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How Do Previous Solid Organ Transplant Recipients Fare After Primary Total Knee Arthroplasty?

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ABSTRACT

Introduction: Total knee arthroplasty (TKA) has been proven to increase knee outcome scores after solid organ transplantation (SOT), but many authors are concerned about a higher complication rate. The purpose of this study is to evaluate the complication profile of TKA after previous SOT.
Methods: A search of the entire Medicare database from 2005 to 2011 was performed using International Classification of Disease, version 9, codes to identify 3339 patients who underwent TKA after 1 or more solid organ transplants including the kidney (2321), liver (772), lung (129), heart (412), and pancreas (167). A cohort of 1,685,295 patients served as a control with minimum 2-year follow-up. Postoperative complications at 30-day, 90-day, and overall time points were compared between the 2 cohorts.
Results: Patients with any SOT were younger (age: <65, odds ratio [OR]: 6.58, $P < .001$), male (OR: 1.88, $P < .001$), and medically complex (significant increase in 28 of 29 Elixhauser comorbidities, $P < .05$). There was a significant increase ($P < .05$) in 11 of 13 (84.6%) recorded postoperative medical complications rates at 90 days. There was a significant increase overall in periprosthetic infection (OR: 2.11, $P < .001$), periprosthetic fracture (OR: 1.78, $P < .001$), and TKA revision (OR: 1.36, $P < .001$). When analyzed by individual organ, heart and lung transplants carried the fewest medical and surgical complications.
Conclusion: The results of this study demonstrate that patients with previous SOT who undergo elective primary TKA have more postoperative complications in the global period and at short-term follow-up. Yet, complication profiles by individual organ varied significantly.

Since 2003 at least 25,000 solid organ transplants (SOTs) have been performed annually in the United States, with 27,036 completed in 2014. While this number has reached a plateau because of organ availability, evolutions in procurement, implantation technique, and posttransplant immunosuppression have dramatically increased recipient survivorship. The majority of organ transplants were in patients aged >50 years, and with the exception of lung and intestine transplantation, 5-year survival rates for this age group average ≥70% [1]. Small retrospective cohort studies have shown that total knee arthroplasty (TKA) in patients with a prior SOT is a worthwhile endeavor as the rate of patient reported good/excellent outcomes after kidney, liver, and lung transplantation ranges from 92% to 100% [2]. In addition, Knee Society scores in these patients were significantly increased after TKA compared to preoperative values (Knee Society score, kidney: 51.2-89.2, liver: 55.0-93.8, and lung: 58.2-92; all $P < .05$) [2]. Promising results have also been shown in prior cardiac and lung transplant recipients with 100% good/excellent patient-reported outcomes in lung patients at final follow-up [3,4]. However, given the need for continued immunosuppression and increased medical comorbidities, many authors have cited concerns regarding increased infection and other postoperative complications in this patient population [5-7]. As perioperative and postoperative complications will be linked to surgeon and hospital reimbursement, little is known about complication profiles in this patient population in the global period (first 90-days after surgery) and at short-term follow-up.

Furthermore earlier reports of TKA in SOT patients focused on the treatment of steroid-induced osteonecrosis [8], while the majority of transplant patients undergoing TKA today are for

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treatment of end-stage osteoarthritis[8,9]. Many of the studies reporting outcomes in total joint arthroplasty and solid organ transplantation to date have been limited by a small number of patients [3,8,9]. A majority of the literature has also focused on TKA in kidney and liver transplantation, but kidney transplants have been decreasing for the past 3 years, whereas lung and heart transplants are on the rise [1]. In addition, to achieve adequate numbers, collection for these studies often spans decades, during which significant advances in the fields of transplant and arthroplasty have occurred [10-14]

The purpose of this study was to use a large national database to identify patients undergoing TKA after various SOTs with a specific focus on postoperative complications. A large national database study would also enable comparison between individual organ transplant types to control to see if one fares worse than the others. We hypothesize that SOT recipients in general will have an increased postoperative complication profile compared to controls, and the individual organ complication profiles will vary.

Methods

A retrospective review of a Medicare database was conducted from 2005 to 2011 containing 100% of inpatient and 100% of outpatient administrative records using Pearl Diver technologies (Warsaw, IN). This study was exempt from institutional review board approval at our institution as deidentified patient data were reviewed. All patients who underwent TKA were included and identified using both the corresponding International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) procedure code 81.54 and Current Procedural Terminology codes 27445, 27446, and 27447. By looking at distinct patient volumes, patients with bilateral TKA and total hip arthroplasty were excluded. Using the Pearl Diver Boolean command language, the ICD-9 diagnosis code for the relevant SOTs (Kidney V42.0, Heart V42.1, Lung V42.6, Liver V42.7, Pancreas V42.83) was used to identify the cohort of patients who carried these diagnoses before the date of their primary TKA. The control group was defined as patients who did not carry a diagnosis of these SOTs before their primary TKA. Using relevant ICD-9-CM and Current Procedural Terminology codes, the rates of various postoperative complications that occurred within 30 days, within 90 days, and overall were evaluated. Minimum 2-year follow-up was required for inclusion. Comorbidities of the various groups were identified based on the Elixhauser comorbidity index and relevant ICD-9 diagnosis codes (Appendix 1). Standard bivariate descriptive statistics were performed to compare both the comorbidity and complication rates. A chi-squared test was used to compare categorical variables, and a 2-sided Fisher exact test was used for categorical variables with decreased incidence (<0.01%). $P < .05$ indicated statistical significance.

Results

Patient Demographics

From 2005 to 2011 1,685,295 Medicare patients underwent TKA without a prior sold organ transplant. In the same time period, a total of 3334 patients who had prior surgical organ transplant underwent primary TKA. There were 2321 kidney transplants, 772 liver transplants, 129 lung transplants, 412 heart transplants, and 167 pancreas transplants patients. The average duration of follow-up for the control cohort was 4.02 years, and the average follow-up for the combined SOT cohort was 3.52 years. There were a higher percentage of males undergoing TKA with an SOT than in the control group (50.1% vs 34.8%, odds ratio [OR]: 1.88, 95% CI: 1.75-2.01, $P < .001$). In addition, transplant patients underwent TKA at a younger age versus the control cohort (age: <65, OR: 6.58, 95% CI: 6.15-7.06, $P < .001$, Table 1).

Patient Comorbidities

Not surprisingly, the transplant cohort as a whole represented a medically more complex population with a statistically significant increase ($P < .05$) in 28 of 29 Elixhauser medical comorbidities. Notable medical comorbidities more prevalent in this group not related to transplantable end-organ failure included peripheral vascular disease ($P = .001$), rheumatoid arthritis ($P = .001$), lymphoma ($P = .001$), and metastatic cancer ($P = .001$). Conditions related to transplantable organ failure were also increased such as diabetes ($P = .001$), chronic obstructive pulmonary disease ($P = .001$), congestive heart failure ($P = .001$), and renal failure ($P = .001$). Furthermore, these complications were also significant across all individual transplant groups. In addition, the transplant cohort overall was more likely to smoke, abuse alcohol, abuse drugs, and carry psychiatric diagnosis of depression (all $P < .001$). The only medical comorbidity that was not significant was prevalence of peptic ulcer disease ($P = .592$).

Postoperative Medical Complications

The transplant cohort overall had a statistically significant increase ($P < .05$) of 11 of the 13 (84.6%) recorded postoperative medical complications at both the 30- and 90-day time points compared to controls with the exception of stroke. The incidence of pulmonary embolism (PE) was statistically decreased overall in the SOT cohort compared to controls (OR: 0.69, 95% CI: 0.49-0.98, $P = .041$, Fig. 1). When separated into individual organ at the 30-day time point, lung and heart transplants appeared to have the most favorable complication profile after TKA as only 6 of 13 medical complications were statistically increased, followed by pancreas (7 of 13), liver (7 of 13), and kidney (8 of 13, $P < .05$, Fig. 1). With regard to 90-day time point, pancreas transplant was the safest with 6 of 15 medical complications being significantly increased, followed by lung (7 of 13), liver (8 of 13), heart (9 of 13), and kidney (10 of 13, Table 2). Acute renal failure (ARF) was the only complication that remained significant ($P < .05$) across each individual organ at 30 and 90 days postoperatively (Fig. 1, Table 2).

Postoperative Surgical Complications

The transplant cohort overall had a statistically significant increase ($P < .05$) of 6 of the 10 recorded acute postoperative surgical

Table 1
Patient Demographics.

	Control		Prior SOT	
	N	%	N	%
Gender				
Female	1,074,440	63.75	1629	48.86
Male	587,958	34.89	1673	50.18
Unknown	33,832	2.01	51	1.53
Age (y)				
<65	164,055	9.73	1385	41.54
65-69	457,278	27.13	799	23.97
70-74	431,912	25.63	623	18.69
75-79	367,631	21.81	386	11.58
80-84	220,725	13.10	130	3.90
≥85	84,502	5.01	42	1.26
Unknown	33,832	2.01	51	1.53
Total cohort size	1,685,295		3334	

SOT, solid organ transplantation.