From the Society for Clinical Vascular Surgery

The effect of anesthesia type on major lower extremity amputation in functionally impaired elderly patients

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Objective: **Patients undergoing major lower extremity amputations are at risk for a wide variety of perioperative complications. Elderly patients with any functional impairment have been shown to be at high risk for these adverse events. Our goal was to determine the association between the type of anesthesia—general anesthesia (GA) and regional/spinal anesthesia (RA)—on perioperative outcomes after lower extremity amputation in these elderly and functionally impaired patients.**

Methods: **The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) data set (2005-2012) was queried to identify all patients aged ≥75 years with partial or total functional impairment who underwent major lower extremity amputations. Propensity matching and multivariate analysis were performed to isolate the effect of anesthesia type.**

Results: **We identified 3260 patients (50% male), 2558 GA patients and 702 RA patients, who were a mean age of 82 years. Anatomic distribution was 59% above-the-knee and 41% below-the-knee amputations. Patients undergoing GA were more likely to have impaired sensorium (9% vs 6%; $P = .035$), be on anticoagulation or have a bleeding disorder (33% vs 17%; $P < .001$), have had a previous operation ≤30 days (16% vs 10%; $P < .001$), and be operated on by a nonvascular surgeon (16% vs 12%; $P = .033$). GA was associated with shorter anesthesia time to surgery (36 ± 48 vs 42 ± 49 minutes; $P < .001$) but a similar operative time (66 ± 33 vs 64 ± 33 minutes; $P = .292$) compared with RA. After propensity matching, rates of 30-day mortality (14% vs 12%; $P = .135$), postoperative myocardial infarction/cardiac arrest (2.9% vs 3.1%; $P = .756$), pulmonary complications (7.3% vs 6.7%; $P = .632$), stroke (0.7% vs 0.9%; $P = .694$), urinary tract infections (6.7% vs 6.5%; $P = .887$), and wound complications (7.6% vs 7.6%; $P = .999$) were similar in patients undergoing GA and RA, respectively. Median length of stay was similar in both groups (5 vs 5.5 days; $P = .309$). Multivariable analyses confirmed that anesthesia type did not significantly affect morbidity and mortality.**

Conclusions: **The mode of anesthesia, GA vs RA, did not have significant effect on perioperative outcomes after major lower extremity amputation in the functionally impaired geriatric population. These findings provide an evidence base that will allow surgeons, anesthesiologists, and patients to make an informed decision about anesthesia type for their procedure. (J Vasc Surg 2016;63:696-701.)**

Major lower extremity amputation, including below-the-knee amputation (BKA) and above-the-knee amputation (AKA), remains one of the most common vascular surgery procedures performed in the United States.[1] Patients undergoing these procedures often have significant comorbidities, with perioperative mortality rates ranging from 0.9% to 14.1% for BKA and 2.8% to 35% for AKA.[2-6] Multiple predictors of poor outcome have been reported, including advanced patient age, coronary artery disease, diabetes mellitus, and end-stage renal disease.[7-9] Despite advancement in perioperative care and anesthesia management, perioperative morbidity and mortality are still high.[10,11]

We sought to determine the association between types of anesthesia—general anesthesia (GA) vs regional/spinal anesthesia (RA)—on outcomes after lower extremity amputation in functionally impaired elderly patients. Elderly patients with impaired functional status represent a high-risk subset of patients where the benefits of one anesthesia type over another may be most pronounced.[12-14] Although RA has been touted to be associated with decreased postoperative cardiopulmonary complications and mortality, such benefits have not been consistently demonstrated in vascular and nonvascular surgical patients.[14-20] Scant data are available to guide the clinician in the choice of appropriate anesthetic method for lower extremity amputations.[14]

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We used the American College of Surgeons National Surgical Quality Improvement Project (ACS-NSQIP) database to determine the association between anesthesia type on outcomes after lower extremity amputation in functionally dependent elderly patients in an attempt to add evidence-based data to aid the operative surgeon and anesthesiologist in deciding which mode of anesthesia is best for this high-risk population. We hypothesized that the type of anesthesia used, GA vs RA, would have no effect of morbidity or mortality.

METHODS

The ACS-NSQIP data set is an independently administrated, validated, and prospectively maintained database of surgical cases performed in academic and nonacademic hospitals across the United States, the details of which have been previously described.[21,22] The ACS-NSQIP data set provides detailed patient and procedural data, major and minor morbidity, and 30-day mortality. The database was queried for all clinical and demographic patient data, periprocedural information, and 30-day specific outcome of morbidity and mortality. Informed consent was waved, and an exemption for patient consent was provided by the Boston University School of Medicine Institutional Review Board for this retrospective study.

All patients aged ≥75 years with known preoperative partial or total functional impairment were identified using the Current Procedural Terminology codes (American Medical Association, Chicago, Ill) for all primary BKA (27880) and AKA (27590) procedures performed between 2005 and 2012. Functional status in NSQIP is based on the patient's ability to perform activities of daily living in the 30 days before their operation. These include bathing, dressing, eating, using the toilet, and general mobility. Partially dependent patients require some assistance from another person for activities of daily living. A totally dependent person requires total assistance for all activities of daily living. We chose these parameters to look at a functionally impaired elderly patient population that may be most likely to show a benefit of one anesthesia type over another.

Patient demographics and clinical comorbidities were obtained for each patients, including history of diabetes mellitus, coronary artery disease, end-stage renal disease, hypertension, chronic renal insufficiency, chronic obstructive pulmonary disease, functional status, and smoking. Also analyzed were the surgical details for each procedure, including operative time, start of anesthesia to surgery time, total time in the operating room, blood product transfusion, and anesthetic modality.

Our primary end point was 30-day mortality. Secondary end points included myocardial infarction (MI) and cardiac arrest; pulmonary complications, defined as ventilator support for >24 hours postoperatively, unplanned reintubation, and pneumonia; wound complications, including combined superficial, deep, organ space surgical site infection, and dehiscence; sepsis, stroke, renal failure, and hospital length of stay (LOS). Patients were grouped by anesthesia type. RA included any combination of regional block, epidural, spinal, and monitored anesthesia care. Any patient undergoing RA who was converted to GA was classified as GA in the data base.

Baseline patient characteristics were compared across groups using the χ^2 test for categoric variables and the *t*-test for continuous variables. Multivariable analyses were performed using logistic regression models adjusting for possible confounders. The covariates were included in the models if they were significantly (at the 0.2 level) different between and across the anesthesia groups based on bivariable analysis. These included procedure type (BKA vs AKA), age, gender, body mass index (BMI), do-not-resuscitate status, history of MI, sepsis, impaired sensorium, bleeding disorder, operation ≤30 days, weight loss ≤6 months, concurrent open procedure, and surgeon specialty. The effect was expressed by odds ratios (ORs) with corresponding 95% confidence intervals (CIs). Then, 2:1 propensity matching was performed to select two GA patients for every RA patient. With a 2:1 matched sample of 540 for RA and 1080 for GA, we had 90% power to detect an OR of 1.58 and 80% power to detect an OR of 1.5 for mortality (our primary outcome measure) at the 0.05 significance level. The propensity score was based on the model, including demographic measures (age, gender, BMI, smoking, functional, and do-not-resuscitate status), medical history (diabetes, hypertension, chronic obstructive pulmonary disease, congestive heart failure, dyspnea, pneumonia, renal disorder, bleeding disorder, weight loss, transient ischemic attack, impaired sensorium, previous surgery, steroid use, open wound or infection), presentation (emergency, American Society of Anesthesiologists Physical Status Classification), procedure (amputation type, surgeon specialty, operation year, concomitant procedures), and hospital teaching status. Nearest neighbor criterion was used to select the matches. Standardized difference of means was used to assess matching procedure.

The outcomes were compared across the matched groups using χ^2 and Fisher exact tests. Gamma regression was used for LOS to model the highly skewed shape of the outcome distribution. Multivariable analysis was the primary analysis, and propensity matching was the sensitivity analysis. Finally, we tested a number of outcome measures, and formally, a correction for multiple testing should be used in such situation; however, because we found no significant associations, the correction was not reported. For all tests, the type I error bound was set at 0.05. Analyses were performed using SAS 9.2 software (SAS Institute Inc, Cary, NC).

RESULTS

Between 2005 and 2012, 9112 patients underwent major lower extremity amputation. Of those, 3260 were aged ≥75 years and had impaired functional status. GA was used in 2558 patients (78%), and RA was used in 702 patients (22%). The gender distribution was similar across the groups, and the GA group was slightly younger (82 vs 83 years, $P < .001$) than the RA group (Table I).