

poventilation, inadequate delivery of inhaled anesthetic gases, and contamination of the operating room, can be caused by disconnection or damage to the breathing circuit [3]. It can be detected by an audible leak sound, collapse of the breathing bag and ventilator bellows, inability to ventilate, decrease in oxygen saturation, fall in end tidal carbon dioxide, decrease in tidal volume and airway pressure [3,4]. Previous case reports have attributed corrugated circuit leaks to tube holders [3] and hot air fans [5]; however, the sharp tip of towel clip forceps is a unique finding. Thus, whenever anything is fastened to surgical drapes using a sharp object, feeling and identifying the objects underneath the surgical drapes, such as breathing circuits or intravenous tubing, is necessary to avoid unintentional damage. The routine practice of checking for leakage in the breathing system after draping can prevent major mishaps. Leaks in breathing circuits may lead to significant complications if they are not identified. Therefore, anesthesiologists' vigilance and preparedness in dealing with such situations can help prevent adverse outcomes.

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Peripherally inserted central catheters placed by anesthesiologists: an analysis of complications among 146 insertions

Peripherally inserted central catheters (PICCs) are inserted to provide central venous access for chemotherapy, frequent blood draws, nutrition, and antibiotic administration, among other indications. PICCs may be utilized on both an inpatient and outpatient basis, and are generally well tolerated and safe for extended use. Complication rates are generally related to the dwell time of the PICC and the severity of the patients' underlying medical conditions [1,2].

In anesthesiology, central venous access allows for central venous pressure (CVP) monitoring, aspiration of venous air embolisms, and effective hemodynamic control with vasoactive infusions in addition to providing additional access when peripheral circulation may be slowed (e.g., hypothermia) or unreliable (e.g., shock). The preferred sites for central line placement include the internal jugular, subclavian, or femoral veins; however, these sites are associated with variable rates of thrombosis, infections, pneumothorax, and other related complications [3]. The choice to place a central venous catheter at a particular site is made individually, considering the patients' underlying health status [3-5].

Literature on the insertion of PICCs by anesthesiologists in the operating room as an alternative route for central venous access in adult patients is lacking. At our institution, many neuroanesthesiologists routinely place PICCs in adult patients in the operating room. Therefore, we conducted this single-center, retrospective study, which was approved by the Institutional Research Board of Stanford University (IRB no. 61180). Through a review of patient medical records, a total of 146 patients were identified as having undergone PICC insertion in the operating room by an anesthesiologist at our institution. Information on any complications associated with the PICCs were extracted from these medical records and categorized as either infections, thromboses, or organ or tissue injuries.

Five different anesthesiologists were the attending physicians for these 146 patients. The mean age of the patients was 47.4 years. A total of 75 males and 71 females were included in this study. Ninety-eight PICCs were placed on the right upper extremity and 48 on the left upper extremity. Sterile technique was observed at all times during insertion, and all patients had a chlorhexidine disc placed and received surgical site prophylactic antibiotics. In all cases, a 20-gauge intravenous catheter was placed under ultrasound guidance and a modified Seldinger technique was used to insert the PICC. Immediately following insertion, the CVP and CVP waveform were recorded and evaluated to ensure that the catheter tip position was consistent with central

venous placement. A postoperative chest radiography was performed in all patients.

All of the included patients underwent intracranial procedures, including 73 neurovascular cases, 72 brain tumor cases, and one epilepsy case. None of the patients underwent chest radiography before arriving in the recovery room or the intensive care unit. The placement of the PICCs was distributed among the four anatomical sites (ante-cubital veins: 103, axillary veins: 27, basilic veins: 15, and cephalic vein: 1). Six PICCs had to be withdrawn for repositioning based on postoperative chest radiography results. The average dwell time was 2.52 days, for a total of 368 catheter days. The dwell times of the PICCs are shown in Table 1.

No infections, thromboses, or organ or tissue injuries were reported in any of the 146 medical records reviewed. No cardiac arrhythmias were observed.

In adults, inserting a PICC as an alternative to conventional central line placement or to provide secondary access has several advantages. First, because they are inserted through a peripheral vein, the risk of pneumothorax is extremely low. Second, they can be placed when the patient is awake. This is especially advantageous for a patient who is expected to require vasoactive infusions shortly after the induction of anesthesia, as the placement of a central line may distract the anesthesiologist. Third, PICC removal should not place the patient at risk of venous air embolism because the venous pressure in the upper extremity should not be negative.

Among all the PICCs inserted in adult patients by anesthesiologists in the operating room included in this study, no infections, thromboses, or organ or tissue complications were reported. This is likely at-

tributable to the short dwell time and routine use of prophylactic antibiotics. While a more extensive study is required to definitively establish the safety profile of PICC placement by anesthesiologists in the operating room, the absence of a single complication should aid in the promotion of widespread use of this technique for establishing central venous access.

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Table 1. Dwell Time for Peripherally Inserted Central Catheters

Dwell time (days)	Number
1	36
2	72
3	20
4	4
5	4
6	2
7	4
8	0
9	0
10	2
11	0
12	0
13	0
14	0
15	0
16	0
17	0
18	1
19	0
20	1