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Clinical Investigation

CLINICAL INVESTIGATION

Catheter-related right internal jugular vein thrombosis after chest surgery

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Abstract

Background: Central venous catheters (CVCs) are frequently used for monitoring haemodynamic status and rapidly delivering fluid therapy during the peri- and postoperative periods. Indwelling CVCs are typically used 7–14 days postoperatively for additional monitoring and treatment, but patients may develop asymptomatic catheter-related thrombosis, leading to life-threatening pulmonary embolism and death. Early detection helps to avoid such complications.
Methods: This prospective observational study investigated the risk factors associated with catheter-related right internal jugular vein thrombosis in patients undergoing chest surgery. The study enrolled 24 patients who were scheduled to receive chest surgeries during which catheters were needed. To detect thrombus formation, Doppler ultrasound examinations from the thyroid cartilage level to the supraclavicular region were used after CVC placement and on each of the following days until the catheter was removed.
Results: No thrombosis was found in patients before surgery, but it appeared in 75% (18/24) after surgery. The risks of thrombosis increased with a longer duration of anaesthesia, greater amounts of bleeding, and use of postoperative ventilator support.
Conclusions: Earlier catheter removal may reduce the risk of catheter-related thrombosis and avoid possibly fatal complications after catheter-related thrombosis.

Key words: catheterization, central venous; internal jugular vein; perioperative period

Central venous catheters (CVCs) are frequently used for the delivery of fluids and medicines, including total parenteral nutrition and antibiotics, and are commonly used in intensive care units (ICUs) and elsewhere to monitor a patient's haemodynamic status.[1] Over time and as physicians have gained experience with the placement of CVCs, failures have declined from 19% for less experienced physicians and residents to 10% for experienced practitioners (data from 1986).[2] In addition, the use of ultrasound guidance has reduced the incidence of CVC placement–related adverse events and the time required for the procedure.[3] Even so, early complications of CVC placement include pleural and arterial punctures, haemorrhages and hematomas, arrhythmias, and air embolisms; complications that appear later during the course of treatment are associated with

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Editor's key points

- Central venous catheters are frequently used for monitoring haemodynamic status and rapidly delivering fluid therapy during the peri- and postoperative periods, but may cause thrombosis.
- In 18/24 (75%) patients, thrombosis was seen postoperatively in the right internal jugular vein, and a longer duration of anaesthesia, greater amounts of bleeding, and the use of postoperative ventilator support were risk factors.

longer-term placement of catheters and include infections, mechanical complications such as equipment failure or migration, and venous thrombosis or stenosis.[1] Indwelling catheters are typically used for 7–14 days postoperatively for monitoring and treatment, but their utility is tempered by patients' asymptomatic development of CVC-related thrombosis, which can lead to pulmonary embolism and mortality.

A study in 1995 found an unexpectedly elevated rate of deep vein thrombosis (DVT) in patients who had received a CVC in a medical ICU; the authors recommended regular ultrasound surveillance, possibly with increased prophylaxis (e.g. anticoagulation therapy).[4] This relatively short-term study did not find an association between the duration of hospitalization and the detection of venous thromboembolism, but, over time, physicians' greater attention to the possibility of embolism formation has resulted in increased patient monitoring. A case report from 2012 regarding a 76-year-old woman with a CVC via the internal jugular vein reported that the patient's position during surgery (i.e. supine with a slightly flexed neck position) and the presence of the catheter caused lower venous blood flow velocity that probably contributed to the thrombus formation.[5]

On the basis of our clinical experiences and findings such as those in the case report just cited, we wondered if our patients who are not ambulatory also have an increased risk for venous thromboembolism. Accordingly, the purpose of this study was to evaluate the incidence, onset time, and related risk factors for perioperative catheter-related right internal jugular vein thrombosis in patients undergoing chest surgery.

Methods

This prospective observational study enrolled 24 patients who were scheduled to receive major chest surgeries and for whom CVCs were needed. Patients were included in the study if they met the following criteria: male and female patients who were 20–80 years old and whose physiological functions were between grades 1 and 3 (ASA class I–III according to the American Medical Association anaesthetist preoperative evaluation) and patients who received thoracic surgery and were expected to accept CVC placement at the Taipei Veterans General Hospital. Exclusion criteria for the study were the following: patients who had skin infections on the right side of the neck, making them unsuitable for placement of the catheter via the right side of the neck; patients who had blood coagulation lesions or bleeding tendencies; patients with thrombocytopenia; patients with a history of right internal jugular vein thrombosis; and patients who presented right internal jugular vein thrombosis or stenosis on preoperative Doppler ultrasound examination. The major outcome was catheter-associated thrombosis.

This study was approved by the Institutional Review Board of Taipei Veterans General Hospital (VGHIRB approval number 2013-02-026B) and all patients provided written informed consent. Patient characteristics, including surgery-related information, are presented in Table 1. Upon assignment to the study, each patient received an ultrasound examination of the internal jugular vein.

Procedures

At the outset of the study, patients met with investigators who explained the study and risks, along with an overview of the goals. At this time, patients provided informed consent. Before surgery, patients underwent Doppler ultrasound examinations of the neck from the thyroid cartilage level to the supraclavicular region. Patients were instructed to lie flat, with the head facing left. The anaesthetist placed the ultrasound probe (GE Healthcare, Chicago, IL, USA) flat on the centre of the right side of the patient's neck for non-invasive examination of the patient's right internal jugular vein beginning from the plane of the thyroid cartilage level and continuing to above the clavicle. This ultrasound examination surveyed the entire jugular vein, including the intended skin puncture site. Data from the scan enabled researchers to calculate the anteroposterior and lateral diameter of the vein (D_{ap} and D_{lat}, respectively) and to determine the cross-sectional area of the jugular vein ($[D_{ap} \times D_{lat} \times \pi]/4$) at the cricoid level. The goal was to confirm that the vein was free of thrombus or stenosis. These ultrasound images were stored on the instrument's internal hard drive and on an external hard drive to facilitate subsequent comparisons.

To begin the procedure, the anaesthetist induced anaesthesia and used standard aseptic methods to puncture the vein at the plane of the cricoid cartilage (central approach), and completed CVC placement (Two-Lumen Central Venous Catheter with Blue FlexTip; Arrow, Asheboro, NC, USA) using a special central venous catheter attachment base (StatLock Stabilization Device; Bard Medical, Covington, GA, USA) and a transparent biological dressing (Tegaderm; 3M, Minneapolis, MN, USA) to hold the catheter in place (spontaneous catheter dislodgement has been reported to have an incidence rate of ~4% and is associated with vigorous coughing and severe vomiting[6]). We recorded the placement time, number of punctures, and whether the catheter placement went smoothly. After completing the catheter placement, the anaesthetist used an aseptic ultrasound sleeve to wrap the ultrasound probe and performed continuous ultrasound examination of the right internal jugular vein from the puncture to above the clavicle. Ultrasound images were stored to facilitate subsequent examinations.

After surgery and while the patient was in the post-anaesthesia care unit, staff members used an aseptic ultrasound sleeve to wrap the ultrasound probe and performed continuous ultrasound examination of the right internal jugular vein from the puncture to above the clavicle and stored the ultrasound images. Daily bedside Doppler ultrasound examinations were used to monitor the patient and to check whether a thrombus had formed in the right internal jugular vein. If no thrombus was detected, the observation was recorded and daily observations were continued until the day after the catheter was removed. If a follow-up ultrasound examination identified a thrombus in the right internal jugular vein, the ultrasound images were charted and the locations were observed and recorded. If the diameter of the thrombus was >4 mm, the catheter was removed and additional ultrasound examinations were