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Patient specific instrumentation influences hemoglobin decrease after total knee replacement

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Abstract

Patient Specific Instrumentation (PSI) may contribute to reduce blood loss after total knee replacement (TKR) by avoiding violation of the medullary canal. The purpose of the study was to compare the hemoglobin (Hb) decrease in two groups of patients undergoing TKR with PSI and conventional instrumentation.

Pre- and post-operative blood samples were collected for twenty-two patients randomly assigned to receive a PSI-assisted or conventional TKR. Post- to preoperative Hb difference was calculated.

A significant difference in Hb reduction in favor of the PSI group was registered on the last day of stay but not on the previous post-operative days: these promising results suggest a beneficial effect of PSI in blood loss reduction. PSI may hence be considered among the strategies available to control and reduce blood loss related to TKR.

1 Introduction

Blood loss in total knee replacement (TKR) is related to longer hospital stay and rehabilitation, higher rate of infections and transfusions and increased overall morbidity [1–3]. Patient Specific Instrumentation (PSI) is supposed to contribute to blood loss reduction by avoiding the use of intramedullary guides. Aim of this study is to investigate differences in blood loss related parameters

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between patients who received PSI-assisted TKR and a control group of conventionally implanted TKRs.

2 Materials and methods

Goal of this study was to compare the estimated hemoglobin (Hb) decrease in two groups of patients undergoing TKR with PSI and conventional instrumentation.

Twenty-four patients were prospectively enrolled and randomized. A cemented prosthesis with patellar resurfacing was implanted using the same sequence of soft-tissue release. Conventional cutting instruments were used in the control group and PSI cutting guides (Trumatch, DePuy) were used in the treatment group. Surgical technique, anesthetic and pain-control medications, antithrombotic and antibiotic prophylaxes and rehabilitation procedures were standardized according to the institution's internal protocols. Blood samples for determination of Hb levels were collected pre-operatively and on 1^{st}, 2^{nd}, 3^{rd}, and last day ($5^{th} \pm 1$ day).

Statistical analysis was performed using GraphPad Prism v 6.0 software (GraphPad Software Inc.). The differences for continuous variables was proved with an unpaired Student's t-test. The significance level was set at p-value lower than 0.05.

3 Results

Twenty-two patients completed the follow-up. A significant difference in Hb reduction in favor of the PSI group was registered on the last day of stay ($p<0.01$) but not on the previous post-operative days (p: n.s.).

4 Discussion

The main finding of our study was that PSI can reduce postoperative Hb decrease. Since Hb decrease may cause short- and long-term complications numerous strategies were developed to reduce it [2,4,5–13]. PSI overcomes the need of violating the medullary canal (which can increase the risk of peri-operative blood loss and embolization of medullary content), making reasonable to expect a reduction in blood loss [14–18].

A reduction in intra- or peri-operative blood loss with PSI was observed in multiple reports [15,19–23], while other authors have failed to observe significant differences [1,2,17,20,21,24–34]. However, only a handful of clinical studies exist, which were specifically designed to investigate peri-operative blood loss after TKR with PSI. [1–3,35–37].

When comparing PSI with conventional instrumentation, Pietsch found a significant difference in the drainage loss but not in Hb loss and transfusions requirements [1] while Rathod identified a non significant trend towards lower Hb drop in bilateral procedures with PSI [37]. Thienpont and Cundy could not detect significant differences in either blood-loss-related parameters or transfusions requirements [2,36]. Schwarzkopf described a significant decrease in intra-operative blood loss for PSI but did not analyze any peri-operative variables [3]. Comparing PSI to computer-assisted surgery, León reported a significant difference in total blood loss and transfusion requirements in favor to PSI [35].

This study, which prospectively investigated the treatment effect on post-operative Hb decrease, showed a significant difference in Hb reduction in favor of the PSI group on the last day of hospital stay but was not able to confirm a difference in the previous days.

Limitations in this study are the relatively small sample size and the absence of an intra-operative esteem of blood loss. Furthermore, a single type of PSI was tested; other systems may perform differently and these results may then not be representative for all different custom-fit technologies available.

5 Conclusions

A significant difference in hemoglobin reduction on the last day of stay was reported in the group treated with, results which need to be confirmed by adequately powered future studies.

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