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Original article

Higher blood loss and transfusion requirement in surface arthroplasty versus conventional total hip replacement

Dario Regis[1], Andrea Sandri[1], Elena Sambugaro[1], Massimo Franchini[2], Eugenio Vecchini[1], Elena Samaila[1], Bruno Magnan[1]

[1]Department of Orthopaedic and Trauma Surgery, University Hospital, Verona, Italy; [2] Department of Transfusion Medicine and Haematology, Carlo Poma Hospital, Mantua, Italy

Summary. *Background and aim of the work:* Surface replacement arthroplasty (SRA) is an alternative to stemmed total hip arthroplasty (THA) providing a femoral bone preserving procedure. Because of the wider surgical dissection, an increased blood loss could be expected. This retrospective study evaluates the transfusion requirement in two homogeneous groups of patients who underwent primary hip replacement electively. *Methods:* Perioperative haematological data of 42 hip resurfacing procedures and 41 conventional cementless THAs were compared. The pre- and post-operative haemoglobin (Hb) levels and the amount of blood transfusions were registered. The median values were compared with use of the non-parametric Wilcoxon signed-rank test. *Results:* In the SRA group, a significantly increased ($p<0.02$) preoperative Hb concentration (13.1 g/dL, range 10.9 to 15.6) was detected in comparison with the THA group (12.5 g/dL, range 10.4 to 15.2). In the resurfacing procedures a median of 900 mL (range 600 to 1500) were transfused vs. 600 (range 300 to 1500) in the conventional THAs, demonstrating a significantly higher transfusion requirement ($p<0.04$). *Conclusions:* Whereas hip resurfacing is a femoral bone preserving alternative to conventional THA with comparable clinical and radiographic outcomes, higher blood loss and transfusion requirement may occur. (www.actabiomedica.it)

Key words: blood loss, Hb level, hip resurfacing, total hip arthroplasty, transfusion requirement

Introduction

Elective total hip arthroplasty (THA) is well established as an effective treatment for symptomatic osteoarthritis of the hip (1), although it is commonly associated with blood transfusions intra- and post-operatively (2).

Surface replacement arthroplasty (SRA) is a relatively new procedure of hip replacement that includes a high potential both for joint biomechanical restoration and femoral bone preservation (3-6). In a SRA, only the articular surfaces of the femoral head are removed, and the neck is left in situ. Consequently, the access to the acetabulum is severely reduced and a wider surgical dissection is required.

Therefore, higher blood requirements could be expected, but only a few published reports have directly compared the two procedures. In two different studies, hip resurfacing had an increased median blood loss, although not significant (7, 8), whereas Fowble et al. found less total blood loss ($p=0.0005$) and fewer transfusions ($p<0.0001$) following SRA (9). Similarly, in a recent meta-analysis review, a greater requirement for blood transfusion was detected in conventional THAs (10).

This retrospective study compares the incidence of blood loss and transfusion requirement in two groups

of patients who received either surface or stemmed total hip arthroplasty.

Materials and methods

This retrospective study enrolled all patients who received elective hip prosthesis in the period August 2004 until June 2009. Forty-two hybrid metal-on-metal resurfacing procedures were performed on 39 patients, 27 males and 12 females (3 having bilateral involvement), with age ranging from 27 to 72 years (median 60). This population was compared with a series of 41 conventional cementless THAs with ceramic-on-ceramic bearings which were performed in 21 males and 18 females (2 were operated on bilaterally), aged from 30 to 77 years (median 67).

The operations were predominantly for primary osteoarthritis (28 and 24 hips, respectively) in patients who had failed nonoperative treatment. Other etiologies were avascular necrosis of the femoral head (7 and 8 cases), posttraumatic arthritis (3 and 1), hip dysplasia (3 in both groups), slipped capital femoral epiphysis (1 resurfacing), and rheumatoid arthritis and ankylosing spondylitis (4 and 1 conventional THAs). Indications for hip resurfacing were considered young age and high activity level. Therefore, the patients were predominantly males (66.7%), with a median of seven years younger than patients receiving THA (60 vs. 67 years, respectively; $p<0.002$). However, the gender difference was not significant ($p<0.23$). No patient in both groups had undergone previous hip surgery. All procedures were performed by the same surgical team via an anterolateral Watson-Jones approach with the patient in supine position (Table 1). No patients in both groups received tranexamic acid by means of topical or intravenous administration.

The haemoglobin (Hb) concentration was measured the day before and after surgery and immediately before discharge (4 or 5 days postoperatively) in order to evaluate blood loss. The total amount of blood transfusion was recorded for all patients as well. Postoperative transfusions were considered for both cohorts when Hb level was <9 g/dL.

Haematological parameters, age, and BMI were expressed as minimum, maximum, and median values, and compared by use of the Mann-Whitney U test, as variables were quantitative and non-normally distributed between groups (11). These data were performed using Stata IC version 10.1 software (StataCorp, 2007) (12). The difference of ratios (overall number of patients, gender, diagnosis, affected side, and number of

Table 1. Demographic data of patients undergone to surface replacement arthroplasty (SRA) and conventional total hip arthroplasty (THA)

		SRA	THA	p (*/#)
N hips (N patients)		42 (39)	41 (39)	
Sex	Female	12 (2 bilateral)	18 (2 bilateral)	0.15*
	Male	27 (1 bilateral)	21	
Age (years)		60 (27-72)	67 (30-77)	**0.002#**
Body mass index		26 (20-32)	27 (17-38)	0.98#
Diagnosis	Primary arthritis	28	24	0.29*
	Head necrosis	7	8	
	Other	7	9	
Side	Right	24	21	0.59*
	Left	18	20	

*: chi-square test; #: Mann-Whitney U test

patients transfused) was evaluated using the chi-square test with Yates' correction for continuity, as non-continuous dichotomous data (13). Analysis involved the use of the R Development Core Team (2008) statistical software (14). A p value less than 0.05 was considered statistically significant.

Results

Preoperatively, the haemoglobin level was significantly higher in the resurfacing group (13.1 g/dL, range 10.9 to 15.6) compared with conventional THAs (12.5 g/dL, range 10.4 to 15.2) ($p<0.02$). However, no statistically significant difference persisted at discharge: 10.2 g/dL (range 7.6 to 12.2) and 10.1 g/dL (range 7.2 to 12.3), respectively ($p<0.72$). The number of patients who received blood transfusions following surface and conventional arthroplasty was equivalent (36 and 35, respectively). However, the median requirement of transfusions was significantly higher ($p<0.04$) in the SRA group (900 mL, range 600 to 1500) in comparison with the THA group (600 mL, range 300 to 1500) (Table 2).

Consequently, resurfacing procedures showed an increased perioperative blood loss compared with stemmed THAs.

Discussion

Although associated with significant blood loss (2), total hip arthroplasty is a widely used surgical technique for the treatment of severe diseases of the hip joint (1). Due to the limited resection of the femoral bone, hip resurfacing has been developed as an effective alternative in young and active patients (15, 16). Comparable clinical and radiographic results of surface and conventional prostheses have been recently reported (9, 17-19). Hip resurfacing requires a more extensive surgical exposure compared with conventional THA, and an increased blood loss could occur. At present, only a few studies have provided data on blood management derived from comparisons of standard hip arthroplasty and resurfacing procedure, and the results are controversial.

Vail et al. retrospectively compared the outcomes of 52 patients (57 hips) who underwent surface arthroplasty with 84 patients (93 hips) who received conventional primary THAs during the same time period (7). The patients had a mean age of 47 years (range 22 to 64) and 57 years (range 17 to 92), respectively. Estimated blood loss was 418 mL and 412 mL, respectively. In a randomised prospective study by Vendittoli et al., the early clinical results of 103 SRAs and 102 cementless THAs were assessed (8). The mean volume of blood loss was 524 mL (range 100 to 2200) in SRA and 482 mL (range 100 to 3300) in THA. The mean transfusion rate was 4.7% and 9.7%, respectively, but no significant difference between the two groups was detected. In a small comparison study of 50 consecutive metal-on-metal surface replacements and 44 consecutive conventional total hip arthroplasties, hip resurfacing had less estimated intraoperative blood loss ($p=0.005$) and less postoperative drain output ($p=0.05$), resulting in 252 mL (719 mL for SRA, 971 mL for THA) less total blood loss ($p=0.0005$) and fewer blood transfusions: 12/50 (24%) for SRAs,

Table 2. Haemoglobin levels (Hb) and transfusion requirement in patients who received surface replacement arthroplasty (SRA) and conventional total hip arthroplasty (THA)

	SRA	THA	p (*/#)
Preoperative Hb [g/dL]	13.1 (10.9-15.6)	12.5 (10.4-15.2)	**0.02#**
Postoperative Hb [g/dL]	10.2 (7.6-12.2)	10.1 (7.2-12.3)	0.72#
Hb difference (pre-post) [g/dL]	3.0 (0.6-5.5)	2.5 (0.1-5.5)	**0.04#**
N patients transfused	36/42	35/41	0.96*
Blood transfusion [mL]	900 (600-1500)	600 (300-1500)	**0.04#**

*: chi-square test; #: Mann-Whitney U test

28/44 (64%) for THAs (p<0.0001) (9). In 2010, Smith et al. evaluated the clinical and radiological outcomes of resurfacing procedures compared with stemmed arthroplasties reviewing 46 studies (3799 SRAs and 3282 THAs) (10). Although THA was associated with a greater transfusion requirement (RR=0.4, CI 0.2-0.6, p<0.001), the related greater estimated blood loss (MD=-152.8, CI -305/-0.5, p<0.05) has to be regarded with caution, due to the high levels of statistical heterogeneity reported.

As little and inadequate data were available, we were encouraged to perform the present study. In our experience, the greater median requirement of transfusions after hip resurfacing (600 vs. 900 mL; p<0.04), despite higher preoperative levels of haemoglobin (13.1 vs. 12.5 g/dL; p<0.02) documents the larger amount of blood loss associated with SRA.

In the last decade, many different strategies regarding transfusion practice have been developed to reduce postoperative requirement of blood transfusions (less invasive surgical procedures, use of procoagulant drugs and topical haemostatic agents, perioperative blood salvage).

Moreover, the validity and effectiveness of a restrictive transfusion policy have been definitively demonstrated in a variety of clinical settings, and THA actually requires less red blood cell transfusions (20).

The weaknesses of this study include the non-randomized design and the limited patient population. However, the demographics were comparable, as the two groups were homogenous for all but age at operation, which conditioned the choice of the surgical procedure. Finally, the most relevant strength of the study is the occurrence that all operations were performed by the same surgical team using the same anterolateral approach.

In conclusion, recent tribological improvements make surface replacement arthroplasty a successful alternative to conventional THA in patients with end stage hip damage, with comparable long-term outcomes. However, the preservation of proximal femoral bone requires longer operative times and wider surgical exposures, and the need of increased blood transfusions has to be considered.

Further studies including larger patient populations are needed to definitively confirm these findings.

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Correspondence:
Dr Dario Regis
UOC Ortopedia e Traumatologia B -
Polo Chirurgico P Confortini,
Azienda Ospedaliera Universitaria Integrata di Verona,
Piazzale A Stefani 1, 37126 Verona, Italy
Tel. +390458123542
Fax +390458123578
E-mail address: regisdario@siot.it