Preoperative Risk Stratification Reduces the Incidence of Perioperative Complications After Total Knee Arthroplasty

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Abstract: The purpose of this study was to validate a screening and management protocol to identify and reduce risk of renal, pulmonary, and delirium complications. A cohort study comparing incidence of perioperative complications on a consecutive series of patients undergoing total knee arthroplasty with a historical control group was conducted. The study cohort was evaluated prospectively to identify and reduce noncardiac medical complications. Medical records were reviewed for in-hospital complications. There were 623 patients in the study cohort and 493 patients in the control population. There was a statistically significant decrease in the incidence of delirium (control, 10.4% vs study, 0.8%; $P = .0001$), renal (4.9% vs 0.6%, $P = .0001$), cardiac (16.3% vs 2.1%, $P = .0001$), and pulmonary complications (5.7% vs 0.8%, $P = .0001$) in the screened patients vs control. Preoperative screening and management for medical complications resulted in a significant decrease in renal, pulmonary, delirium, and cardiac complications. **Keywords:** total knee arthroplasty, risk stratification, perioperative complications.

Complications after total knee arthroplasty (TKA) include systemic (medical) and local (orthopedic, procedure-specific) events. Systemic medical complications are associated with worse outcome and increased mortality after TKA. Medical complications occur in 6% to 9% of patients undergoing TKA [1]. The most common in-hospital complications in TKA are deep venous thrombosis (1.4%) and cardiac events (0.8%-9%) [1-4]. Preoperative risk stratification and management has been successful in reduction of cardiac [5] and thromboembolic complications [6-9] after TKA.

However, there has been less investigation on the impact of noncardiac, medical complications after knee arthroplasty such as delirium, renal failure, and pulmonary complications. Although there has been a paucity of data on management of these noncardiac complications, they are associated with worse outcomes [10] and, in some cases, increased mortality [11].

The purpose of this study was to test a screening and management protocol to identify and reduce risk of renal, pulmonary, and delirium complications.

Methods

This was a cohort study comparing the incidence of complications in a prospectively collected cohort of patients undergoing TKA after introduction of a preoperative risk stratification algorithm (Appendices A, B, C, D, and E; available online at www.arthroplastyjournal.org) to a historical control series. The study group comprised consecutive patients from August 2010 to May 2011. The control group comprised consecutive patients from December 2009 to August 2010. This study was approved by the institutional review board.

Following institutional review board approval, the eligible population was defined to include consecutive patients who underwent TKA by 2 surgeons at a single institution. The study population underwent consecutive primary or revision TKA after the initiation of a preoperative screening algorithm to identify and reduce perioperative medical complications. The historical control population consists of a consecutive series of

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patients who underwent primary or revision TKA by the same surgeons during the year before the institution of the screening and intervention. Both surgeons are arthroplasty fellowship-trained, board-certified orthopedic surgeons who have been in practice for at least 5 years and used the same instrumentation over the study period. Total knee arthroplasty was performed under tourniquet using general and epidural anesthesia during the study period.

Outcome Measures

The main outcome measure was postoperative complications. All patients in this study received preoperative medical evaluation and clearance for surgery. All postoperative patients were evaluated and followed up in-hospital by the same hospitalist physicians who perform preoperative clearance. Our protocol is that all patients are followed up by 2 board-certified internist physicians who specialize in hospital medicine and perioperative care. The hospital course of the patients was followed very closely, and any complications identified by the hospitalist or orthopedic surgeon were recorded.

Complications were defined as an unplanned event that adversely affects the patients' health that is unanticipated or unintended. Furthermore, complications are by definition not part of the routine postoperative course (such as pain). The complications of interest in this study required an intervention (including additional monitoring, laboratory test results, imaging studies, medications, or procedures) distinct from expected postoperative course. Postoperative anemia from expected blood loss was not included as a complication in this study. Complications were prospectively captured in the study population (after institution of the screening algorithm) and retrospectively identified in the control population from direct review of the medical records. The incidence of complications in the control group was determined from retrospective review of the daily progress notes of the treating orthopedic surgeon and hospitalists, discharge summaries, transfer summaries, and coding records. In the study cohort, complications were determined from a prospectively recorded database identified by the treating physicians. Complications were categorized and classified as pulmonary, renal, mental status, or cardiac.

The screening algorithm (Appendices A, B, C, D, and E; available online at www.arthroplastyjournal.org) was constructed based on review of the literature and the treating physicians' experience with perioperative complications. At the time of the preoperative clearance visit, the patients' cardiac, pulmonary, anesthetic, delirium, and renal risk factors were identified from their medical histories. Based on their scoring from historical risk factors, additional preoperative and postoperative care was modified to reduce patients risk based on specific protocols. Cardiac risk stratification was performed according to standard of care (Appendix A; available online at www.arthroplastyjournal.org). Patients at risk for pulmonary complications were volume restricted to avoid pulmonary edema, and aspiration precautions were used (Appendix B; available online at www.arthroplastyjournal.org). Anesthesia risk was assessed with a specific questionnaire (Appendix C; available online at www.arthroplastyjournal.org). Patients at risk for delirium were not administered benzodiazepines and high-dose pain medications (Appendix D; available online at www.arthroplastyjournal.org). Patients at risk for renal insufficiency were carefully hydrated perioperatively, and exposure to nephrotoxic drugs was avoided (Appendix E; available online at www.arthroplastyjournal.org). In addition, enoxaparin was dosed for patients with renal insufficiency. This algorithm was created as part of a hospital quality improvement project to standardize preoperative screening interventions. Patients in the control cohort underwent screening for preoperative cardiac risk stratification as recommended by their primary care physicians according to standard of care. However, there was no standardized documentation of risk stratification and modification for renal risk, pulmonary risk, anesthesia risk, and delirium risk, and our cardiac criteria may be different from those applied in the primary care setting. The algorithm or screening criteria did not change over the study period.

Fisher exact test was used to compare the percentage of patients with complications in each group. Statistical significance was defined as $P < .05$.

Results

There were 623 patients in the study population. The mean age of the study population was 64.4 years (SD, 11 years). The study population was 44% male and 56% female. There were 493 patients in the control population. The mean age of the control population was 65.3 years

Table 2. Specific Complications in Study Population

		No. of Patients	Percentage
Delirium	Delirium	3	0.5%
	Sundowner	2	0.3%
	Total	5	0.8%
Thromboembolic disease	Pulmonary embolism	6	1.0%
	Total	6	1.0%
Cardiac complications	Atrial fibrillation	6	1.0%
	Supraventricular tachycardia	1	0.2%
	Congestive heart failure	3	0.5%
	Angina	1	0.2%
	Myocardial infarction	2	0.3%
	Total	13	2.1%
Pulmonary complications	Pneumonia	2	0.3%
	Edema	1	0.2%
	Aspiration	2	0.3%
	Total	5	0.8%
Renal complications	Urinary retention	4	0.6%
	Total	4	0.6%