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Clinical Practice

Covert stroke after non-cardiac surgery: a prospective cohort study

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Abstract

Background: Overt stroke after non-cardiac surgery has a substantial impact on the duration and quality of life. Covert stroke in the non-surgical setting is much more common than overt stroke and is associated with an increased risk of cognitive decline and dementia. Little is known about covert stroke after non-cardiac, non-carotid artery surgery.

Methods: We undertook a prospective, international cohort study to determine the incidence of covert stroke after non-cardiac, non-carotid artery surgery. Eligible patients were ≥65 yr of age and were admitted to hospital for at least three nights after non-cardiac, non-carotid artery surgery. Patients underwent a brain magnetic resonance study between postoperative days 3 and 10. The main outcome was the incidence of perioperative covert stroke.

Results: We enrolled a total of 100 patients from six centres in four countries. The incidence of perioperative covert stroke was 10.0% (10/100 patients, 95% confidence interval 5.5–17.4%). Five of the six centres that enrolled patients reported an incident covert stroke, and covert stroke was found in patients undergoing major general (3/27), major orthopaedic (3/41), major urological or gynaecological (3/22), and low-risk surgery (1/12).

Conclusions: This international multicentre study suggests that 1 in 10 patients ≥65 yr of age experiences a perioperative covert stroke. A larger study is required to determine the impact of perioperative covert stroke on patient-important outcomes.

Clinical trial registration: NCT01369537.

Key words: magnetic resonance imaging; perioperative period; stroke

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Editor's key points

- In non-surgical settings, covert strokes are associated with cognitive and functional decline.
- The authors determined the incidence of covert strokes in elderly patients undergoing non-cardiac, non-carotid surgery.
- Magnetic resonance imaging revealed a covert stroke incidence of 10%.

Non-cardiac surgery provides substantial benefit to patients but is associated with an increased risk of major vascular complications, including stroke. The estimates of the risk of perioperative stroke in the current literature range between 0.2 and 4.3%.[1–5] Although only a small proportion of patients suffer a perioperative clinically overt stroke, these strokes often have a devastating effect on patients' quality and duration of life.[1]

The POISE Trial included 8351 adults from 123 centres in 23 countries undergoing non-cardiac surgery.[1] The incidence of overt stroke was 0.7% and was associated with a high burden of mortality (32% of patients died after a postoperative stroke) and morbidity (59% of the patients with non-fatal stroke required help to perform everyday activities or were incapacitated at the 30 day follow-up).

In contrast, covert stroke is an acute cerebral ischaemic event that is not clinically apparent. In the non-operative setting, covert stroke is associated with cognitive decline, motor impairment, dependence, and death.[6 7] Modern neuroimaging techniques can detect acute covert stroke with high sensitivity.[7 8] Although a number of large studies have shown a high prevalence of covert stroke in the general population of older adults,[9 10] only a few small studies have evaluated the frequency of covert stroke in the perioperative setting, and these studies were confined to cardiac[11–18] and carotid artery surgical[19] populations. No studies have examined the incidence of covert stroke after non-cardiac surgery that does not directly manipulate the arterial blood supply to the brain.

Methods

This study was a multicentre prospective cohort study of patients undergoing non-cardiac surgery. Our primary objectives were as follows: (i) to develop a preliminary estimate of the incidence of postoperative covert stroke; and (ii) to determine the feasibility of a full, definitive study of the incidence, determinants, and consequences of perioperative covert stroke. We recruited patients from centres in Canada, China, India, and the USA. The research ethics board at each site approved the protocol before patient recruitment.

The protocol was registered with ClinicalTrials.gov (identifier NCT01369537) and was approved by the Research Ethics Board at McMaster University (project number 11-211).

Eligibility criteria

Patients ≥65 yr of age undergoing non-cardiac surgery who required hospital admission were eligible for the study. We excluded patients who underwent carotid artery surgery, had a contraindication to a magnetic resonance (MR) imaging study (e.g. implanted devices not safe for MR studies, or severe claustrophobia), were unable to complete a telephone interview, had a previously documented history of dementia, or resided in a nursing home. We also excluded patients who did not receive neuraxial or general anaesthesia or did not require a hospital stay of ≥3 days.

Patient recruitment

We developed a recruitment schedule that ensured proportionate representation of patients in the study that reflected the worldwide surgical population, as documented in the VISION Study, a 40 000-patient international prospective cohort study of unselected adult patients undergoing non-cardiac surgery requiring hospital admission.[20] Patients were considered enrolled in the study once the MR study was completed in the postoperative period.

Data collection

Research staff obtained patient consent and collected baseline assessments before the day of surgery. Baseline clinical variables included the type of surgery (see Appendix), vascular risk factors and co-morbidities, a cognitive screen using the Montreal Cognitive Assessment (MoCA) instrument,[21] functional assessments using the modified Rankin score[22] and Lawton instrumental activities of daily living (iADL) questionnaire,[23] and quality of life as measured by the EuroQol five dimensions questionnaire.[24] All research staff were trained in the administration of the Confusion Assessment Method (CAM) by a geriatrician. According to study protocol, the research staff assessed patients in the morning and the afternoon to collect data on clinical outcomes and the presence of delirium using the CAM.[25] Research staff contacted patients by telephone 30 days after the surgery to collect data regarding clinical outcomes, physical function, and quality of life.

Magnetic resonance study protocol

Standardized MR imaging of the brain was performed between postoperative days 3 and 10, as soon as the patient was able to tolerate this procedure. The MR study sequences included axial fluid attenuated inversion recovery, gradient echo, T2, and diffusion-weighted imaging (DWI). The MR sequences were performed according to the local standard of care with a minimal 1.5 T MR machine and a slice thickness of 3–5 mm, with no gap. The DWI sequence enabled the detection of acute covert stroke that had occurred within 10 days of the study.[8 26] Diffusion restriction, manifested as hyperintensity on DWI sequences with corresponding lesion on the apparent diffusion coefficient map, suggest acute ischaemia. These findings are attributable to the failure of energy-dependent membrane ion pumps and the development of cytotoxic oedema, which is the characteristic neuroimaging finding of acute ischaemia. Diffusion-weighted imaging lesions attributable to non-ischaemic causes are rare and distinguished by the pattern on magnetic resonance images (MRIs).

The MR imaging results were not blinded to the patients, attending physicians, radiologists, or the study team.

Patient identifiers were removed, and MR images were electronically transferred via a secure encrypted connection to the central imaging interpretation centre. A neurologist and neuroradiologist who were blinded to the baseline characteristics and clinical outcomes independently assessed the MR studies in duplicate and provided a consensus interpretation regarding the presence of imaging lesions that represent acute perioperative cerebral ischaemia and chronic ischaemic findings, defined according to recent consensus criteria.[27] Any disagreements were resolved by consensus.