

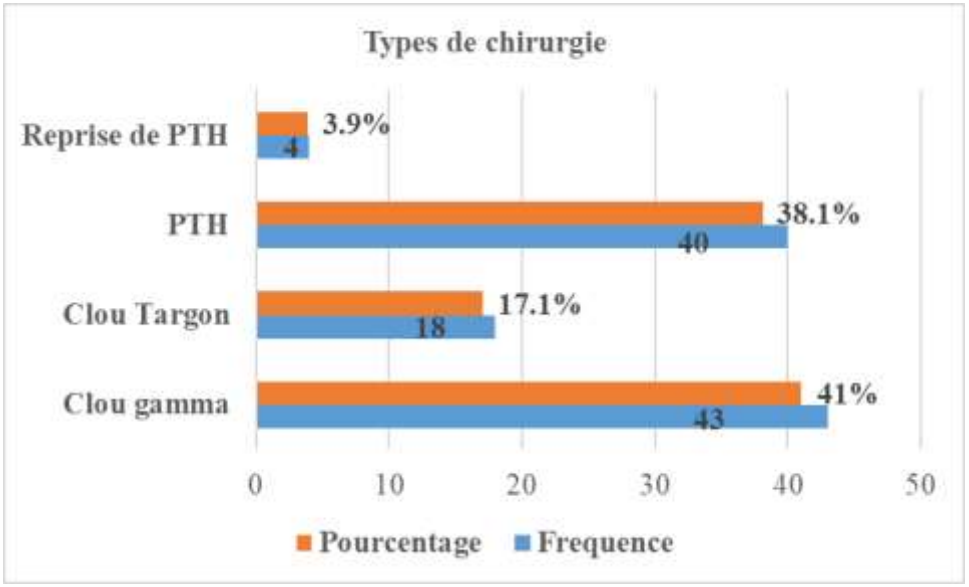

Figure 2. Patients by type of surgery

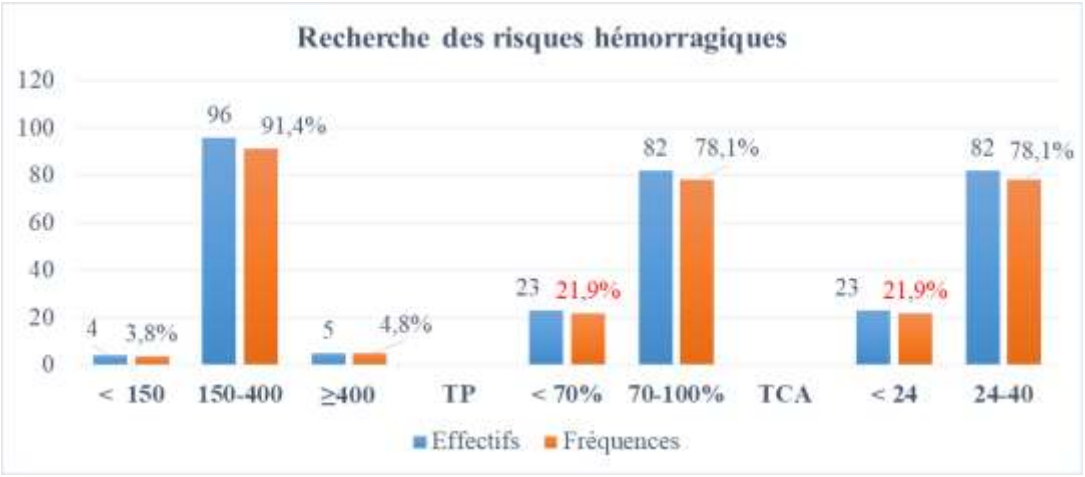

Figure 3. Recherche des risques hémorragiques

Table 1: Evaluation des pertes sanguines selon les types d'anesthésie

Techniques d'anesthésique		**Pertes sanguines peropératoires**						
		< 500 ml	**500 à 1000 ml**	**1001 à 1500 ml**	**1501 à 2000 ml**	**> 2000 ml**	**Total**	**P-value**
AG + hTA contrôlée	Effectif	18	24	14	2	2	60	0,617
	%	17,2%	22,9%	13,3%	1,9%	1,9%	57,1%	
RA	Effectif	15	25	4	1	0	45	
	%	14,3%	23,8%	3,8%	1,0%	0,0%	42,9%	
Total	Effectif	33	49	18	3	2	105	
	%	31,4%	46,7%	17,1%	2,9%	1,9%	100,0%	

hTA: hypotension artérielle

Table 2: Assessment of intraoperative blood loss based on patient temperatures

T peropératoire		**Pertes sanguines peropératoires**						
		< 500 ml	**500 à 1000 ml**	**1001 à 1500 ml**	**1501 à 2000 ml**	**>2000 ml**	**Total**	**P-value**
< 36°C	Effectif	0	0	0	0	0	2	
	% du total	0,0%	0,0%	1,9%	0,0%	0,0%	1,9%	
36 à 37,5°C	Effectif	33	46	17	3	2	99	
	% du total	31,4%	43,8%	15,3%	2,9%	1,9%	94,3%	0,138
> 37,5°C	Effectif	0	3	1	0	0	4	
	% du total	0,0%	2,9%	1,0%	0,0%	0,0%	3,8%	
Total	Effectif	33	49	18	3	2	105	
	% du total	31,4%	46,7%	17,1%	2,9%	1,9%	100,0%	

Table 3: Surgical technique strategies

Technique chirurgicale de prévention de saignement		**Pertes sanguines peropératoires**						**P-value**
		≤ 500 ml	**501 à 1000 ml**	**1001 à 1500 ml**	**1501 à 2000 ml**	**>2000 ml**	**Total**	
Bistouri électrique	Effectif	23	45	16	3	2	89	
	%	21,90%	42,80%	15,30%	2,90%	2,00 %	84,90%	
Bistouri électrique +garrot pneumatique	Effectif	10	4	2	0	0	16	
	%	9,70%	3,80%	2,00%	0,00%	0,00 %	15,50%	0,071
Total	Effectif	33	49	18	3	2	105	
	%	31,40%	46,70%	17,10%	2,90%	1,90 %	100,00 %	

Table 4: Effects of tranexamic acid on intraoperative blood loss

Médicament de prévention du saignement	**Pertes sanguine peropératoire**						**P-value**
	≤ 500 ml	**500 à 1000 ml**	**1001 à 1500 ml**	**1501 à 2000 ml**	**≥ 2000 ml**	**Total**	
ATX (-)	10	22	12	3	1	48	
ATX(+)	23	27	6	0	1	57	0,042
Total	33	49	18	3	2	105	

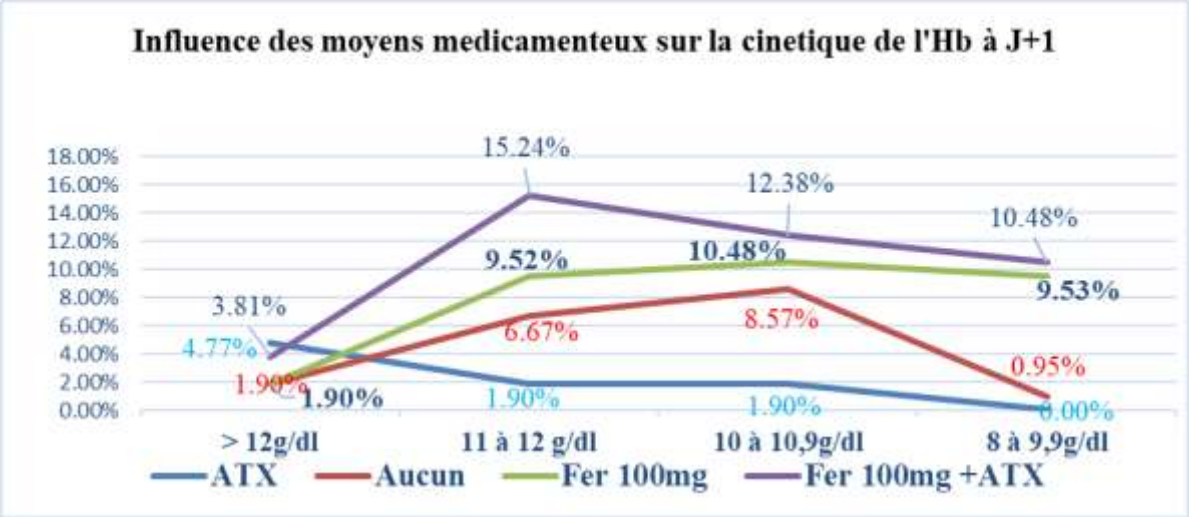

Figure 5. Hemoglobin levels at D+1

4. Discussion

In our study, the majority of our patients were male (76.2%), giving a sex ratio of 3.1. Our results corroborate those of the French study by Ghislain Edjo Nkilly, Arthur Matsanga et al in 2024 in Libreville, Gabon, which found 73.2% male patients versus 26.8% female, with a sex ratio of 2.73[8]. The mean age was 55 years, with a predominance of the [21-25] and [51-55] age groups, i.e. 11.40% (n=12) and 12.40% (n=13). Our result can be explained by the fact that very young subjects are exposed to traumas linked to public road accidents, and the elderly to degenerative joint diseases (coxarthrosis). These data are superposable with those of the study by RAKOTOTIANA Sitrakiniaina in Antananarivo, Madagascar, whose mean age was 33.33 years, with extremes ranging from 04 to 71 years[5].

ASA1 accounted for 66.80% of patients with no particular history, and the most common comorbidity was arterial hypertension (14.30%). According to the results of the study carried out in Madagascar in 2021, 96.28% of these patients had no particular history, and arterial hypertension was also the comorbidity encountered (2.38%)[5]. In the same vein, EL Houri in Morocco in 2017 found that 53% of patients had no particular history, and hypertension was the most common comorbidity at 18.6%[9]. Our data were in line with most regional studies, reflecting the youthfulness of the African population. These young people constitute the most active class, and are exposed to the risks of public road trauma, which is a major cause of death[10].

Our study reveals that almost two-thirds (71.40%) of surgeries were performed in the traumatological context, versus 28.60% of necrotic coxarthroses. All of these surgeries were either settled or scheduled. Our results are superior to those of Jean Baptiste Ramampisendrahova in 2020 in Antananarivo, Madagascar, who found 39.3% in traumatology and 10.7% coxarthrosis in Orthopedics[10]. Our results could be explained by the exacerbation of the prevalence of road and traffic accidents in Chad[11,12].

Haemostasis tests were carried out in all patients. Haemostasis disorders (platelets, PT, APTT) were detected in 21.90% of cases, representing a non-negligible haemorrhagic risk (PT≤.70 and APTT< 24). Thrombocytopenia (platelets < 150,000) was represented in 3.8%. These data are slightly higher than those of El Houri, who found 15% of patients with a TP<50%[9].

Hemoglobin assays were carried out in all patients in the sample, of whom 46 patients (43.81%) had presented with preoperative anemia (Hb≤12 g/dl), of whom 10 (9.52%) had moderate anemia (Hb≤10g/dl.). This result is comparable to data obtained by PINEAU Florian & RABET Jean who found a prevalence of anemia at 42.6% with a mean hemoglobin value of 11.2 ± 1.4 g/dl[13]. Our data are superior to those of RAKOTOTIANA Sitrakiniaina[5]. However, transferrin saturation assay (≤ 20%) and/or Ferritin (≤ 100 µg/l) were not performed, yet martial deficiency is the leading cause of preoperative anemia worldwide[14].

Our data showed that 18 out of 60 anesthetized with GA, i.e. 17.1%, had an intraoperative blood loss ≥ 1000ml versus 5 out of 45 with RA, i.e. 4.8%. In view of these data, we conclude that there was no significant difference between types of anesthesia, although there was a slight decrease in blood loss in the RA group compared with the GA group.

Analysis of our results showed that blood loss was greater (≥1000ml) in the group of patients in whom only the electric scalpel was used (63% versus 5.80%). Despite variations in the site of blood loss depending on whether the tourniquet was used or not, intraoperative bleeding was reduced by the use of the electric scalpel accompanied by the tourniquet. Our results corroborate those of studies by Jawad Amghar and colleagues in Morocco in 2020, who found a reduction in blood loss in the group of patients in whom the tourniquet was used (1234 ml vs. 1557 ml and p=0.016)[15].

According to our analysis, tranexamic acid was used in 57 patients (54.29%). ATX is used perioperatively at a dose of 1g 15 minutes before incision intraoperatively and sometimes at 8 hours postoperatively in a prolonged manner, especially only after PTH. Blood loss ≥ 1000ml was observed in 16 patients (15.24%) who did not receive ATX versus 07 patients (6.67%) who did. Several large-scale Randomized Controlled Trials (RCTs) and meta-analyses have consistently confirmed that intravenous administration of ATX can safely and effectively reduce perioperative blood loss and transfusion requirements in total hip and knee arthroplasty[16]. In Thomas BUBENDORFF's work, bleeding occurs between D0 and D1. This bleeding concerned 60% of THRs and 52% of TKRs. ATX used perioperatively reduced intraoperative and postoperative bleeding for a prolonged period[3]. We believe that our results may be influenced by the absence of a transfusion-sparing protocol for haemorrhagic surgery at CHU la Renaissance, since each anaesthetist applied his or her own habits (practices).

We observed an increase or maintenance of Hb levels using these molecules (combination of iron and tranexamic acid) in the immediate postoperative period to D+5. In particular, 64.76% of patients maintained hemoglobin levels >11g/dl. Irisson et al found that total Hb loss was reduced by ATX: - 2.4 ± 1 g/dL for both types of surgery (PTH and PTG) ($p < 0.001$), and no blood transfusion was prescribed in the ATX+ groups[17]. We believe that the synergy between tranexamic acid and iron influenced the increase in Hb levels compared with Lucien, who used IV iron alone.

Perioperative homologous blood transfusion was used in 14 patients, according to the criteria for monitoring hemodynamic parameters and transfusion thresholds. This transfusion was performed in 3 patients preoperatively, 5 intraoperatively and 6 intra- and postoperatively. Our results are similar to those of RAKOTOTIANA Sitrakiniaina, who reported that, out of 71 patients with severe bleeding, 14 (19.72%) had received a blood transfusion[18]. Other studies have compared the use of ATX and blood products, and found that tolerance was significantly higher in pelvic fractures treated with ATX (6.44 ± 4.42 units, $p = 0.0029$) [19].

5. Conclusion

In view of these data, we conclude that there was no significant reduction in intraoperative blood loss associated with the types of anesthesia, although we note a slight reduction in blood loss in the AR group compared with the GA group. Electrosurgery accompanied by the use of pneumatic tourniquets had an influence on intraoperative bleeding. Tranexamic acid has been shown to be an effective and safe blood conservation technique for the management of intraoperative hemorrhage and to reduce transfusion requirements in major orthopedic and trauma surgery.

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