

EARLY POSTOPERATIVE MORTALITY FOLLOWING TOTAL HIP ARTHROPLASTY IN A COMMUNITY SETTING: A SINGLE SURGEON EXPERIENCE

Kristin A. Miller, M.D., John J. Callaghan, M.D., Devon D. Goetz, M.D., Richard C. Johnston, M.D.

ABSTRACT

The senior author performed 4967 total hip arthroplasties, 4164 primary and 803 revision, between 1970 and 1996 in a community setting. All charts were evaluated for postoperative death including in-house, 30, 60, and 90 days following the procedure. 1.0 per cent of patients (42) died following a primary procedure and 0.87 per cent (7) died following a revision procedure within 3 months of surgery. The number of in-house deaths were 26 (0.52 per cent), including 21 in the primary group (0.5 per cent) and 5 in the revision group (0.62 per cent). In both the primary and revision situation and independent of co-morbidities, age greater than 70 years was significantly associated with increased risk for postoperative mortality ($p < 0.0001$), with 0.44% mortality in patients aged 70 years or younger (0.51 per cent primary and 0.00 per cent revision), and 1.45 per cent mortality in patients greater than 70 years of age (1.38 per cent primary and 1.86 per cent revision). This experience of a single surgeon with a high volume community practice performing both primary and revision total hip arthroplasty, documents a low but significant incidence of postoperative death in the first 3 months following total hip arthroplasty (0.98 per cent).

INTRODUCTION

Death during or shortly following the total hip arthroplasty procedure has been well-documented. However, there are few series of large numbers of patients where the incidence and etiology have been studied.

The purpose for this study was to retrospectively examine the causes for postoperative mortality in the in-house period and first 30, 60, and 90 days following total hip arthroplasty performed by a single surgeon in a community setting with a high volume practice over a 26 year period. Age at surgery, primary diagnosis, anesthesia method and comorbid conditions were evaluated in primary and revision cases, including those with hip fractures or malignancy. The information from this single surgeon's experience of 4967 total hip arthroplasties over 26 years with few changes in the procedure should provide a benchmark for comparison of mortality rates associated with total hip arthroplasty performed with other anesthetics, other surgical techniques, other postoperative management regimens and in similar (i.e., community) or varied (i.e., tertiary care) settings.

MATERIALS AND METHODS

Between 1970 and 1996, the senior one of us (R.C.J.) performed 4967 total hip arthroplasties on 3865 patients, 4164 primary and 803 revision cases. There were no changes made in surgical technique during this time. Anesthesia method consisted of a combination general anesthesia with spinal anesthesia employed for improved muscle relaxation during the procedure. Routine postoperative care included in-house dextran administration and aspirin, anti-embolic stockings, and multi-vitamins for 2 months postop. Patients with revision surgery also received oral antibiotic prophylaxis postoperatively for 6 months. Earlier mobilization postoperatively was begun in 1982. Primary diagnoses included primary osteoarthritis, post-traumatic arthritis, rheumatoid arthritis, congenital hip dysplasia, osteonecrosis, nonunion of the femoral neck, Legg Perthes, acetabular fracture with secondary osteoarthritis, slipped capital femoral epiphysis with secondary osteoarthritis, and malignancy. Utilizing a retrospective review of these records, those who died while in-house and within 30, 60, and 90 days of total hip arthroplasty

Corresponding author is

John J. Callaghan, M.D.
Department of Orthopaedics
University of Iowa Carver College of Medicine
200 Hawkins Drive
Iowa City, IA 52242
Office phone: (319) 356-3110
Fax: (319) 353-6754
email: john-callaghan@uiowa.edu

were analyzed according to age, weight, year of surgery, primary diagnosis, primary versus revision, comorbid conditions and anesthesia method. All patients had a preoperative medical evaluation by an internist which was recorded in the office chart. Autopsies were performed in 20% of cases, with the remainder of the causes of death determined by clinical diagnosis and death certificates. In addition, all patients, who have now been extensively databased, were reviewed to see if the date of death (of deceased patients) occurred within 3 months of their operations. Fisher's exact test was used to compare primary and revision cases with regard to age, year of death and comorbid conditions.

RESULTS

49 patients (0.98 per cent) died within 90 days of total hip arthroplasty, including 42 primary (1.0 per cent) and 7 revision (0.87 per cent). The average age at the time of surgery in the primary cases was 70 years, compared to the senior surgeon's overall age in the primary situation of 63 years. In revision cases, the average age at the time of surgery was 79 years, compared to an average age of 61 years in the overall revision population. There was a statistical difference in age > 70 years in both primary and revision procedures ($p < 0.0001$). There was no difference in death rate in primary vs. revision cases ($p = 0.825$).

Classification of the 4164 primary cases by primary diagnosis included 3211 primary osteoarthritis, 273 post-traumatic including pathologic fractures, 339 nonunion, 179 congenital hip dysplasia, 178 rheumatoid arthritis, 83 osteonecrosis, 28 Legg Perthes, 27 acetabular fracture with secondary osteoarthritis, 26 slipped capital femoral epiphysis with secondary osteoarthritis, and 159 other cases including cases of malignancy.

Classification of deaths by diagnosis for primary procedures included 26 in the osteoarthritis group (0.81 per cent), 7 post-traumatic (2.6 per cent), 2 acetabular fractures with secondary osteoarthritis (7.4 per cent), 1 rheumatoid arthritis (0.56 per cent), and 6 other (3.8 per cent). There was no statistical difference between primary diagnoses ($p = 0.0016$). Classification of deaths by reason for revision included 3 for aseptic loosening (1.0 per cent), 1 for septic loosening (0.1 per cent), 1 for recurrent dislocation (0.1 per cent), and 2 for femoral fracture (0.2 per cent).

Cause of death within 90 days postoperatively in primary cases included 12 myocardial infarction (0.28 per cent), 12 pulmonary embolism (0.28 per cent), 5 pneumonia (0.12 per cent), 4 congestive heart failure (0.09 per cent), 2 sepsis secondary to other infection (0.05 per cent), 1 respiratory arrest (0.02 per cent), 1 arrhythmia (0.02 per cent), 1 renal failure (0.02 per cent), 1

lung carcinoma (0.02 per cent), 1 suicide (0.02 per cent), and 2 multifactorial (0.05 per cent). Cause of death within 90 days postop in revision cases included 3 myocardial infarction (0.37 per cent), 1 pulmonary embolism (0.12 per cent), 1 pneumonia (0.12 per cent), 1 acute respiratory distress syndrome (0.12 per cent), and 1 hemorrhage (0.12 per cent) (Table I-V).

The number of in-house deaths were 26 (0.52 per cent), including 21 in the primary group (0.50 per cent) and 5 in the revision group (0.62 per cent). Most common causes for in-house deaths in the primary cases were 7 myocardial infarction (33 per cent), 8 pulmonary embolism (38 per cent), and 2 congestive heart failure (9 per cent), and in revision cases were 3 myocardial infarction (60 per cent), 1 pulmonary embolism (20 per cent), and 1 acute respiratory distress syndrome (20 per cent). There were no intraoperative deaths and cement was used in all cases. Average length of hospital stay was 14 days.

There were 27 deaths (0.54 per cent) noted within 30 days following surgery including in-house deaths, 22 in the primary group (0.52 per cent) and 5 in the revision group (0.62 per cent). Most common causes for 30-day deaths in the primary cases were myocardial infarction 7 (32 per cent), pulmonary embolism 9 (41 per cent), and congestive heart failure 2 (9 per cent), and in revision cases were 3 myocardial infarction (60 per cent), 1 pulmonary embolism (20 per cent), and 1 acute respiratory distress syndrome (20 per cent).

From 31-60 days, there were 15 deaths (0.30 per cent), including 14 in the primary group (0.34 per cent) and 1 in the revision group (0.12 per cent). Most common causes for death in the primary situation were pneumonia 5 (36 per cent), myocardial infarction 3 (21 per cent), and pulmonary embolism 2 (15 per cent). Most common cause of death in the revision situation from 31-60 days was pneumonia 1 (100 per cent).

There were 7 deaths that occurred 61-90 days following surgery (0.14 per cent), 6 in the primary group (0.14 per cent) and 1 in the revision group (0.12 per cent). Most common causes for death in these primary cases included myocardial infarction 2 (33 per cent), pulmonary embolism 1 (16 per cent), and in the revision group was a single pulmonary embolism (100 per cent)

Myocardial infarction was the most common cause of death overall (30.6 per cent), with fatal myocardial infarctions occurring in 12 within the primary group (0.28 per cent) and 3 in the revision group (0.37 per cent). Cardiac related complications (myocardial infarction, congestive heart failure and arrhythmia) accounted for 40 per cent (17 of 42) of primary deaths. In the primary situation, 8 fatal pulmonary emboli were noted

during the first 15 years of the senior surgeon's practice, whereas 3 were documented in the last 11 years. In addition, 34 of the 49 deaths (1.15 per cent mortality) occurred in the first 15 years, versus 15 deaths in the last 11 years (0.74 per cent mortality). The demographics of the postoperative deaths by time following surgery are recorded in Tables 1-4.

DISCUSSION

Postoperative mortality following total hip arthroplasty has been documented in many hip arthroplasty series.¹⁻¹⁰ Fatal pulmonary emboli has been the focus of most studies.^{1,3,10} However, the literature is lacking in the study of postoperative mortality in a single surgeon's or multiple surgeons' practice involving a high volume of cases over an extended period of time.² The purpose of the present study was to evaluate the early mortality following total hip arthroplasty in a community setting performed by a high volume surgeon.

The incidence of mortality within 90 days after total hip replacement was 0.98 per cent in the present study. A significant correlate to the mortality rate was age greater than 70 years at the time of surgery, making the risk of mortality 0.44 per cent in those 70 years old or less, and 1.45 per cent risk of mortality in those greater than age 70. Death rates were similar for primary and revision cases. The lesser incidence of mortality following revision total hip replacement may represent the health of that population deciding to have the procedure.

Myocardial infarction, the most common cause of death (30.6 per cent) and cardiac related complications accounted for 40 per cent (17 of 42) of deaths following primary arthroplasties. Previous myocardial infarction, diabetes mellitus, and peripheral vascular disease in the patient histories did not correlate with increased incidence of fatal myocardial infarction following total hip replacement. Fatal pulmonary emboli decreased by a factor of 5 within the last 11 years of practice, likely related to earlier postoperative mobilization.

Dearborn & Harris² studied 2736 total hip arthroplasty procedures, and reported a 90-day mortality of 0.2 in per cent primary and 0.7 per cent in revision cases. These values are lower than the 1.0 per cent and 0.87 per cent, respectively, observed in this study. How-

ever, the average age of their patients was 59 years, well below the 70 year average of the present study. This difference may be related to the difference in practices between a community and tertiary care setting. Parvizi et al⁴ reported a .29% 30 day mortality rate in the Mayo Clinic review once again a review in a tertiary center.

Sharrock⁶ studied 15559 total hip arthroplasty and total knee arthroplasty cases, and noted a 3-fold decrease in in-house mortality associated with a change to epidural anesthesia with postoperative epidural analgesia (0.10 per cent from 0.36 per cent). Patients with fractures and metastatic cancer diagnoses were excluded.

Whittle⁹ studied 6385 total hip arthroplasty cases in 1992 for 30 day postoperative mortality, and found mortality to be 0.34 per cent in patients aged 66-69 years and 3.75 per cent in patients aged 80 years or more, with the average mortality of 0.95 per cent. Patients with fractures were excluded from the analysis. Our study corroborates the increase in mortality with increasing age. Because the patient population undergoing elective or emergent total hip arthroplasty tends to be late middle age to elderly, the mortality rate in the general population not undergoing surgery must also be factored. Soderman⁷ studied mortality following total hip arthroplasty in comparison with the general population, and found that the mortality for primary and revision arthroplasty patients was lower than an age- and sex-matched population.

Numerous studies have noted a significant increase in mortality following total hip arthroplasty in patients whose primary diagnoses included fractures and malignancy.⁵ The present study did not find a significant difference in mortality between primary diagnoses, likely due to the much greater number of cases done for primary osteoarthritis versus post traumatic arthritis or malignancy conditions.

This study of a high volume community practice should provide a benchmark for comparison of mortality rates following total hip arthroplasty in other community settings as well as tertiary care settings. It should also provide a historical control for cases where newer anesthetic techniques and postoperative regimens are used.

TABLE 1
Total In-House Postoperative Deaths:

Primary Cases

Patient	Primary Diagnosis	Age at Surgery	Sex	Death on Postop Day	Cause of Death
1	Primary Osteoarthritis	74	M	12	Pulmonary Embolism
2	Primary Osteoarthritis	72	F	3	Congenital Heart Failure
3	Primary Osteoarthritis	75	F	0	Myocardial Infarction
4	Primary Osteoarthritis	75	M	2	Myocardial Infarction
5	Primary Osteoarthritis	80	M	18	Pulmonary Embolism
6	Primary Osteoarthritis	77	M	2	Myocardial Infarction
7	Primary Osteoarthritis	77	F	15	Pulmonary Embolism
8	Post Traumatic	88	F	5	Myocardial Infarction
9	Other	87	F	4	Myocardial Infarction
10	Primary Osteoarthritis	58	M	12	Pulmonary Embolism
11*	Primary Osteoarthritis	51	F	28	Pulmonary Embolism
12	Malignancy	76	M	16	Arrhythmia
13	Primary Osteoarthritis	80	F	7	Respiratory Arrest
14	Primary Osteoarthritis	81	M	15	Pulmonary Embolism
15*	Primary Osteoarthritis	73	M	14	Pulmonary Embolism
16	Primary Osteoarthritis	78	M	3	Myocardial Infarction
17	Primary Osteoarthritis	66	M	14	Pulmonary Embolism
18	Primary Osteoarthritis	80	F	27	Congenital Heart Failure
19**	Primary Osteoarthritis	85	M	21	Cardiac Failure
20	Post Traumatic	71	F	18	Myocardial Infarction
21	Post Traumatic	88	F	20	Sepsis

Revision Cases

Patient	Secondary Diagnosis	Age at Surgery	Sex	Death on Postop Day	Cause of Death
1	Aseptic Loosening	81	M	5	Adult Respiratory Distress Syndrome
2	Post Traumatic	87	M	1	Hemorrhage
3	Aseptic Loosening	85	F	9	Myocardial Infarction
4	Aseptic Loosening	73	M	0	Myocardial Infarction
5	Aseptic Loosening	77	M	2	Myocardial Infarction

*Patient underwent bilateral procedures within 30 day period.

**Patient underwent abdominal surgery postop within 30 day period.

TABLE 2
Total 30 Day Postoperative Deaths Including In-House Deaths:

Primary Cases

Patient	Primary Diagnosis	Age at Surgery	Sex	Death on Postop Day	Cause of Death
1	Bone Mets	56	F	20	Pulmonary Embolism
2	Primary Osteoarthritis	74	M	12	Pulmonary Embolism
3	Primary Osteoarthritis	72	F	3	Congenital Heart Failure
4	Primary Osteoarthritis	75	F	0	Myocardial Infarction
5	Primary Osteoarthritis	75	M	2	Myocardial Infarction
6	Primary Osteoarthritis	80	M	18	Pulmonary Embolism
7	Primary Osteoarthritis	77	F	15	Pulmonary Embolism
8	Primary Osteoarthritis	77	M	2	Myocardial Infarction
9	Post Traumatic	88	F	5	Myocardial Infarction
10	Other	87	F	4	Myocardial Infarction
11	Secondary Osteoarthritis	58	M	12	Pulmonary Embolism
12*	Secondary Osteoarthritis	51	F	28	Pulmonary Embolism
13	Malignancy	76	M	16	Arrhythmia
14	Primary Osteoarthritis	80	F	7	Respiratory Arrest
15	Primary Osteoarthritis	81	M	15	Pulmonary Embolism
16*	Primary Osteoarthritis	73	M	14	Pulmonary Embolism
17	Primary Osteoarthritis	78	M	3	Myocardial Infarction
18	Primary Osteoarthritis	66	M	14	Pulmonary Embolism
19	Primary Osteoarthritis	80	F	27	Congenital Heart Failure
20**	Primary Osteoarthritis	85	M	21	Cardiac Failure
21	Post Traumatic	71	F	18	Myocardial Infarction
22	Post Traumatic	88	F	20	Sepsis

Revision Cases

Patient	Secondary Diagnosis	Age at Surgery	Sex	Death on Postop Day	Cause of Death
1	Aseptic Loosening	81	M	5	Adult Respiratory Distress Syndrome
2	Post Traumatic	87	M	1	Hemorrhage
3	Aseptic Loosening	85	F	9	Myocardial Infarction
4	Aseptic Loosening	73	M	0	Myocardial Infarction
5	Aseptic Loosening	77	M	2	Myocardial Infarction

*Patient underwent bilateral procedures within 30 day period.

**Patient underwent abdominal surgery postop within 30 day period.

TABLE 3
Total 31-60 Day Postoperative Deaths:

Primary Cases

Patient	Primary Diagnosis	Age at Surgery	Sex	Death on Postop Day	Cause of Death
1	Bone Mets	61	F	56	Lung Cancer
2	Post Traumatic	72	M	35	Pneumonia
3	Post Traumatic	63	M	34	Pulmonary Embolism
4	Post Traumatic	78	F	39	Pneumonia
5	Primary Osteoarthritis	73	M	35	Pneumonia
6*	Primary Osteoarthritis	80	M	39	Sepsis
7	Primary Osteoarthritis	65	M	39	Myocardial Infarction
8	Primary Osteoarthritis	68	M	58	Suicide
9	Primary Osteoarthritis	78	M	37	Multifactorial
10	Primary Osteoarthritis	80	M	33	Myocardial Infarction
11	Primary Osteoarthritis	78	F	38	Myocardial Infarction
12	Primary Osteoarthritis	79	F	40	Pneumonia
13	Primary Osteoarthritis	76	M	51	Pulmonary Embolism
14*	Rheumatoid Arthritis	70	F	51	Pneumonia

Revision Cases

Patient	Primary Diagnosis	Age at Surgery	Sex	Death on Postop Day	Cause of Death
1	Dislocation	80	M	52	Pneumonia

*Patient underwent bilateral procedures within 30 day period.

TABLE 4
Total 61-90 Day Postoperative Deaths:

Primary Cases

Patient	Primary Diagnosis	Age at Surgery	Sex	Death on Postop Day	Cause of Death
1	Post Traumatic	70	M	71	Renal Failure
2	Primary Osteoarthritis	74	M	83	Myocardial Infarction
3	Bone Mets	79	M	74	Myocardial Infarction
4	Primary Osteoarthritis	87	M	77	Multifactorial
5	Primary Osteoarthritis	78	M	74	Pulmonary Embolism
6	Septic Hip	94	F	73	Congenital Heart Failure

Revision Cases

Patient	Primary Diagnosis	Age at Surgery	Sex	Death on Postop Day	Cause of Death
1	Aseptic Loosening	73	M	74	Pulmonary Embolism

REFERENCES

1. **Cleves MA, Golden WE:** Assessment of HCFA's 1992 Medicare Hospital Information Report of Mortality Following Admission for Hip Arthroplasty. *Health Serv Res* 31:39-48, 1996.
2. **Dearborn JT, Harris WH:** Postoperative Mortality after Total Hip Arthroplasty. *J Bone Joint Surg* 80-A: 1291-1294, 1998.
3. **Huber O, Bounameaux H, Borst F, Rohner A:** Postoperative Pulmonary Embolism After Hospital Discharge. An Underestimated Risk. *Arch Surg* 127:310-313, 1992.
4. **Parvizi J, Johnson BG, Rowland C, Ereth MH, Lewallen DG:** Thirty-day Mortality After Elective Total Hip Arthroplasty. *J Bone Joint Surg* 83-A:1524-1528, 2001.
5. **Schoning B, Schulitz KP, Pfluger T:** Statistical Analysis of Perioperative and Postoperative Mortality of Patients With Prosthetic Replacement of the Hip Joint. *Arch Orthop and Traumatic Surg* 97:21-26, 1980.
6. **Sharrock NE, Cazan MG, Hargett MJL, William-Russo PG, Wilson Jr PD:** Changes in Mortality After Total Hip and Knee Arthroplasty over a Ten-Year Period. *Anesth Analg* 80:242-248, 1995.
7. **Soderman P, Malchau H:** Mortality After Total Hip Arthroplasty Compared to the Normal Population. *Acta Ortho Scand*, In press.
8. **Taylor HD, Dennis DA, Crane HS.:** Relationship Between Mortality Rates and Hospital Patient Volume for Medicare Patients Undergoing Major Orthopaedic Surgery of the Hip, Knee, Spine, and Femur. *J Arthroplasty* 12:235-242, 1997.
9. **Whittle J, Steinberg EP, Anderson GF, Herbert R, Hochberg MC:** Mortality After Elective Total Hip Arthroplasty in Elderly Americans. *Clin Ortho Related Research* 295:119-126, 1993.
10. **Wroblewski BM, Siney PD, White R:** Fatal Pulmonary Embolism After Total hip Arthroplasty. Seasonal Variation. *Clin Orthop* 276:222-224, 1992.