

Type of Anesthesia and Postoperative Delirium After Vascular Surgery

Louise Ellard, BSc, MBBS,* Rita Katznelson, MD,* Marcin Wasowicz, MD, PhD,* Alan Ashworth, MD,*
Jo Carroll, BHA,* Thomas Lindsay, MD,† and George Djaiani, MD, FRCA, FRCP*

Objective: The purpose of this study was to investigate the association between general (GA), regional (RA), and local (LA) anesthetic techniques with respect to the development of delirium after vascular surgery. The authors hypothesized that patients undergoing GA for vascular surgery would have a higher incidence of postoperative delirium. The role of LA with respect to postoperative delirium in vascular surgery patients previously has not been reported.

Design: Retrospective review.

Setting: Tertiary referral center, university hospital.

Participants: 500 patients undergoing vascular surgical procedures.

Interventions: Based on the chosen anesthetic technique, all patients were divided into GA, RA, and LA groups, respectively. Exclusion criteria were patients with preoperative dementia or abnormal level of consciousness, patients undergoing open abdominal aneurysm repair surgery, and patients undergoing carotid endarterectomy. All anesthetic techniques were conducted according to routine institutional practices. Patients in both the RA and LA groups received intravenous sedation.

Measurements and Main Results: Three hundred ninety-six (79%) patients received GA, 73 (15%) RA, and 31 (6%) LA. The overall incidence of delirium was 19.4% and rates were similar among the 3 groups, with 73 (18.4%) patients in the GA group, 17 (23.2%) in the RA group, and 7 (22.5%) in the LA group ($p = 0.56$). Patients in the LA group were more likely to have emergency surgery and also had a higher incidence of previous cerebrovascular accidents or transient ischemic attacks. There was no significant difference with respect to either onset or duration of delirium among the 3 groups. Median length of hospital stay and in-hospital mortality were similar among the 3 groups.

Conclusions: Delirium rates after vascular surgery were similar with local, regional, or general anesthesia techniques. The presence of risk factors for the development of postoperative delirium should not influence the type of anesthesia provided.

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KEY WORDS: type of anesthesia, vascular surgery, delirium

A CONSIDERABLE NUMBER of patients undergoing vascular surgery develop neurologic complications postoperatively, ranging from subtle cognitive changes to clinically evident confusion, delirium, and stroke. Delirium is a common complication after vascular surgery, with an incidence ranging from 29% to 42%.^{1–5} Both short- and long-term outcomes are affected by development of delirium, including increased length of hospital stay,^{6,7} increased mortality,⁶ and reduced long-term functional outcomes.⁸ A significant cost implication also is associated with development of delirium.^{6,9,10}

Delirium is characterized by fluctuating disturbances of consciousness, attention, cognition, and perception that develop over a short period. The key diagnostic features are defined in the *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition, text revision.¹¹ It is distinct from postoperative cognitive dysfunction (POCD), which lacks formal diagnostic criteria and describes a more persistent impairment of memory and thought process in the postoperative period.¹² It is also distinct from emergence delirium, which may occur immediately after general anesthesia (GA), usually resolves within hours, and often is seen in children.

Different diagnostic tools are available for identifying delirium after cardiovascular surgery. Previously described validated tools include the intensive care delirium screening checklist,¹³ confusion assessment method for intensive care unit (CAM-ICU),^{14,15} the NEECHAM scores,^{16–18} and a chart-based instrument for delirium.¹⁹ The current study used the NEECHAM scores as a tool to diagnose postoperative delirium.

The contribution of GA as an independent risk factor for the development of postoperative delirium remains unclear. Several nonrandomized studies of patients undergoing noncardiac surgery failed to show higher incidence of delirium in patients who received GA compared with those who proceeded under regional anesthesia (RA).^{20,21} Two literature reviews of available randomized controlled trials (RCTs) concluded that there was no difference in rates of delirium between GA and RA.^{22,23} Bryson et al²² identified 8 trials addressing postoperative delirium. Unfortunately, the delirium was referred to as “confusion” in most of these studies. Furthermore, only 1 out of 8 studies addressed the vascular surgical patient population. In their systematic review of the RCTs, Mason et al²³ identified 3 trials that used validated tools to assess delirium. However, these studies addressed only orthopedic and general surgery patient populations.

Although the terms are not interchangeable, other studies have looked at the impact of anesthetic technique on postoperative cognitive dysfunction and once again failed to show a difference.^{24–26} In the vascular surgery literature, Cook et al randomized patients undergoing lower limb revascularization to either GA or spinal anesthesia. There was no difference seen in the incidence of postoperative confusion, although again this is not synonymous with delirium.²⁷ Large data registry reviews for patients undergoing endovascular aneurysm repair (EVAR) found that GA was associated with higher postoperative morbidity and longer hospital stay even though patients

From the *Department of Anesthesia and Pain Management, Toronto General Hospital; and †Division of Vascular Surgery, University of Toronto, Toronto, Canada.

Address reprint requests to George Djaiani, MD, DEAA, FRCA, FRCPC, Department of Anesthesia and Pain Management, Toronto General Hospital, University Health Network, Eaton North 3-410, 200 Elizabeth Street, Toronto, ON, M5G 2C4, Canada. E-mail: george.djaiani@uhn.ca

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Table 1. Types of Vascular Surgery Procedures Performed

Type of Procedure, Number of Patients (%)	Number of Patients (n = 500)
Endovascular repair of aortic aneurysm	107 (22)
Revascularization of lower extremities	192 (39)
Thrombectomy/embolectomy	88 (17)
Amputations	92 (18)
Wound debridement/evacuation hematoma	21 (4)

receiving GA were relatively healthier, although delirium was not specifically studied.^{28,29}

This retrospective study investigated the association between general, regional, and local anesthetic techniques with respect to the development of delirium after vascular surgery. The author hypothesized that patients undergoing GA would have a higher incidence of postoperative delirium after vascular surgery. The role of LA with respect to postoperative delirium in vascular surgery patients previously has not been reported.

METHODS

After Institutional Ethics Review Board approval, a retrospective review of the perioperative anesthesia and vascular surgery database was conducted on all patients undergoing vascular surgery at Toronto General Hospital from June 2006 to December 2007. The current study built on previous publication¹⁹ but explored the different types of anesthesia in a larger patient population expanded over an 18-month period. Exclusion criteria included patients with preoperative dementia or abnormal level of consciousness, patients undergoing open abdominal aneurysm (AAA) repair surgery, and patients undergoing carotid endarterectomy. Elective and emergency cases were included, with surgery including amputations, peripheral revascularization, and EVAR procedures. Demographic data, including age, gender, medical history, preoperative medication, and the type and urgency of surgery, were collected. The database was analyzed by two independent research associates who had been trained in analyzing large databases with respect to detecting perioperative delirium in the hospital setting.

Perioperative anesthesia management and surgical techniques were according to standard institutional practice. Patients were divided into GA, RA, and LA groups based on the chosen anesthetic technique. GA for vascular surgery patients in this institution typically includes 0.025 to 0.05 mg/kg of midazolam, 1 to 3 µg/kg of fentanyl, 0.5 mg/kg of rocuronium, sevoflurane 1-2%, and 0.01 to 0.04 mg/kg of hydromorphone. RA was defined as spinal, epidural, sciatic, or ankle nerve blockade. In the LA group, local anesthetics were infiltrated by the surgeons. Conscious sedation was provided to patients in both the RA and LA groups. The medications used included increments of fentanyl, 10 to 25 µg, or remifentanyl, 0.025 to 0.1 µg/kg/min infusion, and/or a total dose of midazolam ranging from 0.5 to 5 mg. In patients older than 70 years, administration of midazolam was limited to a maximum dose of 2 to 3 mg.

Postoperative delirium was assessed using the NEECHAM confusion scale,³⁰ which was a part of the standard patient evaluation after vascular surgery. The scale has 9 items separated into 3 categories that include evaluation of the patient's ability to process information, a behavioral assessment, and assessment of physiologic control. A total score out of 30 is calculated, with 27 to 30 corresponding to normal, 25 to 26 indicating that the patient is at risk of confusion, 20 to 24 indicating mild confusion, and a score of less than 20 indicating moderate-to-severe confusion. Assessments were performed daily until discharge from the hospital. A patient with a NEECHAM score of less than 25 was considered to have delirium. The onset and duration of delirium were recorded.

Comparability of groups was tested with the use of chi-square statistics, or Fisher's exact test on qualitative variables, and the

ANOVA or Mann-Whitney U test on quantitative variables. A *p* value < 0.05 was considered significant. Statistical analysis was conducted with the use of MINITAB® statistical software (Minitab Inc., State College, PA).

RESULTS

A total of 1282 vascular surgical procedures were performed during the study period. The NEECHAM scores were available in 592 patients. The inclusion criteria were satisfied in 500 patients. A total of 396 (79%) patients received GA, 73 (15%) RA, and 31 (6%) LA. The type of procedures and the type of anesthesia employed are presented in Table 1 and Figure 1, respectively. Regional anesthesia was composed of epidural anesthesia (n = 18), spinal anesthesia (n = 39), sciatic/femoral nerve blocks (n = 12), and ankle blocks (n = 4).

The overall incidence of delirium was 19.4%, and rates were similar among the 3 groups, with 73 (18.4%) patients in the GA group, 17 (23.2%) in the RA group, and 7 (22.5%) in the LA group (*p* = 0.56). Demographic analysis revealed that patients in the LA group were more likely to be having emergency surgery (71% LA v 32% GA and 42% RA; *p* = 0.01). This group also had a higher incidence of previous cerebrovascular accidents or transient ischemic attacks, although this was not significant (35% LA v 19% GA and 25% RA; *p* = 0.08) (Table 2).

Patients with delirium were, on average, 5 years older (74 ± 10 v 69 ± 12 years, *p* = 0.0001). A total of 161 (32%) procedures were performed on an emergency basis. Delirium was present in 46 (28%) and 51 (15%) patients undergoing emergency and elective surgical interventions, respectively (*p* = 0.0006). The NEECHAM scores were significantly lower in patients with delirium. Median scores were 21 [IQR 19, 24] and 28 [IQR 27, 30] in patients with and without delirium, respectively (*p* < 0.00001). There were 28 (29%) and 76 (19%) patients receiving β-blockers preoperatively in the delirium and no-delirium groups, respectively (*p* = 0.03). Similarly, 45 (46%) and 217 (54%) patients received statins in their respective groups (*p* = 0.18).

There was no significant difference with respect to either onset or duration of delirium among the 3 groups (Table 3). The median hospital length of stay was 13 (range, 2-232) and 7 (range, 2-152) days in patients with and without delirium,

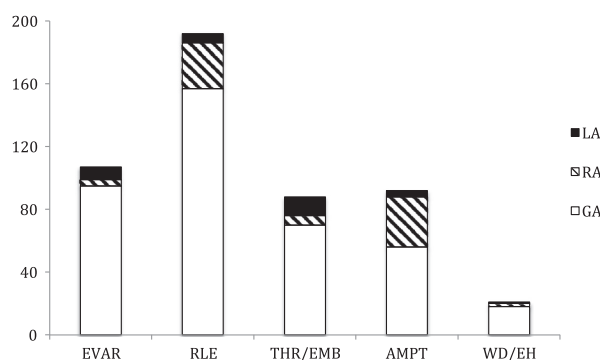


Fig 1. Types of anesthetic and surgical procedure. AMPT, amputations; EVAR, endovascular aortic aneurysm repair; GA, general anesthesia; LA, local anesthesia; RA, regional anesthesia; RLE, reperfusion of lower extremities; THR/EMB, thrombectomy/embolectomy; WD/EH, wound debridement/evacuation hematoma.

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