Utility and futility of central venous catheterization

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ABSTRACT

Central venous access is useful for monitoring central venous pressure, inserting pulmonary artery catheter and administering vasoactive drugs in hemodynamically unstable patients. Central venous catheter (CVC) insertion through internal jugular vein may cause major vessel injury, inadvertent arterial catheterization, brachial plexus injury, phrenic nerve injury, pneumothorax, and haemothorax. We describe unusual presentation of hemothorax following CVC placement in a patient undergoing vestibular schwannoma excision. The patients’ trachea intubated after several attempts during which thiopentone up to 600 mg administered. Thereafter, under ultrasound guidance, an 18G introducer needle placed in the right internal jugular vein but guide-wire did not advance. Meanwhile, the patient became hemodynamically unstable and a CVC placed in right subclavian vein and norepinephrine infused at 0.05 µg/kg/min; simultaneously, 1000 ml normal saline administered through CVC. The hemodynamic instability attributed to thiopentone administered during endotracheal intubation. The surgical procedure cancelled, and the patient shifted to critical care unit (CCU). Mechanical ventilation continued. In CCU, hemodynamic parameters further deteriorated and 0.1 µg/kg/min epinephrine started. Bedside lung ultrasound showed a large collection in pleural space on the right side. Chest radiograph showed a homogenous opacity obliterating costophrenic angle on the right side. A possibility of hemothorax considered, chest tube inserted and 1000 ml sanguineous fluid drained. Blood sample drawn through CVC showed air from proximal and middle lumen but distal lumen drained blood. Another CVC placed in the femoral vein and subclavian vein CVC removed. The vasoactive drug infusion transferred to CVC in femoral vein and 2 units pRBCs transfused. Hemodynamic parameters gradually stabilized and the patient recovered completely.

Keywords: Central venous catheterization, hemothorax, hypotension, pneumothorax

Central venous catheter (CVC) insertion is generally utilized in the intraoperative and postoperative management of major surgical procedures including cardiac, vascular, thoracic and neurosurgical procedures. Central venous access is useful in administering vasoactive drugs, for the monitoring of central venous pressure, for the insertion of pulmonary artery catheter and for inserting pacing wires. CVC insertion is associated with several complications. We describe an unusual presentation of hemothorax following CVC insertion in right internal jugular vein in a patient scheduled for vestibular schwannoma excision.

CASE REPORT

A 32-year-old woman weighing 60 kg diagnosed with left-sided vestibular schwannoma presented for its excision. General examination and systemic examination were unremarkable; the airway examination revealed Mallampati Grade-III with short neck. Laboratory investigations results were within normal limits. The patient consented to publication of the case report.

On the day of surgery, the patient shifted to the operating room and monitoring started with electrocardiogram,
heart-rate, pulse oximetry, and non-invasive blood pressure. Anesthesia induced with fentanyl 100 mcg, thiopeptone 300 mg and vecuronium 6 mg. Bag and mask ventilation was not difficult but multiple attempts were needed to secure the airway with a 7.0-mm ID flexo-metallic endotracheal tube. To ensure adequate anesthesia and attenuate pressor response during repeated attempts to endotracheal intubation several boluses of thiopentone (total 300 mg) were administered. Anesthesia maintenance started with O₂, N₂O (40:60) and isoflurane and ventilation adjusted to endtidal CO₂ 30 mmHg. Thereafter, radial artery cannulated for arterial blood pressure (ABP) monitoring; and, a 18G introducer needle placed under ultrasound guidance in right internal jugular vein (IJV) for CVC insertion but the guide-wire could not be advanced through the needle and attempts to advance it failed. Meanwhile, ABP decreased to 70/40 mmHg. A landmark guided CVC, 7F, inserted in right subclavian vein, normal saline 1000 ml administered and noradrenaline infusion started at 0.05 µg/kg/min. ABP did not increase; in view of hemodynamic instability, the surgical procedure cancelled, and the patient shifted to the critical care unit (CCU). Mechanical ventilation continued. In CCU, hemodynamic parameters (systolic ABP 60-70 mmHg; HR 156/min) further deteriorated and epinephrine infusion started at 0.1 µg/kg/min. A bedside lung ultrasound of the right chest showed a large collection in the pleural space. Chest radiograph [Figure 1] further confirmed a homogenous opacity obliterating the costophrenic angle on the right side. Hemothorax was considered and immediately, chest tube inserted and about 1000 ml sero-sanguineous fluid drained over 45 min from the pleural cavity. Blood sample was drawn from central venous catheter for investigation; on aspiration, the proximal and middle lumen drained air, whereas the distal lumen drained blood. Another CVC was placed in the femoral vein and the CVC in subclavian vein removed. The vasoactive drug infusion transferred to CVC in the femoral vein and 2 units packed red blood cells transfused. The hemodynamic parameters gradually stabilized and the patient recovered completely. The patient later underwent vestibular schwannoma excision uneventfully.

DISCUSSION

CVC insertion is an essential skill for anesthesiologists as well as critical care physicians. Central venous access is useful for administering vasoactive drugs and irritant drugs; for monitoring central venous pressure; for insertion of pulmonary artery catheter and temporary cardiac pacemaker wires; for hemodialysis, for total parenteral nutrition, and when peripheral venous access is not available. Generally, CVC insertion is an innocuous procedure; however, several complications specific to site of CVC insertion are reported. Major vessel injury, hematoma, inadvertent arterial catheterization, brachial plexus injury, phrenic nerve injury are common to left as well as right IJV cannulation whereas thoracic duct injury specifically can occur in left-sided IJV or subclavian catheterization. Blitt and Wright reported puncture of an endotracheal tube cuff during catheterization of IJV. Most damaging complications are pneumothorax, hemothorax or pneumohemothorax. Complications are significantly reduced when CVC is placed under ultrasound guidance compared to the landmark-guided approach, but its placement has complications and is not completely safe. In non-cardiac surgery, where the chest is not opened, pneumothorax, hemothorax or pneumohemothorax may go unnoticed and may complicate intraoperative and postoperative management. Considering many complications of CVC, the caregiver should consider its risk-benefit and decide its use judiciously. The present patient developed severe hemodynamic instability that was attributed to multiple doses of thiopentone administered to ensure anesthesia and to attenuate pressor response during attempts at endotracheal intubation. Hemodynamic instability was aggravated by blood loss in pleural cavity; moreover, the vasoactive drugs and intravenous fluid administered for managing hemodynamic instability were ineffective as they were infused in the pleural space. Delayed diagnosis of malposition of CVC could be fatal; therefore, a prompt and accurate diagnosis of its life-threatening complications such as pneumothorax, hemothorax or hemopneumothorax must be made early. The clinical manifestations of pneumothorax/hemothorax depend on whether the patient is breathing spontaneously or mechanically ventilated. Awake

Figure 1: Chest X-ray shows central venous catheter, chest drain and obliteration of costophrenic angle suggesting pleural collection
and spontaneously breathing patients may develop respiratory distress, mild chest pain and desaturation; whereas mechanically ventilated ones develop sudden increase in the plateau airway pressures, in some cases, a decrease in expiratory volume can be a useful clue to diagnose pneumothorax. A decrease in breath sound or absence of breath sounds occurs depending on the severity of hemothorax/pneumothorax. Imaging techniques, chest X-ray, lung ultrasound and CT scan chest are confirmatory. A bedside anteroposterior chest radiograph done 2-4 hours after CVC can show air or collection. ‘Deep sulcus sign’ on chest radiograph is diagnostic of pneumothorax in mechanically ventilated patients. Sonographic signs include the absence of ‘lung sliding’, loss of ‘B lines’, presence of the lung point sign and ‘A-lines’. The ‘lung-point sign’ is 100% specific for pneumothorax and defines its border. In the present patient, lung ultrasound and chest X-ray confirmed the presence of large pleural collection; however, it is intriguing why the proximal and middle lumen of CVC drained air whereas distal lumen drained blood. Apparently, the proximal and middle lumen of the CVC were placed in the pleural space and drained air, whereas the distal lumen was lying in the collected blood (hemothorax) and aspirated blood; air can still be drained if there is lung injury and pneumothorax.

To summarize, aspiration of air from CVC should raise a suspicion of its placement in pleural space and a possibility of pneumothorax. No response to the administration of intravenous fluids and vasoactive agents further confirms the misplacement of CVC. In view of associated life-threatening complications of CVC insertion, the decision to place CVC in patients should not be taken lightly and its utility (benefit) versus risk should be considered before its insertion. In surgical procedures where its utility is uncertain, it should be used judiciously.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest
There are no conflicts of interest.

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