Regionalization of Primary Total Knee Arthroplasty: Predictors and Implications

Christopher Dy, MD, MPH, USA
Robert G. Marx, MD, MSc, FRCSC, USA
Ting Jung Pan, MPH, USA
Huong Do, MA, USA
Hassan Mohammed Ghomrawi, PhD, MPH, USA
Stephen L. Lyman, PhD, USA

Hospital for Special Surgery
New York, NY, USA

Summary:
The association between hospital volume and decreased complications following total knee arthroplasty (TKA) has prompted calls for regionalization of orthopaedic care. While the benefits of high volume hospitals are well known, the predictors and implications of patient migration to high volume centers for primary TKA is not well understood.

Abstract:
Background:
The association between hospital volume and decreased complications following total knee arthroplasty (TKA) has prompted calls for regionalization of orthopaedic care. While the benefits of high volume hospitals are well known, the predictors and implications of patient migration to high volume centers for primary TKA is not well understood.

Methods:
A cohort of 1,502,511 patients who underwent primary TKA over 16 years (1991-2006) across 13 states was generated from the Agency for Healthcare Research and Quality’s Healthcare Cost and Utilization Project. Patients were grouped based upon whether they underwent primary TKA at a high volume hospital (>200 TKA performed per year) and whether a high volume hospital was available within their local hospital service area (HSA). The “base” cases are patients that stayed locally and underwent surgery at the highest volume hospital available locally. The “local suboptimal” cases are patients that stayed locally and underwent TKA at a lower volume hospital, despite a higher volume hospital being available within their HSA. The “optimally regionalized” cases are patients that underwent primary TKA outside their HSA at a higher volume hospital than available locally. Patient characteristics (age, sex, comorbidities, insurance type), community factors (education level, poverty level, median household income, population density), and hospital characteristics (annual TKA volume, number of hospital beds, teaching status) were analyzed using univariate statistics and multivariable regression modeling to determine predictors for “local suboptimal” and “optimally regionalized” cases. Short-term complications (infection, cardiovascular, and orthopaedic) were identified. Multivariable logistic regression models were used to determine the influence of regionalization patterns on the occurrence of short-term complications.

Results:
More than half (52.5%) of primary TKA were performed in local low volume hospitals in 1991, declining to 21.3% in 2005. Minority patients were 30% more likely than white patients to have a TKA at a local low volume hospital (OR 1.30; 99% CI: 1.28, 1.32). Medicaid-insured patients were 11% more likely than privately-insured patients to have a TKA at a local low volume hospital (OR 1.11 [1.09, 1.13]).

Of patients who left their HSA in 1991, 7.0% optimally regionalized, undergoing TKA at a higher volume hospital than available locally. This increased to 28.5% by 2005. Patients who were older (OR 0.76 [0.75, 0.77]), insured by Medicare (OR 0.82 [0.81, 0.82]), or insured by Medicaid (OR 0.76 [0.74, 0.77]) were less likely to regionalize to a...
higher volume hospital. Patients from areas of higher poverty were less likely to regionalize optimally (OR 0.85 [0.84, 0.86]), while patients from areas with higher population density were more likely to optimally regionalize (OR 1.31 [1.30, 1.32]). Optimal regionalization was associated with a significantly lower risk of orthopaedic complications (OR 0.71; 99% CI 0.69, 0.74) but significantly increased risk of cardiovascular complications (OR 1.62; 99% CI: 1.51, 1.71).

Discussion:
While over one-fifth of patients undergo TKA at a local low volume hospital, an increasing percentage of patients are leaving their HSA to undergo TKA at a higher volume hospital. Although there is a lower risk of orthopaedic complications with regionalization to a higher volume hospital, the increased risk of cardiovascular complications must be interpreted with caution. While this may be reflective of sicker patients undergoing TKR at high volume centers, more detailed investigation should be conducted to evaluate the level of risk of cardiovascular complications for patients who leave their HSA. There are race- and insurance-based disparities in the likelihood of undergoing TKA at a local low volume hospital or regionalizing to a higher volume hospital. These relationships need to be better understood to avoid vulnerable populations being left behind if orthopaedic care is increasingly regionalized. If systematic regionalization were to occur based solely on patient choice, this could potentially result in vulnerable populations receiving care at hospitals with decreased volume, potentially jeopardizing patient safety.