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Readmission and Complications for Catheter and Injection Femoral Nerve Block Administration After Total Knee Arthroplasty in the Medicare Population

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ABSTRACT

There is general agreement that femoral nerve blocks (FNB) provide adequate immediate postoperative analgesia after total knee arthroplasty (TKA), although the effect of this technique on hospital readmission and other complications has not been quantified in a large sample. The Medicare 5% sample was used to identify TKA patients who were grouped according to postoperative FNB administration: FNB via injection; FNB via pain pump; and no FNB. Multivariate Cox regressions were used to evaluate risk factors for the postoperative outcomes. Both FNB groups were associated with a lower risk of readmission (30, 90 and 365 days, $P < 0.001$). Future clinical studies may help elucidate whether the lower hospital readmissions may be associated with more effective pain control with the use of FNB.

There are associations between pain after TKA and a patient's risk for early postoperative complications and hospital readmission. Pain after TKA can be severe and may not diminish until 48–72 hours after the surgery [1]. Effective post-operative pain control is required to assist patients in early physiotherapy and ambulation, which has been associated with a reduced length of stay [1], as well as risks for infection, DVT, and arthrofibrosis [1]—the three most common causes for hospital readmission [2]. Regardless of the primary indication for readmission after TKA, it is clear that many causes are multifactorial [2], and associated with the ability to control pain during the early postoperative period [3]. Ultimately, poor pain control may manifest itself in longer hospital stays [4], elevated readmission rates [3], and a higher cost of care [5–8].

Traditionally, opioid analgesics have been a modality for postoperative pain management after TKA, although they are associated with a risk of nausea, pruritus, vomiting, respiratory depression, prolonged ileus, and cognitive dysfunction [9–11]. Regional pain control techniques such as femoral nerve blocks (FNBs) are reported to provide adequate pain control during initial mobilization while limiting the patient's exposure to opioid related adverse events [12]. For TKA patients, a continuous femoral nerve block (CFNB) administered as a local anesthetic infusion using a catheter, is the current gold standard for FNBs and is in widespread practice for postoperative analgesia after TKA [13]. An alternative modality for FNB utilizes a single shot local anesthetic bolus. Yet another alternative modality uses a sciatic nerve block in conjunction with an FNB when complete anesthesia to the posterior aspect of the knee is also desirable [1]. There is general agreement that FNBs provide adequate immediate postoperative analgesia, though there are concerns they may cause quadriceps weakness, neuropathy, and postoperative falls [14,15]. Recommended clinical pathways include early mobilization, continuous passive motion, and weight-bearing as the patient can tolerate with a walker or crutches, and potentially decreasing the concentration of local anesthetics [14,16]. The use of a knee immobilizer has been shown to be effective in reducing falls in patients receiving an FNB for pain control after TKA [17].

A recent review of FNB use in TKA identified a number of gaps in the literature [2], including few studies comparing continuous FNB to single-shot FNB and that more studies are required to evaluate complications of FNB administration, including quadriceps weakness and falls. More data are also necessary to evaluate whether the addition of a sciatic nerve block is beneficial [1]. In an effort to address these shortcomings, the current study examined the use of FNB for TKA in the Medicare population. The purpose was to determine if differences exist in short-

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term outcomes between TKA patients who receive a postoperative FNB via injection, via catheter, or patients who do not receive a FNB. In addition, the study examined patients who received an additional sciatic nerve block. We hypothesized that patients receiving an FNB for adjunct postoperative pain control would have a lower risk for early readmission, but would be at increased risk for accidental falls in the early postoperative period.

Methodology

The Medicare 5% limited data set (LDS) was used to identify patients with a TKA procedure between 2003-2011. These data are a systematic 5% sample of all Medicare beneficiaries, and it captures the medical services and claims generated from approximately 2.5 million enrollees. Patients were identified by the CPT-4 code 27447 or *ICD-9-CM* procedure code 81.54 in the claim records. Patients were then grouped according to postoperative FNB administration: FNB via injection (CPT-4 code 64447); FNB via pain pump (CPT-4 code 64448); and no FNB. Patients were recruited continuously during the study period and followed for up to 1 year after the TKA, or censored at end-of-study, termination of enrollment, or death. Bilateral TKA and unicondylar knee arthroplasty patients were excluded. Only discharges indicated as "routine" or "routine with home health service plan" were included, excluding those discharged to a rehabilitation facility, skilled nursing facility, or other institutions. This was done to minimize any differences in discharge facilities between groups. It is expected that the extra care and observation provided in these facilities could potentially reduce complications and falls. Patients who received benefits for a reason other than age (i.e., end-stage renal disease or disability) or Medicare beneficiaries who received their care through the Medicare Advantage (Part C HMO) program were excluded. Patients who died in the hospital were also excluded, as it would be difficult to designate them in any particular treatment group. Patients' enrollment status, age, and date of death, were derived using the matching 2003–2011 Medicare beneficiary denominator files. There were 39,067 patients within the Medicare 5% dataset who met the inclusion criteria. Of these patients, 3425 received an FNB through a catheter, 5370 received an FNB through injection, and 30,272 patients did not receive an FNB.

Outcomes examined include readmission, revision, postoperative complications, accidental falls, mortality, and diagnosed stiffness (Table 1). The frequency of these outcomes was examined within 30 days, 90 days, and 1 year after surgery. Revisions were identified using CPT-4 procedure codes 27486, 27487, 27488, while other postoperative events were identified using the appropriate *ICD-9-CM* diagnosis and procedure codes. The outcome "mechanical complication" includes implant loosening, implant fracture, periprosthetic fracture, osteolysis, and unspecified mechanical complications.

Multivariate Cox regressions were used to evaluate risk factors for the postoperative outcomes. Patients who did not experience the event or died within the post-TKA follow-up periods were censored. If multiple events of the same type occurred (e.g., accidental falls), the first occurrence of the event was considered in the regression. In addition to FNB administration, covariates included in the Cox regressions were age, gender, region of residence, race, patient's overall health status (Charlson comorbidity index), socioeconomic status (using the Medicare buy-in status as surrogate), administration of a sciatic nerve block (CPT-4 codes 64445-64446), hospital LOS, and existing disease diagnoses for diabetes, heart failure, ischemic heart disease/atherosclerosis, or cardiopulmonary disease (identified for up to a year prior to the index surgery). The Charlson index quantifies the presence of comorbid conditions into a composite score, and has been determined to be a valid method for estimating the risk of death from comorbid disease [18]. The year of the surgery was also included as a covariate in the regression analyses, testing whether the treatment effects were changing over time. A separate model was generated for each outcome, allowing for risk profiles, which may vary accordingly. All data processing and statistical analyses were conducted using the SAS (9.3) software package (Cary, NC).

Results

The three groups were similar according to race ($P \geq 0.192$), pre-existing ischemic heart disease ($P \geq 0.173$) and Charlson Index score ($P \geq 0.114$) (Figs. 1 and 2). There were small but significant differences in age (injection and catheter patients were younger than patients with no FNB, $P \leq 0.001$), region ($P < 0.001$), and gender (catheter patients were more likely to be female than non-FNB patients, $P = 0.033$). Injection patients were more likely to have diabetes ($P = 0.011$) and less likely to have a diagnosed heart failure ($P = 0.01$) than patients with no FNB. Catheter patients were more likely to have a pre-existing diagnosis of pulmonary heart disease than injection or non-FNB patients ($P \leq 0.028$). Over 20% of the patients in each group had either pre-existing diabetes or ischemic heart disease/atherosclerosis diagnosis (Fig. 2). There was a sharp increase in the number of patients who received some form of an FNB between 2008 and 2009 (Fig. 3).

Table 2 shows cumulative complication counts for each group at all follow-up points. Hazard ratios were calculated comparing each of the FNB groups to patients who did not receive a postoperative FNB. Both FNB groups were associated with a lower risk of readmission (30, 90 and 365 days, $P < 0.001$) (Table 3). Pertaining to complications, the injection group was associated with a higher revision (30 days, $P = 0.015$) and DVT risk (30, 90, 365 Days, $P < 0.012$) compared to patients who did not receive a block. The injection FNB group also had a higher rate of diagnosed knee stiffness (30, 90, 365 days, $P < 0.014$) compared to patients who did not receive an FNB.

Regarding falls, there were no significant differences between groups, but there was a non-significant increased HR for both FNB groups at 30 days (Injection FNB HR = 1.60, $P < 0.09$; Catheter FNB HR = 1.24, $P = 0.587$). The minimal relative risk for comparing the

Table 1
ICD-9 and CPT4 Codes Used to Identify Complications, Revision, and Mortality.

	ICD9 Diagnosis Code	*ICD9* Procedure Code	CPT4 Code
Urinary retention	788.2X		
Accidental falls	E880.X, E881.X, E882.X, E883.X, E884.X, E885.X, E886.X, E887X, E888.X		
Infection	996.66, 996.67, 998.59		
Deep vein thrombosis	453.4, 451.1, 451.19, 451.2, 451.81, 451.9, 453.1, 453.2, 453.8, 453.9		
Pain in joint	719.46		
Stiffness in joint	719.56, 718.56		
Wound complication	998.32	86.22 or 86.28	
Mechanical complication	996.40, 996.41, 996.43, 996.44, 996.45 996.46, 996.47, 996.49, 996.77, 996.78		
Revision			27486, 27487, 27488
Readmission	Subsequent inpatient claim records		
Mortality	extracted from denominator file		