

Influence of operation duration on perioperative morbidity in revision total hip arthroplasty

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This retrospective study investigated the impact of patient and procedure-related parameters on the complication rate following revision total hip arthroplasty. Complications included vessel and nerve damage, periprosthetic femoral fracture, wound infection, wound bleeding, prosthesis dislocations, thromboembolism, cardiac and pulmonary complications, and death. The influence of operation duration, gender, revision status, ASA classification, and type of fixation of the primary implant on the perioperative morbidity was investigated in a sample of 60 revision procedures (cemented stems, cemented or cementless cups). Odds ratio [OR] and 95% confidence interval [CI] were estimated with multiple regression models.

Perioperative morbidity was significantly correlated to operation duration (OR = 1.03 ; CI : 1.00-1.05), but not to age (OR = 1.01 ; CI : 0.93-1.09), gender (OR = 2.66 ; CI : 0.50-14.05), revision status (OR = 2.34 ; CI : 0.54-10.05), ASA classification (OR = 1.24 ; CI : 0.30-5.18), or type of fixation of the primary implant (OR = 2.49 ; CI : 0.47-13.17)

Duration of the revision operation appeared as a predictive parameter for perioperative morbidity in revision total hip arthroplasty in our study group.

INTRODUCTION

In contrast to primary total hip replacement, which is a routine procedure in the treatment of advanced hip osteoarthritis (13), revision total hip arthroplasty is still a demanding surgical procedure for the surgeon as well as for the patient (16).

Patients necessitating revision of their implants are on average older than those receiving a prima-

ry implant, and usually show higher morbidity. Furthermore the procedure of exchanging an artificial hip partially or totally is technically more difficult and has a higher potential for perioperative morbidity and mortality (12).

It was the purpose of this study to assess the incidence of perioperative complications in a sample of 60 revision total hip replacements. In addition the impact of operation duration, age of the patient, gender, revision status (revision of a primary implant or re-revision of an implant), preoperative risk classification according to the American Society of Anaesthesiologists (ASA classification), and type of fixation of the primary implant (cemented or hybrid) on the perioperative complication rate was investigated.

MATERIAL AND METHODS

Within this study, sixty revision total hip replacements were analysed. The indication for revision

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surgery was aseptic loosening of the prosthesis. Revision surgery was performed between September 1999 and May 2002 predominantly under regional anaesthesia. Depending on the bone stock, uncemented or cemented revision implants were inserted. Bone defects were bridged with allogenic bone. To improve comparability, only revisions of fully cemented and hybrid (cemented stem, uncemented cup) total hip replacements were assessed and revisions of THA with uncemented stems were excluded because, in our experience, removal of a cemented stem appeared as the main factor in the occurrence of intraoperative morbidity and complications and the average duration of surgery as well as the average intra-operative blood loss were similar for hybrids and fully cemented prostheses.

The surgical procedure for all investigated hips was through a standard lateral Bauer approach (2). One surgeon (S.K.), experienced in revision total hip arthroplasty, performed all procedures. In all cases both stem and cup were replaced because both showed radiological signs of aseptic loosening.

Difficulty of the revision surgery varied considerably. We did not perform a specific grading of surgical severity, since the available radiographic severity evaluation systems are unreliable (3). Technical complications (dislocation, arterial and nerve damage, fracture, bleeding) and complications related to the general health condition (infection, death, cardiac and pulmonary morbidity) were not differentiated due to the specifics of the statistical method applied (multivariable logistic regression with dichotomous documentation of data).

The routine prophylactic DVT program consisted in mobilisation from the first postoperative day and a daily dose of low molecular weight heparin.

Extracted variables

The following variables were extracted out of the patients' notes: Age of the patient (years), gender (female vs. male), perioperative risk-status according to the classification (grade 1 to 4) of the American Society of Anaesthesiologists (ASA classification), preoperative revision status of the hip (primary implant vs. revision implant exchanged), type of fixation of the implant (hybrid vs. cemented), intraoperative blood loss (ml), and duration of the revision operation (minutes).

Perioperative complications

The following complications occurring during the revision procedure and/or within the first three postope-

rate weeks were defined as perioperative complications and documented dichotomously with regard to their occurrence: vessel damage requiring vascular surgery, femoral or sciatic nerve damage, periprosthetic femoral fracture, wound infection requiring antibiotics or revision, excessive bleeding requiring reintervention, prosthetic dislocation, thromboembolism, cardiac and pulmonary complications followed by ICU treatment, and death.

Thromboembolic complications occurring after 21 days were not documented since patients were discharged to rehabilitation hospitals and could not be followed up. Thromboembolism itself was documented by ultrasound, phlebography or spiral CT-scanning.

Statistical analysis

Multivariable logistic regression was used to analyse the association between the target variable (perioperative complication; yes/no) and a set of independent variables (age, gender, ASA classification, preoperative revision status, fixation of the implant, operating time). The likeliness of perioperative complications was estimated by odds ratios and their 95% confidence interval. In the full model, each variable was controlled for all other variables in the model. Finally, stepwise regression procedure was applied to find the best-fitted, most parsimonious model that best describes the association between perioperative complications and the independent variables (final model). Statistical analysis was performed using the SAS software (version 8.10, SAS Institute, Cary, NC, USA).

RESULTS

The descriptive data of all sixty cases are listed in table I. More patients were female (60%) than male (40%) and most had an ASA Classification of either grade two (58.3%) or grade three (40%). Primary revisions accounted for 71.7% of the cases. The average operating time (155 minutes) was more or less similar for hybrids and fully cemented prostheses. In addition, the average intraoperative blood loss was similar for both procedures (2500 ml). Periprosthetic fracture (n = 4, 6.7%) as the major intra-operative complication did not markedly influence the average operating time (152 minutes, range: 120 to 198 minutes), where-

Table I. — Descriptive data of the revised 60 total hip replacements

Variable	Parameter
Age	mean : 72.8 years ; range : 41 to 89 years
Gender	36 (60.0%) female 24 (40.0%) male
ASA Classification	1 (1.7%) 1 35 (58.3%) 2 24 (40.0%) 3 0 4
Pre-operative revision status	43 (71.7%) primary implants 17 (28.2%) revision implants
Type of fixation	31 (51,7%) hybrid prostheses 29 (48.3%) fully cemented prostheses
Operating time	mean : 155 minutes [cemented : 157 minutes ; hybrid : 153 minutes] ; range : 75 to 240 minutes
Intraoperative Blood loss	mean : 2500 ml [equal for hybrid + cemented] ; range : 800 to 12000 ml

Table II. — Descriptive data : Absolute and relative number of perioperative complications, n = 60

Variable	n	%
Vessel damage (requiring vascular surgery)	0	0
Nerve damage (femoral/sciatic nerve)	4	6.7
Periprosthetic femoral fracture	4	6.7
Wound infection (requiring revision/antibiotics)	1	1.7
Bleeding (requiring revision)	2	3.3
Prosthetic dislocations	4	6.7
Thromboembolism	2	3.3
Cardiac complications (requiring ICU treatment)	0	0
Pulmonary complications (requiring ICU treatment)	0	0
Death	1	1.7

as the average intra-operative blood loss was distinctly increased (3175 ml, range : 2700 to 3500 ml).

Major complications occurred with different frequencies within the sixty revision total hip replacements. The absolute number of each perioperative complication is listed in table II. Overall, 17 major perioperative complications (28.3%) occurred in 15 patients (25%). One patient with a fully cemented implant showed both a pulmonary complication and wound infection and one patient from the hybrid group developed fracture and dislocation. One patient died from a cause related to the surgical procedure (1.7%).

The impact of each independent variable on the target variable and the perioperative complication rate is listed in table III.

In the final best fitting and most parcimonious model, only duration of the revision operation remained significantly correlated to the incidence of peri-operative complications. Each additional minute of operating time was correlated to a 3% increase of peri-operative complications (see table IV).

DISCUSSION

Primary total hip replacement is established worldwide as a standard orthopaedic procedure

Table III. — The impact of the investigated parameters on the target variable [= perioperative complications], logistic regression, n = 60

Variable	Perioperative complications OR (95% CI)	
	crude	adjusted*
Age [years]	1.01 (0.93-1.09)	1.02 (0.94-1.10)
Gender [male]	2.66 (0.50-14.04)	2.74 (0.40-18.59)
ASA Classification [grade 1+2]	1.24 (0.30-5.18)	1.42 (0.25-8.14)
Preoperative revision status [primary implant]	2.34 (0.54-10.05)	1.76 (0.33-9.27)
Fixation of the primary implant [hybrid]	2.44 (0.55-10.82)	2.49 (0.47-13.17)
Operating time [minutes]	1.03 (1.00-1.05)	1.03 (1.00-1.05)

* : Each variable controlled for all other variables in the model.

Table IV. — The impact of the investigated parameters on the target variable [= perioperative complications], logistic regression, final model, n = 60

Variable	Perioperative complications OR (95% CI)
Operating time [minutes]	1.03 (1.00-1.05)

re (12). Results are generally regarded as satisfactory (8, 12). Revision total hip replacement however is still a demanding procedure with less satisfactory results. Although revision procedures are predominantly concentrated at surgical centers which have the logistic equipment as well as the clinical expertise for revision procedures (12), peri- and postoperative complication rates are still high. Complications predominantly include vessel and nerve damage, periprosthetic femoral shaft fracture, wound infection, wound bleeding, prosthetic dislocation, thromboembolism, cardiac and pulmonary complications, and death.

The complication rate assessed in our patient sample (table II) was similar to what was reported in recent literature. Kavanagh *et al* who studied 206 revision total hip replacements reported a frequency of femoral fracture of 3.6%, a deep infection rate of 1.2% and a postoperative dislocation rate of 9% (7). Wallensten and Olsson reported 3.3% infections in 40 revision procedures (15). Perka and co-workers analysed the influence of obesity on the perioperative morbidity and mortality

in 229 revision total hip arthroplasties and reported 50 intra- or postoperative complications, with an average of 0.22 per patient (11).

In other investigations, however, higher complication rates were reported (1, 6, 9, 10). Dandy and Theodorou described an infection rate of 17% (4) and Hunter *et al* a rate of 32% (6) in their study groups of patients undergoing revision total hip replacements. The reason for these differences remains unclear. Differences in the hospital equipment to manage these high-risk patients as well as upcoming complications and different training levels of surgeons performing this demanding operation might be responsible. This assumption is supported by the report of the German Quality Assurance Association "Bundesgeschäftsstelle für Qualitätssicherung GmbH" (8), stating that the number of postoperative dislocations and the infection rate following revision total hip replacement are significantly lower in centers with a high training level in revision surgery (more than 20 procedures per year) compared to hospitals with less than 20 revision procedures per year. The average postoperative dislocations rate was 3.7% (n > 20), versus 6.1% (n ≤ 20), and the average wound infection rate was 1.1% (n > 20), versus 2.0% (n ≤ 20).

It was a further purpose of this investigation to sort out, whether patient and procedure-related parameters have a significant impact on the complication rate. These parameters were duration of the revision operation, age of the patient, gender, revision status, grade in the ASA-Classification, and type of fixation of the primary implant.

Multiple logistic regression revealed that only duration of the revision operation was significantly correlated to peri-operative complications, as defined in our study. The other parameters had no statistically significant impact. To our knowledge this correlation has not been described yet. In a study of deThomasson *et al*, who investigated 181 revision total hip arthroplasties, the complication rate was significantly increased in patients graded ASA 3 or older than 75 years (5). The authors concluded that the patient's age and general health status are important factors in relation to complications. Strehle *et al* reviewed 53 revision total hip replacements and came to similar conclusions as to grading in the ASA classification (14). However all of their patients were octogenarians. Such conclusions cannot be drawn from the results of our study. The resulting discrepancy might be explained by the fact that the independent influence of each variable on the target parameter "peri-operative complications" was analysed separately in our study, whereas other investigations drew their conclusions out of the combination of high age (older than 80 years) and a high ASA-Classification only. Furthermore, our patient sample was much younger with an average age of 72.8 years and was predominantly classified ASA 2.

Since in this study the recorded and analysed parameters were limited to the essential ones, we are aware that our data have limited explanatory power. With this study design, we were able to take into account confounders (age, gender, ASA-Classification, revision status, and fixation of the primary implant) which are considered to be important. However, additional confounders not included in the study may exist that might significantly influence complications during revision total hip replacements, and could possibly modify the results of this retrospective analysis. In addition, intra-operative complications (e.g. femoral fracture or multiple complications), which might result in a different level of morbidity, were not taken into consideration specifically due to the statistical method applied (multivariable logistic regression with dichotomous documentation of data). Having these limitations in mind, our findings demonstrate the important role of operation duration on the

perioperative complication rate in revision total hip arthroplasty.

Severity of surgery is commonly believed to strongly determine the risk for complications. Our investigation did not quantify this severity due to the lack of standardised measures, as mentioned above, which might be considered as a reason for systematic error. To reduce such a possibility of bias as far as possible, our patient sample was strongly standardised (one surgeon ; aseptic loosening only ; complete replacement with cemented and hybrid total hip arthroplasties only, using a standardised approach ; identical perioperative protocol).

To summarise, duration of the revision operation was the only parameter that was found to have a statistically significant correlation to the risk of complications in our study group of 60 revision total hip arthroplasties. Duration of the operation, which is affected by a number of patient and procedure-related factors, may be considered as a marker for the surgical severity of these revision procedures.

Therefore patients with an extended duration of revision surgery following failed total hip arthroplasty should be considered to be at higher risk in the postoperative care, irrespective of other patient and procedure-related parameters.

Further studies on this issue are advocated to confirm these conclusions and to investigate the underlying reasons for the correlation noted.

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