Patient blood management in Hip and Knee surgery: A methodological approach – Part 2 → Blood losses strategy and anemia tolerance

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Abstract

A patient's surgical journey always begins when a surgeon recommends recourse to surgery. The surgeon will focus on the joint to be replaced and the anesthesiologist (and other specialists if needed) will deal with other aspects of the patient's care. Our analysis deals with "blood risk" issues, but also touches upon all aspects associated with this kind of surgery. The preoperative management of the blood resource will be based on the outcome of the activities performed by anesthesiologist and surgeon, as well as of any other specialists who might be consulted for a specific case. In orthopedic patients who are candidates to undergo surgery entailing perioperative bleeding, the occurrence of anemia has been observed to range between 24% and 35%. Based on these data, the test to measure iron levels allows to observe the quantity of iron in the blood, mighting to perform a MSBOS (Maximum Surgery Blood Order Scheduling).

An important concept to present is the low Ht physiology! It has been observed that avoiding hypovolemia is essential and that the main determinants of whole blood fluidity are the red blood cell concentration (hematocrit), plasma viscosity, cellular interactions and shear rate. Finally an intense monitoring decreases the tendency towards need for allogeneic transfusion.

Based on these criteria and on our experience in Orthopaedic surgery, in a clinical application of the low Ht Physiology, in a good knowledge concerning blood losses recovery, antithrombotic prophylaxis, antifibrynolitic activity and, least but non last, normotermia and pain control, we suggest a multimodal approach on this problem and some useful solutions.

Key words: Hip /Knee surgery- Blood- Anemia- Low Hematocrit - Anesthesia

Introduction:

A patient's surgical journey always begins when a surgeon (the medical professional in charge of the patient's care) recommends recourse to surgery. Within this journey, the surgeon will focus on the joint to be replaced and the anesthesiologist (and other specialists if needed) will deal with other aspects of the patient's care.

Out of this premise arises the need for guidance that may be defined as the "Patient blood management" protocol, applicable to any surgical procedure. In the "part one" we've analyzed the preoperative evaluation, the erythropoiesis stimulation and some notes on "low Ht physiology". In this "part two", we specifically address hip and knee surgery.

This analysis deals with blood losses risk issues, but also touches upon all aspects associated with this kind of surgery.

Individual strategies and techniques aim at achieving optimal outcomes in terms of both prosthesis implantation and the entire care process.

This process is comprised of several phases:

Decrease of perioperative (not only intraoperative) blood loss

Optimization of tolerance to anemia throughout the entire perioperative period

A- Limiting blood loss

The most important task **during the preoperative phase** is undoubtedly identifying and managing hemorrhagic risk. If until a few years ago preparation for surgery called for collecting, where possible, whole blood from the patient (the currently outdated predeposit autologous blood donation and/or hemodilution, which is always of great interest but not easy to implement and associates with risks unless there is a firm grasp of the "low Ht physiology"), there is currently a tendency to increase the patient's own blood volume and to manage any possible increase of hemorrhagic risk.

Recent guidelines recommend the use of structured questionnaires to identify patients who are at risk for bleeding and for a potential quantification on hemorrhagic risk in patient with congenital coagulative disorders, thus allowing to decrease bleeding and preserve individual patients blood reserve. (1)

As part of the preoperative workup, a questionnaire on the patient's clinical and pharmacological history indeed appears to be more effective compared to an evaluation based only on the results of routine laboratory tests [activated partial prothrombin time (aPTT), prothrombin time /International Normalized Ratio (PT/INR), platelet count].

A key element in this phase is the patient's physician's approach to a number of issues capable of modifying the patient's hemorrhagic risk.

Antiaggregants

A first important issue concerns the management of antiplatelet therapy.

It is well-known that selective cyclooxygenase 2 (COX-2) nonsteroidal anti-inflammatory drugs do not cause an increase in bleeding in total knee replacement (TKR) and total hip replacement (THR) and therefore it is not necessary to discontinue them prior to elective prosthesis surgery of lower extremities(2). By contrast, ibuprofen, diclofenac and indomethacin do significantly increase blood loss in prosthesis surgery, for which reason it is advisable to discontinue these agents while continuing to provide pain management(3).

Aspirin (ASA) in monotherapy and at a low dosage can be prescribed both for primary prevention (i.e. to maintain a good circulation in elderly patient) and for a real antiaggregant role (secondary prevention) in patient with a prior cardiovascular episode..

As the patient assumes this drug for a secondary prevention, we don't require discontinuation prior to an orthopedic surgery, nor it is necessary to delay the surgery because of ASA administration.

Otherwise, according to the most recent Italian intersociety consensus, ASA for primary prevention must be discontinued 7 days prior to elective arthroplasty surgery, and is to be discontinued upon admission to the hospital in case of surgery for femur neck fracture. If low-dose ASA is taken as secondary prevention, it must be continued also throughout the perioperative period at a dosage of 75-100 mg/day(4).

Ticlopidine and clopidogrel belong to the class of first and second generation thienopyridines, respectively; they both inhibit ADP-induced platelet activation by binding to the P2Y12 receptor. Since clopidogrel and ticlopidine, as well as other antiplatelets, cause perioperative bleeding, in case of increased bleeding risk, it is recommended to discontinue these agents at least 7 days prior to surgery, without replacing them with an LMWH (Low Molecular Weight Heparin).

A double oral antiplatelet therapy is necessary for stent patients, in whom discontinuing one or both antiplatelet drugs would entail, especially during the first month after the procedure, a significant risk of stent thrombosis, a life-threatening. In such cases, it might be useful to replace the antiplatelet with an LMWH(5).

Anticoagulants

Another important issue is the management of anticoagulant therapies. Currently, two different categories of drugs are available on the market: Vitamin K Antagonists and New Oral Anticoagulants. The approach to surgical patients may differ greatly, based on the kind of drug administered: the decisive factor is the drug's mechanism of action and target

In the case of **Vitamin K Antagonists** it is very important to bear in mind that it is not safe to perform elective surgery (an urgent surgery must only be dealt with) in subjects with INR values > 1.5. Because as a rule the effectiveness of the drug is obtained with INR values ≥ 3, a bridging before surgery is necessary, to be then followed by bridging after surgery to restart personal therapy.

A possible scheme to be used calls for:

Halt of dicumarol drug 5 days prior to surgery and at the same time start of treatment with Low molecular weight heparin (LMWH) (Nadroparin 0.4-0.6 ml or Enoxaparin 4000-6000 IU based on patient weight and thromboembolic risk)

Timing of LMWH administration that allows for a 12–24 hour halt prior to surgery (e.g., administration at 08:00 p.m.)

Measurement of INR values upon admission (surgery may be performed in presence of INR values ≤ 1.5) and continuation of treatment with LMWH

Day of surgery: LMWH as per thromboembolic prophylaxis scheme (patient weight)

Day 1 and Day 2 postsurgery: LMWH as per thromboembolic prophylaxis scheme

Day 3 postsurgery: LMWH as per scheme and dicumarol agent given at the presurgery dosage

Starting from Day 4 after surgery: dicumarol as per habitual dosage, discontinuation of LMWH and measurement of INR values to adjust, if necessary, dosage of therapy

On the other hand, in case of **NOACs- new oral anticoagulants** (Apixaban, Dabigatran, Rivaroxaban), no available laboratory test is able to indicate when the patient may safely undergo surgery (from the viewpoint of hemostasis) but it is important to take into consideration renal function, and based on this parameter, arrange for therapeutic halt.

Table 3 : Time interval depending on GFR (6)

Creatinine Clearance	Dabigatran (Pradaxa)		Apixaban (Eliquis)		Rivaroxaban (Xarelto)	
	Low risk surgery	High risk surgery	Low risk surgery	High risk surgery	Low risk surgery	High risk surgery
> 80 ml/’	24 h	48 h	24 h	48 h	24 h	48 h
50-80 ml/’	36 h	72 h	24 h	48 h	24 h	48 h
30-50 ml/’	48 h	96 h	24 h	48 h	24 h	48 h
15-30 ml/’	Not indicated	Not indicated	36 h	48 h	36 h	48 h

In clinical practice, the drug is halted 48 hours prior to a prosthesis replacement surgery, without being replaced by any other drug, and is restarted in the postoperative period.

Unlike vitamin K antagonists (in which the effective therapeutic range after restarting administration occurs in approximately 5 days), the peak of activity of NOACs occurs 1 – 3 hours from administration (herein lies the potential risk for bleeding in the immediate postoperative phase for surgeries associated with precarious hemostasis). If a peridural catheter had been placed, its removal must allow for the appropriate time interval to avoid spinal hematomas (at least 12 hours), and in case of invasive procedures, restart may occur on the same evening of the procedure, except in case of bruising at the injection site.

NOACS must be administered the same day of surgery (<u>at least 12 hours after the end of the procedure</u>), based on the risk of thrombosis and of bleeding and depending on the type of procedure. It is recommended to restart administration at a lower dose in case of twice daily administration. Therefore, in case of a surgical procedure that ends by noon, the drug may be restarted within midnight. In all other cases, and in case of precarious hemostasis, the drug must be restarted the morning after.

If oral treatment is not possible after surgery, patients must restart anticoagulant therapy with LMWH, and NOACS must be re-introduced when possible. In case of high bleeding risk, restart of therapy with a NOAC is to be postponed until 48 – 72 hours, but in such an event therapy with LMWH must be initiated to prevent VTE.

Another extremely important factor for limiting blood loss is implementation of techniques and administration og drugs able to decrease bleeding.

Anesthesia

Various studies have demonstrated that using **neuraxial blockade** (epidural e subarachnoid anesthesia), especially for orthopedic surgery, might associate with a significant decrease in bleeding (7 – 8)

However, data are not unanimous since a meta-analysis concerning patients undergoing total knee replacement surgery (TKR) did not capture any significant difference between neuraxial blockade and general anesthesia. It nonetheless appears that neuraxial blockade may decrease transfusion requirements thanks to the relative systemic hypotension it induces by blocking the sympathetic nervous system and the ensuing decrease of venous tonicity (9).

As regards **general anesthesia**, the use of propofol-based, totally intravenous anesthesia associates with decreased blood loss (especially in spinal surgery). However, studies that have compared blood loss with different anesthesiological techniques in orthopedic surgery should be interpreted with caution, since they were mainly conducted at a time when transfusion practices were more liberal than the ones in use today.

Body temperature

As concerns **body temperature**, its correlation with the entity of transfusion support is nowadays well-established. Hypothermia during surgery is the result of a combination of different factors that contribute to the loss of body heat (low ambient temperature in the operating room, administration of non-warmed fluids, and alteration of thermoregulation mechanisms induced by anesthesia)(10).

Even a moderate decrease in body temperature may affect physiological hemostasis mechanisms, changing platelet function and inhibiting temperature - dependent coagulation enzymatic reactions. It has been shown that even a mild hypothermia (decrease of body temperature by < 1 °C) might increase blood loss by up to 16%, with the related increase of the probabilities of requiring transfusion (22%) (11).

A possible contribution to towards maintaining body homeostasis might be given by local regional anesthesia techniques, provided the anesthesiological team is experienced in this technique, with a view to limiting intraoperative blood loss.

It is still necessary to prevent and treat hypothermia by warming infusion solutions in advance and keeping the patient warm, in order to limit intraoperative bleeding, as well as for evident reasons of comfort.

Pharmacological techniques

Drugs used to reduce surgical bleeding and transfusion requirements during surgery act by either preventing or correcting hemostasis defects in the perioperative phase.

Fibrinolysis represents a major cause of bleeding in surgical patients(12).

There are a few types of surgery (total hip replacement [THR], total knee replacement [TKR] with tourniquet, cardiopulmonary bypass, liver transplantation) that have a stronger association with fibrinolysis, and more than other types of surgery benefit from the use of TXA (tranexamic acid).

Systematic reviews of randomized controlled clinical trials show that using TXA has a significant impact on decreasing transfusion requirements, especially in heart and orthopedic surgery(13 – 14).

Intravenous administration of TXA in hip and knee replacement surgery is now routine at centers performing this kind of prosthetic surgery. The dosage of TXA for which there is a consensus in literature is, both in hip and knee replacement surgery, an initial dose of 15 mg/kg prior to surgery, followed either by an infusion of 1 mg/kg/hour after 4-6 hours or by repeating the initial dose in the postoperative period (6-8 hours).

One of our papers compared two populations, only one of which received pharmacological treatment.

Table 4 : Link between Tranexamic acid and transfusion in Hip surgery

Hip replacement surgery		
	TXA yes	TXA no
No transfusion	120	89
Trasfusion	16	28
chi-squared test normal	Significant → p:0.01	
Corrected as per Yates	Significant p:0.01	
	Odds ratio → 2,36	

Table 5 : Link between Tranexamic acid and transfusion in Knee surgery

Knee replacement surgery		
	TXA yes	TXA no
No transfusion	262	93
Trasfusion	18	33
chi-squared test normal	Significant → p:0.00001	
Corrected as per Yates	Significant p:0,00001	
	Odds ratio → 5,16	

Since there might be a doubt concerning the "non-TXA" population, as it was not as numerous as the other and because of possible bias due to the clinical conditions of "non-enrolled" patients, we performed a comparison of a similar case series, at a time when anti-fibrinolytics were not yet being used.

Table 6 : Cases report 2010 (no Tranexamic use) and 2012 (Tranexamic adopted)

	2010	**2012**
Prosthesis Replacement Cases Series	**569 (208 THR - 361 TKR)**	**659 (253 THR - 406 TKR)**
Transfused Patients		
THR	**116 pts**	**44 pts**
TKR	**102 pts**	**51 pts**
% THR with transfusion	**55.7%**	**17.3%**
% TKR with transfusion	**28,2%**	**12.5%**

Table 7 : About THR

THR	**2010**	**2012**
No transfusion	**92**	**209**
Transfusion	**116**	**44**

Results of a statistical analysis (chi-squared test) that was significant (p:0.00001) both with respect to normal data and to data corrected as per Yates, with an odds ratio of 0.17.

Table 8 : About TKR

TKR	**2010**	**2012**
No transfusion	259	355
Transfusion	102	51

Results of a statistical analysis (chi-squared test) that was significant (p:0.00001) both in the normal data and in the data corrected as per Yates, with an odds ratio of 0.36, providing clear evidence concerning usefulness of pharmacological treatment.

Continuing our journey, during the 2015 surgical activity (pharmacological treatment was by then well-established) we assessed the data concerning transfusion against application of the TXA protocol.

Table 9: data concerning Transfusion related to TXA method applied

Type	**Case series**	**% of total**	**Transfusion**	**%**
NO Tranexamic acid	89	7.5	18	20.2%
YES Tranexamic acid – pre-op	465	39.4	63	13.5%
YES Tranexamic pre- and post-op	627	53	36	5.7%

The sample size s unfavorable for the "no TXA" group, since the drug is discontinued in presence of major heart rhythm disorders (such as atrial fibrillation) and in presence of creatinine clearance values < 50 ml.

The difference in recourse to transfusions is undoubtedly significant when comparing the "no TXA" to the "yes TXA "– pre-op", but the trend is even more favorable when compared the third group (yes TXA, pre—and postop) versus either of the other groups taken into consideration.

In particular, a statistical analysis using the chi-squared test with Yates correction shows the following findings:

Non significant difference between the "no TXA group" and the "yes TXA group", with p=0.1024 and an odds ratio of 1.62.

Significant difference between the "yes TXA – pre— and postop group" and both the "no TXA group" (p:0.0001 with odds ratio 4.42) and the "yes TXA – pre-op group" (p=0.0001 with odds ratio 2.73)

B- Intra- and post-operative blood salvage

Intra-operative blood salvage is a blood sparing technique that allows to use blood lost in the surgical field. This blood is suctioned and anticoagulated before being placed in a collection reservoir, then is passed through filters of varying diameter to capture microaggregates, and finally vehicled into a bowl of specific cell separators, where it will be concentrated by centrifuging and then washed with saline solution prior to being readministered to the patient.

Intraoperative blood salvage is indicated in many types of elective and urgent surgical procedures, when a > 500 ml blood loss is expected, and whenever a blood loss ≥ 20% of patient blood volume is anticipated (15).

Table 10: cases and ratio of intraoperative salvage

Type	**Case series**	**%**
Intra-op blood salvage prepared	700	60%
Intra-op blood salvage (completed with reinfusion of the recovered blood to patient)	110	9.3%

A personal evaluation has shown that, out of 700 cases of prosthetic surgery, intraoperative blood salvage was prepared in 60% of cases, but was actually completed (with readministration of the washed red blood cells) in 9% of cases.

Post-surgery blood salvage consists in collecting in a specific container the blood that the patient loses through surgical drainage tubes, and to subsequently readministering it to the patient. This procedure may be conducted using either the "non-wash" or the "wash" system.

For the "non-wash system", the blood is transferred from the container connected to the drainage tube to the infusion set, and is readministered without being further processed. A double integrated filtration system is used, initially with a 100-200 μ filter, to capture fibrin and macroaggregates, followed by a 40 μ filter to capture microaggregates. It is not necessary to use anticoagulants because this blood is free from fibrinogen. This system requires simple, inexpensive and user-friendly methods(16).

The following table – 11 - shows findings arising from our personal experience:

Type	Case series	%
Post-op blood salvage prepared	1025	87%
Post-op blood salvage completed "NO TXA" group	46	52%
Post-op blood salvage completed "YES TXA" group	64	13.7%
Post-op blood salvage completed "YES TXA – pre- and post-op" group	62	9.8%

The data are quite different when considering the use of postoperative blood salvage relative to treatment with tranexamic acid. Also this case, and providing further proof of the efficacy of pharmacological treatment, the administration of 15 mg/Kg of tranexamic acid significantly decreases blood loss during the first hours after surgery, with a reduction in recourse to postoperative salvage from 52% to 13.7 and 9.8%, respectively.

C- Optimization of tolerance to anemia

Preoperative evaluation of cardiac reserve intends, firstly, to identify patients for whom cardiac stresses that associate with surgery and with the perioperative period might represent a special risk of morbidity and mortality, which adds on to the risks associated with the underlying disease.

From this point of view, the evaluation of tolerance to anemia is inferred from current hemodynamic stability and from the cardiac reserve which may be measured using various exams (echocardiogram, echocardiogram stress test…) and is studied (and if necessary, corrected) during the preoperative evaluation phase by the anesthesiologist and the cardiologist (17).

Cardiorespiratory functional reserve should be studied in all patients who are potentially at risk for acute perioperative anemia as part of the preoperative work-up, precisely to better characterize the patient and better manage a possible "low hematocrit" situation.

Hemoglobin levels continue in any case to be the most widely used transfusion trigger together with clinical evaluation of the patient. After the clinical trial TRICC (*Transfusion Requirements in Critical Care*), published in 1999, various studies demonstrated that adopting restrictive transfusion thresholds (Hb = 7-8 g/dl) ensure safety for the patient and reduces transfusion requirements (18)

In orthopedic patients, the recent trial FOCUS (*Transfusion trigger trial for **F**unctional **O**utcomes in **C**ardiovascular patients **U**ndergoing **S**urgical hip fracture repair*) demonstrated that in elderly patients with high cardiovascular risk, a liberal strategy (transfusion threshold of Hb = 10 g/dl) does not decrease mortality or inability to walk unassisted sixty days after surgery, nor does it decrease morbility during hospitalization compared to a restrictive strategy (transfusion threshold of Hb=8 g/dl or symptomatic anemia) (19).

The greater effectiveness of the restrictive transfusion threshold (Hb < 7 g/dl) compared to a liberal threshold (Hb < 9 g/dl) is also supported by the significantly lower mortality observed in patients with gastrointestinal bleeding (20).

Another randomized study has on the other hand demonstrated the equivalence of the restrictive strategy (hematocrit > 24%) relative to a liberal strategy (hematocrit > 30%) in patients undergoing heart surgery (21).

Within an evaluation performed in this setting, and making reference to our case series of year 2015, it is quite clear that a low Hb value directly correlates to a significantly higher transfusion requirement, thus supporting of the choice to avoid prosthesis surgery in patients who are considered to suffer from anemia based on WHO criteria.

Table 12 : link between preoperative Hb levels and transfusion perioperative

Surgery	**Preoperative Hb**	**Case series**	**Transfusion performed**	**Ratio**
THR				
	<12.0 g%	19	8	42%
	<14.0 g%	218	28	12.8%
	>14.0 g%	376	6	0.15%
TKR				
	<12.0 g%	21	10	47.6%
	<14.0 g%	176	26	14.7%
	>14.0 g%	181	4	0.22%

Intraoperative phase

Oxygen delivery (DO_2) is the result of the product of cardiac output (CO) by arterial oxygen concentration (CaO_2).

Therefore, from a physiological point of view, stable DO_2 may be obtained by adjusting therapeutically the two factors involved.

As concerns hemodynamic function, the so-called optimization (or goal-directed therapy [GDT]) is nowadays supported by the more numerous and better clinical evidence currently available. The physiological rationale underlying GDT follows the notion that optimizing the patient's cardiovascular function, by means of a special and codified therapeutic approach, allows for the best oxygen delivery for that specific patient.

It has been amply demonstrated that managing blood volume based on GDT principles allows also for the best dosage of fluid therapy, thus avoiding complications that associate both with excessive and with inadequate fluid administration, with a favorable impact on patient outcomes.

Anemia and blood volume are NOT synonymous

Hyperoxic pulmonary ventilation is indicated (FiO2 = 1) in case of acute intraoperative anemia in patients under general anesthesia and receiving mechanical ventilation. This technique, especially when used in combination with normovolemic hemodilution might be useful, at least to allow for the best oxygen delivery until bleeding is controlled (22).

In case of patients with decreased physiological reserve that might cause a perioperative decrease of tolerance to anemia, we believe it appropriate to propose a postoperative observation of adequate duration (at the discretion of the physicians taking care of the patient) in varying care intensity settings, based on the requirements of the patient.

The purpose is not only to monitor the patient, but also to support the physiological variables which are involved in the process of adapting to anemia.

From this viewpoint, control of postoperative pain is a very important aspect, both in the immediate post-surgery phase (which is essential) and later on.

The correlation between ***postoperative pain, stress and consumption of oxygen*** has been well known for quite a number of years. Moreover, acute postoperative pain which is not adequately treated causes a cascade of reflexes that impact physiological homeostasis, such as internal secretion of catabolic hormones that cause significant hemodynamic, renal and immune repercussions.

Many organs and systems are involved in this issue.

The possible complications arising from inadequate pain management affect the following systems:

Respiratory

Cardiovascular

Gastrointestinal

Genitourinary

Neuroendocrine metabolic system

Musculoskeletal system

Respiratory complications: Pain, especially combined with the effect of residual anesthesia, induces a decrease of pulmonary volumes which, accompanied by depressed cough reflex, leads to onset of atelectasis and multiplies the odds of respiratory infections in a case of hypoxemia.

Cardiovascular complications: On the one hand pain, decreased motor compliance thus inducing an increase in venous congestion and, as a consequence, increasing odds of thromboembolic complications. It also induces a stimulation of the sympathetic nervous system which is responsible both for a decrease in district flow (thus causing delayed wound healing and muscular acidosis), and for hypertension and tachycardia (potentially increasing risks of ischemia).

Gastrointestinal complications: Pain induces a decrease of gastric and intestinal motility, which are both already impaired after surgery, and which are the focus of much attention, with proposed early enteral feeding.

Genitourinary complications: Urinary retention is a possible complication of neuraxial blockade and pain is known to increase risks of this complication. Urinary retention is directly responsible for delayed recovery and for urinary tract infections caused by use of bladder catheters.

Neuroendocrine and metabolic complications: Pain induces hyperglycemia, a rise in blood fibrinogen, a "very risky" increased platelet aggregation and, last but not least, negative protein catabolism which is undoubtedly impairs the physiological healing processes.

In consideration of all these possible outcomes correlated to the pain symptom, a periodical evaluation of postoperative pain (both at rest and not at rest) must be carried out to optimize pain management. Either of the following international scales may be used: NRS (*Numeric Rating Scale*), VAS (*Visual Analogical Scale*) and VRS (*Verbal Rating Scale*).

We have for many years been committed to and focused on these aspects, not only to manage pain as a vital symptom, but also and above all in consideration of all the topics discussed above.

Table 13 : Data from a review of surgical population in 2015

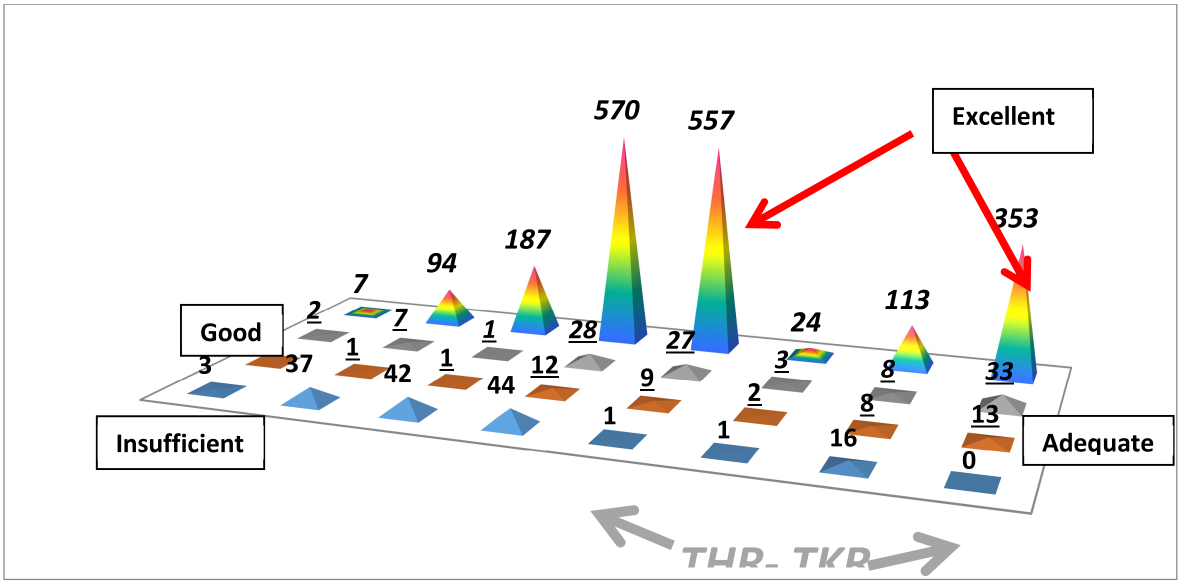

Table 14 : Data based on THR/TKR surgery

Conclusions

Our discussion on what must – or should – be done to correctly manage patients undergoing hip and knee replacement surgery merely intends to focus attention on all details and on all the phases and steps of the preoperative period.

To face a blood management in a patient undergoing surgery (mainly orthopaedic surgery) we have to consider the problem as a "unique" with a lots of components.

First of all we have to evaluate the patient, with the coexisting diseases and the erythropoiesis. As we consider the blood losses depending on a prosthetic surgery (hip or knee, doesn't matter) we can't forget the direct link between preoperative Hemoglobin values and the perioperative transfusion.

During the operative time we have to activate all possibilities in minimizing blood losses and in limiting any Hemoglobin decrease. Not simply avoiding surgery but, mainly, evaluating drugs and the link between drugs and anesthesia.

If we stop any bleeding drugs, we use antifibrynolitic drugs to face the bleeding in the first postoperative hours and we use all techniques for saving blood, we can obtain a very small postoperative blood losses.

Finally, if we manage a good anesthesia (regional vs general, probably), try to maintain a good body temperature level (warming the patient during surgery) and we search and optimal pain relief, we can surely obtain the final result we are looking for.

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