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Quality of Life and Cost-Effectiveness 1 Year After Total Hip Arthroplasty

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Abstract: Quality of life index (Quality Of Well-Being [QWB]) was used to calculate the costs per quality of well year (QWY) in total hip arthroplasty (THA) and compare it to other interventions. Ninety-eight primary and/or revision THA were reviewed. Patients had minimum 1-year follow-up. Quality of life index was used to calculate the costs per QWY in primary and revision THA. Preoperative QWB for primary THA was 0.52 ± 0.06 SD; revision was 0.53 ± 0.07 SD. The QWB change at 1 year for primary THA was 0.08 ± 0.13 SD; revision THA was 0.06 ± 0.14 SD. Calculated costs per QWY were $5572 for primary procedures and $10 775 for revision procedures. Cost-effectiveness of THA compares favorably with other surgical and medical interventions such as epilepsy ablation surgery and gastric bypass surgery. **Keywords:** cost-effectiveness, quality of life, primary hip arthroplasty, revision hip arthroplasty.

Health care expenditures will hit the 2.5 trillion dollars mark for the first time in history in 2009 and are expected to double by the year 2018 [1]. The Medicare program currently pays for about 60% of the arthroplasty procedures performed in the United States. In 2007, the combined expenditures of hip and knee arthroplasty surgery were estimated to have been approximately 15.6 billion dollars [2]. These costs were the highest of all elective procedures within the Medicare program. Medicare has labeled some procedures as overvalued and has cut surgeon reimbursement during the last several years. Arthroplasty surgery in particular has been targeted with reductions since 1992 that exceed 40% in 2007 [3].

Surgeons performing total hip arthroplasty, especially primary hip surgery, have had the deepest cuts. The reimbursement for a primary arthroplasty today is 39% less than what it was in 1991. The current reimbursement for revision hip arthroplasty is only 5% more than the reimbursement for primary hip arthroplasty [4]. The Medicare fee schedule is often done based solely on the time it takes to perform a procedure and little attention to the cost-effectiveness.

Cost-utility ratios allow an investigator to calculate the relative cost-effectiveness of health care interventions [5]. These ratios use measurements of the patient's quality of life before and after a medical or surgical intervention and are given as a numerical estimate of the patients quality of life [6]. These ratios use the concept of a quality well year (QWY). A *quality well year* is defined as a year of relatively symptom-free living that represents extreme satisfaction with one's quality of life. A quality well year is calculated using the improvement in quality of life measures such as the Quality of Well-Being Index (QWB index), the patient's life expectancy, and the health resources consumed during a specific intervention. The relative cost-effectiveness of numerous medical and surgical interventions have been assessed using these ratios [7]. The relative cost of a QWY is considered a cost-utility ratio as it allows cross comparison between costs and benefits of health interventions. Health policy analysts use the cost-utility ratios when planning health care delivery in populations.

In previous work, our group has reported on the quality of life immediately after knee arthroplasty and the dollar value of a QWY obtained by a total knee arthroplasty [8]. The objective of this study was to assess the relative cost-effectiveness of hip arthroplasty and compare it to other surgical and nonsurgical interventions.

Methods

Patient Selection

Two hundred seventy-six (276) consecutive hip procedures were performed. Sixty-five hemiarthroplasty procedures were excluded; 32 patients (64 procedures)

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had bilateral involvement. Nineteen revisions were excluded for being almost exclusively liner swaps. The remaining 98 hip arthroplasties were included in this analysis. All patients completed the QWB index preoperatively and at the 1-year follow-up. All data were collected prospectively. End-stage arthritis was diagnosed based on patient symptoms and radiographic findings; symptoms prompting surgical intervention included continuous rest-related and activity-related pains in the affected joint, inability to function, or failure of a previously replaced hip.

A total of 71 primaries and 27 revision procedures were included in the study. The 27 revisions included 5 conversions from hemiarthroplasties to total hips. The cohort was composed of 52 females (53.1%) and 46 males (46.9%). This included 35 females (49.3%) and 36 males (50.7%) who underwent primary hip arthroplasty and 17 females (63.0%) and 10 males (37.0%) who underwent revision hip arthroplasty (n = 98). Patient demographic information and diagnoses are shown in Tables 1 and 2.

Quality of Well-Being Index

Few instruments are available that quantify the quality of life before and after a medical intervention. The QWB index was developed by Kaplan [9]. This index has been widely used in assessing patients having cystic fibrosis [10,11], non–insulin-dependent diabetes [12], and several other disease processes and has also been used to assess differences between sex [13]. The QWB index has been validated in construct and content for the Anglo and Hispanic as well as black populations; therefore, English or a Spanish version was administered depending on the patient's ethnic origin. This questionnaire has also been used to compare disease characteristics between white and nonwhite populations [14].

The Quality of Well-Being is a relatively lengthy questionnaire that is divided into 3 scales: mobility scale, physical activity scale, and social activity scale. In addition, symptom problem complex is calculated based on the importance of different symptoms and their effects on a patient's life. For example, death has a value of 0.727, whereas using glasses or contact lenses has a value of 0.101. These weights have been obtained after statistically evaluating more than 10 000 patients [15]. Quality of Well-Being has been validated in construct and content.

Table 1. Sex, Racial, and Ethnic Distribution

	No. of Patients	%
Female	52	53.1
Male	46	46.9
White	81	82.7
Black	17	17.3
Hispanic	57	58.2
Non-Hispanic	41	41.8

Table 2. Diagnosis Distribution

Diagnoses	No. of Patients	%
Osteoarthritis	45	45.9
Rheumatoid	10	9.8
Osteonecrosis	10	9.8
Failed implant	23	23.4
Other	10	9.8

Economists generally seek to measure the quality of life using the concept a cost-utility index. These indexes use a measure to assess quality of life using a scale where 0 represents death and 1 is equivalent to full health. This is used to normalize quality of life and be able to compare medical and surgical interventions on a common scale [16].

An approach to scoring of the Short Form 36 (SF-36), reported in the Journal of Health Economics (2002), is a preference-based health utility index. This index, which is labeled the *SF-6D* is a new health state classification and utility scoring system based on 6 dimensions ("6D") of the SF-36 and permits a "bridging" transformation between SF-36 responses and uses. The SF-6D preferences can be applied to any SF-36 data set for purposes of economic evaluation (eg, estimation of quality-adjusted life years [QALYs]). The authors compared 2 instruments and concluded that there are significant problems with the cost utilities and QALYs estimated via SF-6D [17].

The Quality of Well-Being is better suited to policy analysis and to economic studies that require the calculation of a QALY. If the interest is in cost-effectiveness or cost-utility analysis, the consideration should be using the QWB or a related utility-based measure. If the interest is in reviewing a profile of outcomes, it may be better to use the well-established and well-validated SF-36 [18].

Resource Consumption Calculations

The chief financial officer at our hospital provided the charges and the cost-to-charge ratios for every fiscal quarter. These ratios are standard in the hospital industry and are calculated quarterly, based on the case mix for that particular quarter. The cost-to-charges ratios were then used as a multiplier on the charges to convert them to costs. Cost-utility ratios were then calculated.

Quality Well Year Calculations

The individual patients age was then used to calculate the patient's life expectancy using standard insurance tables [19]. The cost of a QWY was then calculated based on published mathematical relationships [20,21]. The mathematical equation is described as follows:

$$\text{QWY} = \Sigma\ (\text{total cost}) / \Sigma[(\Delta \text{QWB}) \times (\text{life expectancy})],$$

where Σ costs indicates the sum of the costs for each procedure and ΔQWB indicates the difference in QWB between the preoperative and the 1-year follow-up. The difference between the preintervention and the post-intervention QWB (ΔQWB) multiplied by the patient's life expectancy yields the number of QWYs obtained with the intervention in that particular patient. A *quality well year* is defined as a year of relatively little pain and a high quality of life. The cost of a QWY is then calculated by dividing the dollars spent to perform the intervention by the number of QWY obtained.

Statistical Analyses

All statistical analyses were performed using SPSS 12.0 (SPSS Inc, Chicago, Ill) for Windows. The analysis of variance was used to analyze nominal with continuous variables. Pearson correlations were used to analyze the relationships among continuous variables. Post hoc tests and multivariate analyzes were performed to control for age, ethnicity, and sex. A *P* value of less than .05 was considered significant.

Results

A total of 98 total hip arthroplasties were included in the study. The average preoperative QWB index total score for primary cases was 0.5 2 ± 0.06 SD and for revision cases was 0.53 ± 0.07 SD. The average postoperative QWB index total score was 0.60 ± 0.01 SD for primary and 0.60 ± 0.2 SD for revision cases. No statistically significant difference was seen in preoperative or postoperative QWB scores between primary and revision cases (*P* = .4 and .8, respectively). Conversely, there was a statistically significant difference between preoperative and postoperative QWB scores (*P* = .002) both for primary and revision cases (Table 3).

The average cost for all cases was $11 003 ± $3115 SD. The average cost of the primary procedures was $10 732 ± $2764 SD. The average cost for the revision procedures was $11 715 ± $3859 SD. The average cost of a QWY was $5572 for primary procedures and $10 775 for revision procedures. The calculated cost for a QWY in the combined group was $6668.

No statistically significant difference was seen in total costs, cost of a QWY, or preoperative and postoperative QWB scores with respect to procedure type (primary or revision), age, sex, race, ethnicity, or patient diagnosis.

Table 3. Quality of Well-Being Index Preoperative and Postoperative Scores (Scores ± SD, n = 98)

	QWB Preoperative	QWB Postoperative 1 y	*P*
Total QWB score	0.52 ± 0.07	0.6 ± 0.1	<.0001
Symptom complex domain	0.3 ± 0.04	0.26 ± 0.08	<.0001
Mobility domain	0.04 ± 0.03	0.02 ± 0.03	<.0001
Physical activity domain	0.07 ± 0.05	0.04 ± 0.03	<.0001
Social activity domain	0.07 ± .02	0.05 ± 0.03	<.0001

Discussion

The assessment of the cost-effectiveness and the impact on the quality of life of medical and surgical interventions is of utmost importance in this current era of cost containment. From a health policy standpoint, Laupacis et al [22] divided cost-outcome data into 4 groups. Very cost-effective interventions were those procedures costing less than $20 000; interventions costing from $20 000 to $100 000 were considered as moderately cost-effective; interventions costing more than $100 000 were possibly effective but expensive for society; and inefficient medical interventions.

Between February 2000 and February 2008, more than 500 articles were published in the medical literature on the cost-effectiveness of different medical and surgical interventions. The economical effectiveness of these interventions is extremely variable [23-31]. In the process of delineating specific cuts in the budget, little attention has been paid to the relative effectiveness of the interventions targeted for budget reductions. Cost-effective procedures should be rewarded economically, and procedures that are not cost-effective should be discouraged by low reimbursement.

The first cost-effectiveness study reported in the literature was done by Liang et al [5]. In their study, the cost-effectiveness of a total hip arthroplasty was determined using the Bush index of Well-Being scale (a unit of health status, the “Well-Year,” which expresses the output of health programs in the number of years and the health-related “quality of life” produced by a treatment or program [32]). This group concluded that total hip arthroplasty was cost-effective, but no specific dollar amount was published for cross comparison with other health interventions. The cost per QWY for primary total hip arthroplasty determined by Laupacis et al [22] was $27 139 during the first year and $8031 during the first 3 years (Canadian Dollars). Chang et al [33] published that a total hip arthroplasty in men aged 85 years or older cost society $80 000 dollars per QWY. They stated in their conclusions that numerous assumptions had been made to calculate the cost-utility ratio for hip arthroplasty but that it was an effective surgical intervention.

Data from the present study have calculated that primary and revision total hip arthroplasty costs society an average of $6700.00 per QWY. These calculated values compare relatively well with other surgical interventions such as epilepsy ablation surgery $18 331 to $32 000 per QWY [34,35] and extremely favorable with gastric bypass surgery that can range from $5000 up to $35 600 per QWY [36] (Fig. 1). Our current results as well as data reported previously, clearly demonstrate the cost-effectiveness of total hip arthroplasty surgery. Costing less than $30 000.00 per QWY, total hip arthroplasty is a bargain to society [37] and

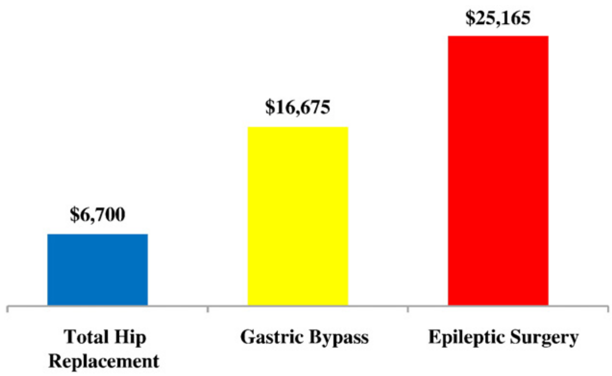

Fig. 1. Costs medical and surgical interventions.

significantly improves the quality of life of patients undergoing this surgical intervention.

Gill and Feinstein [15] published a comprehensive review on the instruments available to measure quality of life. Few of these instruments allow assessment of the cost-effectiveness of surgical or medical interventions and permit the economic evaluation of these procedures [15]. The QWB index was chosen by our group as a measure of quality of life because it also allows investigators to cross compare the effectiveness of total hip arthroplasty with different medical interventions. Cost-utility indices similar to the QWB and measures such as the SF-36 have been used previously in major orthopedic publications. Swiontkowski et al [38] published a review on the outcome and cost-effectiveness in trauma patients. In this study, they used the SF-36, the QWB, and the Sickness Impact Profile to assess trauma interventions. One of the strengths of our study involves precisely, the use of the QWB index. Although this index represents a global evaluation of the patients general health, we have previously demonstrated a statistically significant improvement in the QWB score after total knee arthroplasty at the 1-year period using this measure [8].

Patients with arthroplasty indications that do not have surgery would consume a significant amount of resources. These patients need transportation, living arrangements, as well as medications for their hip arthritis. The annual cost of nursing care for a nonindigent patient was estimated to be $30 000 per year. These cost savings are not taken into account in our calculations. Unfortunately, very few articles have been published with end-stage disease that can be compared, across different interventions and different specialties in medicine [39].

A major drawback of our analysis of revision procedures is that we had a small number of procedures (n = 27), and 5 of these procedures were conversions from hemiarthroplasties to total hips. Other drawbacks in our investigation include the use of cost-to-charge ratios to calculate the resource consumption, as well as the lack of inclusion of the postdischarge costs. These cuts include rehabilitation costs, as well as postoperative visits. In addition, professional fees were left out of our calculations.

Conclusion

Total hip arthroplasty procedures are extremely cost-effective when compared to other surgical and medical interventions in medicine.

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