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EDITORIAL:

Safety Concerns with Combined Pediatric Procedures in a Single Anesthetic Episode

by Rebecca Hong, MD; Richard J. Berens, MD; and Bishr Haydar, MD, FAAP

Pediatric anesthesia professionals are frequently tasked with coordinating multiple surgical and/or imaging procedures in a single anesthetic episode in so-called "combined procedures."[1] This practice is common, comprising 6.5–26% of pediatric anesthesia cases[2] and includes examples such as combining a simple (e.g., myringotomy) and a more complex surgery (e.g., cleft palate repair) done by different surgeons; a child who cannot cooperate with care undergoing a surgical procedure combined with an echocardiogram and phlebotomy; a patient undergoing a surgical procedure and a radiology imaging procedure; and a patient undergoing a "triple scope"—direct laryngoscopy by otolaryngology, flexible bronchoscopy by pulmonology, and upper endoscopy by gastroenterology, all within the same anesthetic episode. Perceived benefits in combining procedures include increased access, efficiency, and convenience for patients and families; fewer preoperative episodes of fasting and anxiety; fewer inductions of anesthesia, intravenous cannulations, and intubations; fewer recovery periods; and reduced opioid exposure. Combined procedures may improve patient safety (for example, in patients with difficult airways) and may also reduce patient out-of-pocket expenses.[1] Despite the multitude of benefits, combined procedures can also be associated with significant risks to patient safety.[1-3] For example, endotracheal intubation is often chosen rather than less invasive airway management due to the need for transport, increased length of time under anesthesia, required procedural positioning changes, or the need for a controlled airway for one of the procedures. Additional real-world examples from the authors' institutions of complications in the context of combined procedures are noted below:

- An intubated infant was transported between imaging suites using a Jackson-Rees circuit that was improperly closed, resulting in bilateral pneumothoraces from barotrauma.
- A critically ill teenager required cardiac catheterization and bronchoscopy, and coughing during flexible bronchoscopy led to significant bleeding from the catheterization access site.
- A toddler with suprasystemic pulmonary hypertension experienced cardiac arrest during the fifth of five combined procedures, after 5 hours of anesthesia. The combination of prolonged anesthesia-related reductions in blood pressure and heart rate and use of intravenous contrast that worsened contractility contributed to this arrest.
- A child undergoing a planned combined tracheostomy and gastrostomy tube placement experienced inadvertent dislodgement of the fresh tracheostomy during the gastrostomy tube placement, resulting in respiratory-induced cardiac arrest.



Adverse intraoperative and postoperative events occur at a greater rate in combined procedures, compared to separate procedures.[1,2] This appears to be at least in part due to selection bias, as combined procedures are more often selected for medically complex patients, or those with significant behavioral or health care access challenges.[1,2] Other factors include prolongation of anesthesia duration, transport under anesthesia (if required), and negative interactions between procedures, where one procedure may negatively influence the success of the other procedure. For example, a surgical venous access device may become infected if combined with a laparotomy for perforated bowel, which is a "contaminated" wound class. Another example is a procedure where prompt postoperative neurologic exam is preferred (neurosurgery, orthopedic surgery), combined with procedures where some residual sedation may be preferred (cardiac catheterization).

In addition, hospital workflow is often designed for single-specialty care, resulting in the potential breakdown of safety systems during combined procedures. These safety mechanisms can include requirements for site marking, consents, and time outs, as well as electronic reminders, advisories, and checklists in the electronic health record (EHR). Specific documentation protocols may also be more difficult for combined procedures.

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Combining procedures often leads to significant inefficiencies within operating rooms and imaging suites. Schedules become interlinked, and a delay in combined procedures can adversely impact many other subsequent patients or concurrent patients in other rooms, as well as patients' families and the surgeons and proceduralists. In particular, adequate postoperative handoff by the surgeons may be challenging as they are likely engaged in a different case when their combined procedure patient is transitioning to the recovery unit. Some children experience markedly prolonged time under anesthesia amid unforeseen delays. Combined procedures may also reduce surgical productivity and operating room block utilization.[1,4]

At the individual patient level, the decision to combine procedures is highly nuanced. The decision should consider all relevant stakeholders, including the patient/family, anesthesia professionals, and proceduralists, as well as overall systems efficiency. To make this decision, anesthesia professionals can consider:

- Local guidelines and practice/experience with combined procedures
- Patient/family preference
- Patient-specific risk of prolonged anesthesia (combined procedures) versus multiple anesthesia episodes
- Social determinants of health/improving patient access to care
- Whether procedures have conflicting goals and requirements
- Whether specialized resources are required for anesthesia care (cardiac anesthesia team; pre- or post-anesthesia admission, ICU)

We suggest several interventions to attempt to improve patient safety and outcomes for combined procedures, including consenting patients specifically for combined procedures, as has been mandated at our institution (University of Michigan). We also suggest a maximum duration of four hours for combined procedures, based on a significant increase in observed adverse event rates beyond this time.[2,3]

In conclusion, combined procedures are common in pediatric anesthesia care, especially for medically complex patients, and offer multiple benefits for patients and families. However, combined procedures are associated with a higher adverse event rate. The decision to combine procedures should be individualized for the specific patient and planned procedures, taking into account the risks of prolonged anesthesia versus having multiple separate anesthesia episodes.

Rebecca Hong is a clinical assistant professor of anesthesiology at Michigan Medicine/University of Michigan Medical School, Ann Arbor, MI.

Richard J. Berens is a professor of anesthesiology and pediatrics at the Children's Wisconsin/Medical College of Wisconsin, Milwaukee, WI.

Bishr Haydar is a clinical associate professor of anesthesiology at Michigan Medicine/University of Michigan Medical School, Ann Arbor, MI.

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