Editorial

Bringing ICU technologies to the operating room: Transforming patient care?

Anesthesiology has undergone significant advancements since WTG Morton's historic 1846 demonstration of general anesthesia (GA).[1] Safer anesthetic drugs and advancements in technology have enabled unprecedented surgical achievements. The first documented death under GA alerted the clinicians to monitor vital signs such as respiration, pulse, and skin color.[2] A better understanding of respiratory, cardiovascular, renal, and metabolic physiology led to precise targets and endpoints for ventilation, fluid management, vasopressors, and inotrope use. This goal-directed therapy has been in practice in the management of critically ill patients in the intensive care unit (ICU) for a long time.[3] Learning from the ICU experience, the technology for goal-directed therapy is also being used in operating rooms (OR) during anesthesia.

Invasive and minimally invasive hemodynamic monitoring have replaced non-invasive ones for major surgical procedures. Initially, it was invasive arterial pressure and central venous pressure monitoring only, but lately, minimally invasive cardiac output monitoring has been included as well. Several different devices based on pulse contour analysis are available, including the FloTrac/Vigileo system, PiCCO, and LiDCO systems to monitor cardiac output and optimize fluid administration perioperatively, just like in an ICU. ICU-developed protocols for goal-directed fluid therapy and monitoring of fluid responsiveness using stroke volume variation and pulse pressure variation are now standard in OR practice and have been shown to reduce the risk of complications, length of hospital stay, and mortality.[4] Other variables, in addition to cardiac output monitoring such as systolic volume, tissue oxygen markers, and echocardiographic measures, are also suggested for perioperative hemodynamic management.[5] These approaches facilitate precise fluid titration tailored to individual patient needs, minimizing both hypo and hypervolemia-associated complications.

The perfusion index; diameters and collapsibility of major veins such as inferior vena cava, subclavian, internal jugular and femoral vein; pleth variability index; and variations in the aortic velocity time integral have been studied for prediction of hypotension following both GA and spinal anesthesia induction.[6-8]

Similarly, restricted red blood cell transfusion practice, found safe in critically ill patients, is also being followed perioperatively.[9,10] The TRICC Trial and ABC Trial conducted in critical care settings showed the advantages of restrictive blood transfusion strategies.[9,11] Subsequently, similar trials on perioperative patients, such as the TRICS III trial, also demonstrated the non-inferiority of restrictive transfusion policy.[12]

The point-of-care testing including arterial blood gas monitoring, chemistry, co-oximetry panels, and coagulation testing has made its way from the ICU to the OR. With its fundamental advantage of rapid acquisition of laboratory data, it has been shown to be useful in the management of the surgical patient for guiding drug therapy, surgical strategy, and medical management.[13]

Once predominantly an imaging tool in critical care, ultrasound has become indispensable in the intraoperative setting. Ultrasound guidance for vascular access and nerve block has proved to enhance procedural accuracy and safety.[14,15] The cardiovascular ultrasound has demonstrated its utility for the assessment of left and right ventricular function, regional wall motion abnormalities, pericardial effusions, and gross valvular pathology and to establish the mechanism of shock.[16] In airway management, it helps in the identification of difficult airways, real-time guidance of endotracheal tube placement and confirmation of its position within the trachea, airway-related nerve block, emergent cricothyrotomy, and confirmation of fasting status (gastric ultrasound).[17-19] Additional uses of perioperative ultrasound include evaluation of intracranial pressure via ocular ultrasound, transcranial Doppler ultrasound, transesophageal echocardiography, etc.

ICU-driven advancements in mechanical ventilation (MV) strategies, including lung protective ventilation, are being used in perioperative respiratory management. Low tidal volume ventilation with open lung strategy, with or without recruitment maneuver, has been shown to reduce the risk of postoperative pulmonary complications (PPCs), atelectasis, and pneumonia.[20] Intraoperative ventilatory parameters associated with PPCs include higher mechanical power (MP), low dynamic respiratory system compliance (<30 mL/cmH_2O), low oxygen saturation (<96%), and lower end-tidal carbon dioxide.[21] In the current issue of this journal, Shaji *et al.*[22] reported the influence of an increase in intra-abdominal pressure (IAP) on ventilatory MP delivery during pneumoperitoneum for laparoscopic cholecystectomy. The prospective cohort study found that ventilatory MP delivery rises linearly with an increase in IAP. They have suggested that targeting an IAP-guided MP delivery could be an attractive approach for perioperative MV.

The use of ICU technologies in the OR apparently results in improved and more effective patient care during surgical procedures. However, it must be kept in mind that the patient profile in ICUs is very different from that of the OT in terms of hemodynamic instability, lung compliance, and multiple organ involvement. Therefore, extrapolating the various critical care technologies to routine OT patients may be of relatively less importance, and the benefits are yet to be quantitively established.

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