



Mortality After Shoulder Arthroplasty



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ABSTRACT

One year post-operative mortality among patients with primary elective total shoulder arthroplasty (ETSA) and traumatic shoulder arthroplasty (TSA) were compared to the general population of a large healthcare system. Standardized mortality ratios (SMRs) and 95% confidence intervals (CIs) were calculated. 614 ETSA patients, 1.0% one year mortality, and 168 TSA patients, 5.4% mortality rate, were evaluated. Patients with ETSA (SMR = 0.4, 95% CI 0.1–0.7) had lower odds of mortality than expected, while patients with TSA (SMR = 1.8, 95% CI 0.6–3.0) did not have higher than expected odds of mortality compared to the reference population. Understanding excess mortality following shoulder arthroplasty surgery allows providers to evaluate current practices and identify ways to optimize patients prior to surgery.

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The reported rates of post-operative mortality associated with shoulder arthroplasty (SA) are generally low (0%–0.8%) [1–5]. In comparison to other arthroplasty procedures, like knee arthroplasty, patients typically have comparable if not lower mortality and morbidity rates post-operatively [1]. While the risk of mortality after hip or knee arthroplasty surgery in patients with elective or traumatic indications compared to the general population is well understood in the United States [6–8], it has not been examined in patients who underwent SA. It is likely that the possibility of excess mortality associated with SA has not been examined because of the challenges associated with evaluating and monitoring large representative cohort of patients with these procedures.

The purpose of this study was to evaluate the one year post-operative mortality of patients that underwent elective total SA (ETSA) and traumatic SA (TSA) in a large integrated healthcare system.

Methods

Study Design, Sample, Data Collection

A retrospective analysis of SA procedures performed in 2010 within a large integrated healthcare system was conducted. Both primary ETSA (N = 614) and SA due to trauma (N = 168) (either total SA or

hemiarthroplasty, referenced here as TSA) were included. The indications for surgery in the ETSA group were osteoarthritis (75.1%, N = 461), rotator cuff arthropathy (19.1%, N = 117), osteonecrosis (2.4%, N = 15), rheumatoid arthritis (2.0%, N = 12), and others (1.5%, N = 9). Revision SA procedures were not included in order to keep the sample homogenous.

The institutional Shoulder Arthroplasty Registry was used to identify the procedures. Procedures performed within the two largest regions participating in the registry, Southern and Northern California, were included [9,10]. The integrated healthcare system covers over 6.6 million people in the regions included and is socio-demographically representative of the geographical areas it covers [11–13]. Detailed information on the data collection procedures, coverage, and participation of the registry have been previously published [9].

The type of procedure (traumatic or elective), volume of procedures, age, gender, and one year mortality of patients were obtained from the registry. One year post-operative mortality was the endpoint of the study and is prospectively monitored by the registry.

Reference Group

The reference population used for the study was the membership population of the integrated healthcare system for 2010 (Table 1). Data on the membership and mortality for the entire cohort were obtained from an administrative database within the organization, which monitors the institution's membership and service utilization.

Statistical Analysis

Gender and age specific volumes as well as one year mortality rates for each of the groups (ETSA and TSA) were summarized. For the

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Table 1

2010 Kaiser Permanente California (Southern and Northern Regions) Membership, Deaths and Death Rates/100,000 Members by Age Groups.

	Total ^a			Females			Males		
	N	Deaths	Rate	N	Deaths	Rate	N	Deaths	Rate
0–1 year	136,103	325	238.8	66,350	54	81.4	69,734	64	91.8
1–4 years	244,764	43	17.6	119,048	13	10.9	125,697	24	19.1
5–14 years	905,751	103	11.4	443,286	39	8.8	462,402	52	11.2
15–24 years	878,984	541	61.5	442,627	121	27.3	436,239	247	56.6
25–34 years	804,613	584	72.6	431,928	143	33.1	372,624	276	74.1
35–44 years	901,831	1141	126.5	468,888	359	76.6	432,880	502	116.0
45–54 years	1,005,457	2965	294.9	522,320	964	184.6	483,036	1349	279.3
55–64 years	881,361	5840	662.6	466,609	2043	437.8	414,476	2938	708.8
65–74 years	487,842	7738	1586.2	260,782	3154	1209.4	226,932	3865	1703.2
75–84 years	263,765	11,483	4353.5	146,608	5217	3558.5	117,077	5549	4739.6
85 years and over	94,796	12,485	13,170.4	60,159	6701	11,138.8	34,595	4880	14,106.1
All ages	6,605,271	43,250	654.8	3,428,605	18,808	548.6	3,175,692	19,746	621.8

^a There were missing gender (N = 11,334; 0.2%) and age (N = 37,580; 0.6%) information, and as a result numbers do not perfectly add up.

reference population the end of year membership was used as the denominator and mortality rate was calculated from the number of deaths in 2010 divided by the number of members in the end of year membership estimates. Expected deaths were calculated by multiplying the reference population death rate of each category by the number of cases for a specific procedure group. Standardized mortality ratios (SMRs, observed deaths/expected deaths) and 95% confidence intervals (CI) using indirect standardization methods were calculated. Excess deaths were calculated from the difference of observed and expected deaths. All results are presented for the overall group by trauma or elective group, by age, as well as by gender. Analyses were performed using SAS (Version 9.2, SAS Institute, Cary, NC, USA).

Results

The overall one year mortality rate of ETSA was 1.0% and of TSA was 5.4%. Table 2 has mortality rates by age and gender groups. The median time from surgery to death was 244 (interquartile range (IQR) 211–295) days for the ETSA group and 149 (IQR 63–261) days post-operative for the TSA group.

Overall, the gender and age adjusted odds of death within one year after ETSA were 60% (SMR = 0.4, 0.1–0.7) lower in these patients than patients from the reference population. The gender and age adjusted odds of one year mortality after TSA compared to the reference population were not significantly different (SMR = 1.8, 95% CI 0.6–3.0), Fig 1. No statistically significant differences between

the SMR of difference age and gender groups were observed in either the ETSA or TSA group (Table 3).

Discussion

This study found that patients undergoing primary ETSA had a lower than expected mortality at one year post-operation and those undergoing TSA did not have a significantly different mortality risk than the study's reference population.

To our knowledge, previous studies have not evaluated the risk of mortality associated with elective SA one year post-operatively compared to the general population. However, previous studies have reported similarly low mortality rates in patients undergoing elective SA [1,3]. Most studies report a low mortality rate of 0%–0.8% [1–5,14] associated with SA, which varies depending on whether in-hospital, 30 or 90-day mortality was reported. Additionally, certain studies have reported that the mortality rates after SA are lower than other arthroplasties during similar periods of time [1,3]. Because of the previously reported lower incidence of death among total knee and hip arthroplasty patients [6,7,15] our observation of a lower risk of death among SA patients when compared to the general population is not unexpected. A 60% (SMR = 0.4) lower than expected mortality in patients having elective SA was observed in our 2010 cohort of patients. This could be explained by patient selection for surgery, increased medical contact during the perioperative time period that results in identification of acute medical issues, or better management of chronic conditions in these patients.

Table 2

Overall and Gender Specific Number of Primary Elective Total Shoulder Arthroplasty and Traumatic Shoulder Arthroplasties, Deaths, and Excess Deaths Within One Year of Procedure by Age Group, 2010.

	Total Cases			Females		Males	
	N	Deaths N (%)	Excess Deaths	Deaths N (%)	Excess Deaths	Deaths N (%)	Excess Deaths
Elective, Primary							
25–34 years	2	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0
35–44 years	5	0 (0.0)	0.0	0 (0.0)	0.0	0 (0.0)	0.0
45–54 years	24	0 (0.0)	–0.1	0 (0.0)	0.0	0 (0.0)	–0.1
55–64 years	149	2 (1.3)	1.0	2 (3.3)	1.7	0 (0.0)	–0.6
65–74 years	234	3 (1.3)	–0.7	3 (2.5)	1.5	0 (0.0)	–1.9
75–84 years	181	0 (0.0)	–7.9	0 (0.0)	–4.0	0 (0.0)	–3.2
85 years and over	19	1 (5.3)	–1.5	0 (0.0)	–1.6	1 (20.0)	0.3
Total	614	6 (1.0)	–9.2	5 (1.6)	–2.4	1 (0.3)	–5.5
Traumatic							
35–44 years	3	0 (0.0)	0	0 (0.0)	0	0 (0.0)	0
45–54 years	15	1 (6.7)	1	1 (12.5)	1	0 (0.0)	0
55–64 years	45	1 (2.2)	0.7	1 (2.8)	0.8	0 (0.0)	–0.1
65–74 years	47	2 (4.3)	1.3	0 (0.0)	–0.4	2 (20.0)	1.8
75–84 years	43	2 (4.7)	0.1	1 (2.9)	–0.2	1 (12.5)	0.6
85 years and over	15	3 (20.0)	1	1 (8.3)	–0.3	2 (66.7)	1.6
Total	168	9 (5.4)	4.1	4 (3.1)	0.9	5 (12.5)	3.9

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