The management of a difficult airway can be one of the most challenging clinical problems encountered by the anesthesiologist. The presence of a difficult airway is associated with increased morbidity and mortality [1]. Management of intubation difficulty in adult or pediatric patients requires efficient cooperation and effective communication among all clinical providers to ensure effective ventilation and decrease the occurrence of respiratory complications [2,3]. In addition, failed tracheal intubations are reported to be more common among the obstetrical population [4]. Recent studies have examined intubation techniques, neuromuscular blocking agents, airway equipment and improved algorithms for the detection and management of a difficult airway [5]. Our review highlights manuscripts published last year in the *Journal of Clinical Anesthesia* that pertain to all aspects of the clinical practice of anesthesiology.

### 1. Airway management

Delivery of the endotracheal tube into the trachea can be performed with various airway management devices. Flexible bronchoscopy has been established as the gold standard instrument for direct visualization of the airways but requires training. The video laryngoscope offers the advantage of direct visualization and may be more adaptable to use in emergency airway situations. Kurahashi et al. reported a successful tracheal intubation with the McGRATH™ MAC (McGRATH; Aircraft Medical Ltd., U.K.) video laryngoscope during chest compression in a difficult airway patient [6].

An intubating laryngeal mask airway (ILMA) can also be useful securing the airway as it allows unobstructed ventilation and can be used as a conduit to assist the placement of an endotracheal tube. In a randomized prospective clinical trial involving 40 adult patients, Hanna et al. investigated the use of an LMA Fastrach intubating laryngeal mask airway (ILMA) compared to flexible bronchoscopy (FB) for awake intubation in patients with difficult airways [7]. The number of attempts, time to endotracheal tube placement, patient satisfaction and adverse events were recorded. The authors concluded that the first attempt to endotracheal tube placement was significantly less in the ILMA group compared to the FB group (95%, 58%, *P* = 0.003). The success rate within three attempts was the same for both groups (95%). The time it took to place the endotracheal tube was greater in the FB group compared to the ILMA group; 246 s, 92 s; *P* ≤ 0.001. Patient satisfaction was not different between groups and no adverse events were reported.

Another type of laryngeal mask airway (LMA), Ambu® AuraGain™ LMA (Ballerup, Denmark) contains a larger port that can be used as a conduit for blind endotracheal intubation. In addition, it also has a...
gastrointestinal access port which minimizes the risk of aspiration [8]. Jang et al. reported that the AuraGain™ LMA with esophageal Doppler monitoring enables anesthesiologists to evaluate patients’ cardiac output accurately through a convenient probe insertion via a gastric drain port [9].

There are also many types of LMAs that are intended only for ventilation. Recent advances in supraglottic airway devices (SAD) have been shown to be associated with less peri-operative airway complications in children when compared to tracheal intubation [10]. In contrast to the first-generation devices, the second generation devices include a gastric port to reduce the risk of pulmonary aspiration of gastric contents. Liu et al. discussed the importance of the need for formal teaching and training with the use of the second generation LMA-ProSeal. Without proper experience with insertion technique and patient positioning, poor sealing pressure may occur when using the LMA-ProSeal [11].

A newer device, the Laryngeal Mask Airway Protector (Teleflex Medical Japan, Tokyo, Protector), is a single use SAD comprising of a pharyngeal chamber with dual gastric access ports. Moreover, it has an integrated cuff pressure indicator that uses three color bars showing the cuff pressure range (yellow < 40 cm H2O, green 40 to 60 cm H2O, and red > 60 cm H2O), allowing for rapid visual assessment [12,13]. These assessment of changes in airway pressure, for example due to perioperative positioning, which may be challenging for the clinician to detect using standard devices are clinically useful since high cuff pressures are a contributor to tracheal pharyngeal adverse outcomes such as transient sore throat [14,15]. Tan et al. described the placement of the LMA Protector in patients in beach-chair position receiving multimodal anesthesia including an ultrasound-guided interscalene block followed by general anesthesia [16]. All patients were fitted successfully on the first attempt with minimal dislodgement of the LMA Protector in situ during patient repositioning. Although the authors concluded that the placement was relatively smooth with confirmed placement (flexible video bronchoscopy) and positive ventilation, further studies are warranted with respect to advanced uses of the LMA Protector.

In maxillofacial surgeries and patients with a limited mouth opening, airway management is frequently performed with nasotracheal intubation. One of the most common complications following nasotracheal intubation is tissue damage leading to postoperative sore throat with a reported incidence of 40 to 66% [17,18]. Tachibana and colleagues investigated whether nasotracheal intubation using a fiberoptic bronchoscope reduces the occurrence of postoperative sore throat [19]. Using a numerical rating score (0 = none, 10 = severe) to assess sore throat 24 h after surgery, the authors reported that the severity was less in patients who received fiberoptic bronchoscope guided nasotracheal intubation compared to those who received the blindly guided Macintosh laryngoscope technique [IQR 0 (0 to 0), 1 (0 to 3), P = 0.0007]. In addition, the median time to completion of intubation was shorter with fiberoptic nasotracheal intubation [IQR 48 (32 to 80) s] than with the Macintosh laryngoscope [88 (56 to 110) s], P < 0.0001.

During nasotracheal intubation, the guidance of the tip of the nasotracheal tube into the glottis can be challenging, especially in patients with limited mouth openings. Yang et al. described a novel technique involving a wire attached to the distal tip of a nasotracheal tube allowing for manipulation of the distal curvature of the tube increasing the success rate of nasotracheal intubation [20]. This may be an alternative method in situations where the cuff inflation technique fails [21].

The incidence of difficult intubation has been reported to be as high as 5.8% in the general population and 16.7% in patients with a BMI > 30 kg/m² [22,23]. In a prospective observational randomized trial, Castillo-Monzon et al. compared the speed and success of tracheal intubation using either the Macintosh or Airtraq laryngoscopes in morbidly obese patients scheduled for surgery [24]. In the Airtraq group, 95.65% of patients presented a glottic view 1 and 2a (P = 0.006) and required less additional maneuvers to perform the tracheal intubation (P = 0.001) compared to the Macintosh group. In either group, there was no case of failed intubation or difficult intubation or ventilation reported. Similar to other studies, patients allocated to the Macintosh group did experience an increase in heart rate within 5 min after tracheal intubation [25]. The use of the Airtraq created less hemodynamic stimulus irrespective of the induction technique performed. The Airtraq device allows visibility of the glottic opening using less force than traditional laryngoscopy making it useful for assessing vocal cord mobility following thyroid surgery [26]. To improve Macintosh laryngoscopy placement, a lip pulling technique facilitates effective laryngoscopy and limits lip injuries [27].

When encountering a difficult airway, the gold standard of airway management is awake fiberoptic intubation, which requires numbing the upper airway to suppress the gag, swallow and cough reflexes [28]. Topical anesthetics, such as lidocaine, are routinely used to anesthetize the airway. Elkoundi et al. reported the use of nebulized administration of ketamine in a patient with documented lidocaine allergy [29]. The topical ketamine effect is thought to attenuate the local inflammatory response in addition to its peripheral analgesic effect. Previous reports have demonstrated that topical ketamine produced analgesia in patients suffering from neuropathic and cancer pain [30] as well as attenuating postoperative sore throat [31]. Nebulized ketamine as a single agent for awake fiberoptic intubation may be a viable option for airway blocks with further studies needed to evaluate its efficacy.

In a randomized clinical trial, Komasawa and colleagues compared the impact of stylet application for tracheal intubation for postoperative pharyngeal pain or hoarseness in patients undergoing elective surgery [32]. The incidence of postoperative pharyngeal pain was significantly higher in the stylet group (10/20 patients) than in the control group (2/20 patients; P = 0.013). The incidence of hoarseness did not significantly differ between groups (P = 0.45). The authors concluded that the stylet application itself increases the incidence of postoperative pharyngeal pain.

There are many contributing factors that increase the probability of encountering a difficult airway [33-35]. The presence of an anatomical mass in the head neck region can also make securing an airway very challenging and may require imaging as part of the airway management plan [36]. A major contributing factor affecting difficult intubation is the facial angle of the mandible. In a prospective study of 123 patients undergoing maxillofacial surgery under general anesthesia, facial angles were measured with a cephalometry. Difficult intubation was reported in 12% of patients with the facial angle ≤82.5° demonstrating a high sensitivity of predicting difficult intubation [37]. As an alternative to nasotracheal intubation and when orotracheal intubation is not practical, Altemir’s technique of submental intubation [38] may be performed successfully in maxillofacial surgeries and provide trans-mallary access to the cranial base [39,40]. In head and neck surgery, such as thyroid surgery, the use of electromygographic endotracheal tube has become popular to identify and monitor the recurrent laryngeal nerve to avoid injury [41].

Because a highly accurate single airway assessment tool does not exist, multiple assessments of patient and airway characteristics have been used in combination to predict difficulty in airway management [42]. One such assessment is the thyromental height measurement (THM). This assessment is performed by measuring the vertical height form the anterior border of the thyroid cartilage to the anterior border of the mandibule. The optimal sensitivity and specificity cut-off point of the THM measurement has been suggested to be at a cut-off point of 50 mm [43]. In a prospective, blinded study involving 451 subjects undergoing general anesthesia, Selvi et al. compared the predictive values of different airway assessment tests including the THM, the modified Mallampati test (MMT), upper lip bite test, and thyromental distance (TMD) measurement for prediction of a difficult laryngoscopy. The optimal cut-off points for THM for predicting difficult
amination was successful needle placement on compared to the palpation technique \( \text{P} = 0.001 \). Moreover, compared to the palpation group, patients in the ultrasound group demonstrated a successful needle placement on first attempt \( \text{P} = 0.01 \). The authors concluded that ultrasonography in spinal anesthesia significantly reduced skin punctures and increased the success rate on first puncture. Hypotension is a common side effect of spinal anesthesia and it has been postulated that the speed of the injection may play a role [53,54]. In a randomized controlled trial involving 77 adult Asian women undergoing cesarean delivery, Chiang et al. investigated the speed of spinal anesthesia injection and its effect on hypotension [55]. Patients were randomized either to receive a fast injection (2.3 mL in 15 s) or a slow injection (2.3 mL in 60 s) during their spinal anesthesia. Systolic blood pressure was assessed every minute for the first 10 min and the incidence of hypotension (reduction in blood pressure of > 30% of baseline) was recorded. The authors demonstrated that there was no difference in the incidence of hypotension between groups \( \text{P} = 0.497 \).

Patients with a body mass index of > 30 kg/m² represent a population that is technically challenging to identify the epidural space and increased failure rate for epidural labor analgesia. In a systematic review by Kula et al., obesity was associated with increasing technical difficulty and failure of analgesia for women undergoing labor prompting the suggestion, which has been previously reported [56,57], that providers should reserve more time for obese patients [58]. Women who are induced should also have more time to be counselled about the possibility of conversion to neuraxial analgesia [59].

Lumbar epidural analgesia solutions consist of local anesthetic alone or together with adjuvants that are added to improve the quality of analgesia [60]. Some adjuvants, such as neostigmine and clonidine, have been associated with hypotension, sedation, and bradycardia [61] prompting the search for alternative adjuvants with less side effect profile. Patients receiving a single intravenous perioperative dose of dexamethasone, an anti-inflammatory medication, experienced less postoperative pain and required less postoperative opioids [62]. In a double-blinded randomized controlled trial, Dubé et al. compared intravenous 8 mg dexamethasone in 50 mL normal saline to 50 mL of normal saline as an analgesia adjunct in labor analgesia [63]. The administration of study drugs for both groups began 45 min prior to the procedure. The average hourly drug consumption was significantly lower in the IV dexamethasone group as compared to the IV control group \( (10.34 ± 1.79 \text{ mL/h vs.} 11.34 ± 1.83 \text{ mL/h; mean difference 1.007, 95% CI 0.199–1.815; } \text{P} = 0.015) \). The median number of bolus doses was 4 (IQR 3–6) in the dexamethasone and control groups, respectively \( \text{P} = 0.162 \). The authors concluded that IV dexamethasone decreased hourly average drug consumption of levobupivacaine-fentanyl combination through the epidural route.

Pre-emptive treatment prior to surgery is one of many methods used to achieve better postoperative pain control. Li et al. conducted a meta-analysis of randomized controlled trials comparing the use of gabapentin with placebo in open hysterecomy procedures [64]. Postoperative opioid requirements and visual analogue pain scores (VAS) were recorded. The total opioid consumption at 24 h was less in patients who received gabapentin \( (\text{MD} = −11.61, 95\% \text{ CI:} −16.71 \text{ to } −6.51, \text{P} = 0.00) \). Moreover, the VAS pain score at 4, 12, and 24 h after the procedure were less in the gabapentin group \( \text{P} = 0.00 \). Similar to previous reports [65,66], the authors concluded that gabapentin was effective in reducing postoperative opioid consumption and pain scores after open hysterecomy.

Prior studies have suggested that ondansetron may antagonize acetaminophen due to their opposite effects on 5-HT3 pathways [67]. In a randomized double-blind controlled trial, Koyuncu et al. investigated the effect of ondansetron on analgesic efficacy of acetaminophen after abdominal hysterectomy [68]. One hundred twenty patients were given 1 g acetaminophen at skin closure and randomized to either ondansetron HCl (8 mg, 2 mL IV) or saline (2 mL IV). The primary endpoint was postoperative pain scores while at rest or sitting and 24-hour total opioid consumption. The median total postoperative opioid consumption during the first 24 h after surgery was no different between groups, \( (\text{ondansetron group 441 (280 to 578) mg, placebo group 412 (309 to 574) mg, } \text{P} = 0.95) \).

The authors confirmed that acetaminophen analgesia is partially mediated by serotonin receptors, but further studies are warranted to demonstrate clinical significance.

3. Regional analgesia and pain management

There continues to be development of novel ultrasound-guided
regional anesthesia techniques targeted to improve the quality of analgesia and increase patient satisfaction making peripheral nerve blockade a very attractive technique for the management of acute and chronic pain. Although patient-controlled analgesia (PCA) is frequently administered for postoperative pain following abdominal surgery, paravertebral blocks has been reported to provide better pain relief and reduce opioid consumption compared to iv opioid regiments [69]. In addition, paravertebral blocks have shown analgesic efficacy in patients presenting with multiple rib fractures [70]. Yenidunya et al. investigated the efficacy of ultrasound-guided thoracic paravertebral block intraoperatively and 24 h postoperatively in patients undergoing donor nephrectomy. Thirty patients received general anesthesia and were randomly allocated to either a unilateral paravertebral catheter (bupivacaine) or patient controlled analgesia with morphine. Intraoperative remifentanil consumption was higher in the morphine group, and postoperative morphine consumption was significantly lower in the paravertebral group, P < 0.001. The authors found no difference in pain scores among groups during the first 24 h after surgery. The authors concluded that continuous thoracic paravertebral block provides good intraoperative stability with a low anesthetic requirement and reduces postoperative morphine consumption for up to 24 h [71].

The quadratus lumborum block is a deep muscle abdominal wall block in which local anesthetic is deposited in the space between the quadratus lumborum muscle and the medial layer of the thoracolumbar fascia. The local anesthetic can extend into the paravertebral space providing effective somatic and visceral pain relief [72]. Several reports have described various techniques of performing the block such as the Sindwani technique for laparoscopic nephrectomy [73], the anterior sub-costal method for lower abdominal surgery [74], the ‘Gaurav-Aditi’ technique [75], the paramedian sagittal oblique approach [76], transmuscular posterior approach [77], continuous analgesia via catheter for open nephrectomy [78] and lumbar spinal fusion [79,80]. Ishio et al. compared bilateral ultrasound-guided posterior quadratus lumborum (UG-QLB) blocks (20 mL of 0.375% ropivacaine) to normal saline in patients undergoing laparoscopic gynaecological surgery under general anesthesia [81]. Numerical pain scores at rest and movement did not become different between groups until 1 h following surgery where they were higher in the control group compared to the UG-QLB group, P ≤ 0.001. At 24 h after surgery, NRS scores remained higher in the control group, P ≤ 0.001.

Postoperative pain following breast cancer surgery remains a clinically difficult challenge despite the addition of new peripheral nerve block techniques [82,83]. A recently described technique targets the internal mammary region by numbing the anterior branches of the intercostal nerves Th2 to Th6 which has been demonstrated to provide perioperative pain relief following median sternotomy [84]. Two patients had infections but no patient developed a hematomas or pneumothorax [85]. Ushishima et al. investigated the difference in local anesthetic spread between the sagittal and transverse approaches of the ultrasound-guided transversus thoracic plane (TTP) block [86]. The larger the local anesthetic spread the better perioperative pain management. Similar to the findings in a cadaveric study [87], the authors concluded that the sagittal approach to TTP block spreads over a wider area than the transverse approach in a clinical setting. Perioperative pain relief following breast cancer surgery can be achieved with pectoral nerve blocks however, the internal mammary region is missed which may result in incomplete analgesia. The local anesthetic is placed between the pectoralis major and the pectoralis minor muscle and above the serratus anterior muscle to block the pectoral, intercostobrachial, III-VI intercostal, and the long thoracic nerves [88]. Together with a pectoral nerve blockade (PECS), the transversus thoracic muscle plane block has been shown to be effective in providing analgesia following breast cancer surgeries [89-91].

Prolonging the analgesia of peripheral nerve blocks with adjuvants has been a topic of investigation for many years with dexamethasone leading the way [92-95]. Sakae et al. evaluated the effect of intravenous or perineural dexamethasone with 0.75% ropivacaine ultrasound-guided interscalene brachial plexus blocks on the duration of analgesia following shoulder surgery [96]. In a randomized control trial, sixty adult patients were randomized to either 20 mL of 0.75% ropivacaine with 1 mL of isotonic saline, 20 mL of 0.75% ropivacaine with 1 mL (4 mg) perineural dexamethasone, or 20 mL of 0.75% ropivacaine with 1 mL of isotonic saline and intravenous 4 mg dexamethasone. A blinded observer assessed the onset of the block using pinprick assessments assessing the sensory distribution every minute up to 20 min following needle placement. The postoperative evaluation was performed every 3 h (up to 24 h) and then every 6 h up to 48 h after surgery. The authors concluded that the duration of the motor and sensory block was prolonged in patients who received perineural 4 mg dexamethasone compared to those patients in the intravenous dexamethasone or control group (P < 0.05). Future studies investigating the dose-response of systemic dexamethasone are warranted [97].

An alternative to opioid based intravenous patient-controlled analgesia is ultrasound-guided transversus abdominis plane (TAP) block for postoperative pain management of patients following abdominal surgery including patients undergoing hepatectomy [98,99]. Patients have reported moderate to severe pain following procedures such as laparoscopic cholecystectomy [100]. The duration of pain relief after a single-shot TAP block is 6 to 12 h hence the attractiveness of placing a continuous catheter for postoperative analgesia. Choi et al. compared the analgesic efficacy of ultrasound-guided single shot and continuous TAP block to intravenous patient-controlled analgesia (IVPCA) in 108 patients undergoing laparoscopic cholecystectomy. Patients were randomized into three groups: Group A received IVPCA; group B received both ultrasound-guided single shot TAP block with 0.2% ropivacaine (20 mL) and IVPCA; and group C received continuous TAP block using an ultrasound-guidance-inserted indwelling catheter. The primary outcome was analgesic efficacy using the numeric pain rating scale at 48 h postoperatively. The authors concluded that compared to IVPCA with or without single shot TAP block, ultrasound-guided continuous TAP block provided similar analgesia in somatic pain and less analgesia in visceral pain [101]. Further studies are needed to investigate the duration of continuous TAP blocks beyond 48 h and the possible addition of local anesthetic adjuvants in improving the analgesia duration of TAP blocks [102].

A recent described peripheral nerve block technique called thoracolumbar interfascial plane (TLIP) block has been gaining popularity among anesthesiologists for postoperative pain relief following spine surgery [103,104]. The TLIP block consists of depositing local anesthetic into the fascial plane between the multifidus and longissimus muscles at the level of the third lumbar vertebra. The needle placement is near the surgical incision site which creates a risk of potential infection. Ahiskalioglu et al. described a modified approach called the lateral TLIP block which the needle placement is directed toward the fascial plane between the iliocostal muscle and longissimus muscles at approximately the level of the lumbar vertebra. Since the administration of local anesthetic is further away from the incision site there is less potential for infection [105,106]. The spread of local anesthetic was further evaluated by Ushishima et al. using ultrasound-guided placement of 10 mL of blue dye into the aforementioned fascial plane in three embalmed human cadavers [107]. The authors confirmed that spread of the dye reached the dorsal rami of the first to fourth lumbar nerves.

Patients with herpes zoster pain often experience severe physical disability and emotional distress making pain management challenging. Targeting the involved spinal segment via direct placement of analgesic medication may minimize undesired side effects. Kim et al. describes a novel technique that provides segmental epidural analgesia using an electrical stimulating catheter. By targeting the exact dermatome targeted during drug administration may reduce the amount of analgesics required [108]. Larger studies are needed to further investigate these promising alternative techniques in pain management.
4. Pediatric anesthesia

Patient anxiety in pediatric patients is frequently encountered prior to surgery and same-day procedures and usually requires pharmacological intervention [109,110]. Recent studies have demonstrated that increased anxiety has played a role in disrupting the healing process [111], increasing anxiety requirements including postoperative pain medications [112], increasing the risk of infection [113], and affecting the overall postoperative recovery [114]. The use of non-medication tactics, such as video games, cartoons, and clowns has been promising to alleviate preoperative anxiety in children. Aydin et al. investigated the role of distraction by giving children play dough (Play-Doh) prior to their scheduled elective surgery. The one hundred four children, ages 3 to 7 years, were randomized to receive play dough or not prior to the administration of oral premedication. The premedication anxiety was assessed using the modified Yale Preoperative Anxiety Scale (mYPAS) immediately after entering the preoperative holding area, 3 min after entering the preoperative holding area, and during the administration of premedication. There was no difference among groups upon entering the preoperative holding area. Children in the play dough group reported lower mYPAS scores at 3 min after entering the preoperative holding area, and during the administration of premedication compared to the control (P ≤ 0.001). The study demonstrated that distraction in the form of playing with play dough facilitated administration of oral premedication in children [115]. This finding is similar to a previous review that revealed that parental presence during induction of anesthe- sia (PPIA) did not diminish the child's anxiety and that future focus should be on non-pharmacologic interventions such as video games or clips [116]. Ozdogan and colleagues demonstrated that maternal presence during induction of anesthesia weakened salivary cortisol levels, a measure of physiologic stress, following induction and in the recovery room [117]. However, the authors did not find any signif- icant differences in the State-Trait-Anxiety Inventory and concluded that correlation between salivary cortisol levels and PPIA are unclear and that further studies are warranted.

The number of pediatric patients reporting postoperative pain re- mains unacceptably high which may contribute to maladaptive behav- ioral changes and perioperative morbidity affecting the child's overall well-being [118-120]. Opioids are the first line option for post-surgical pain control but emphasis on their safety and the potential of diversion has become a major concern among health providers and regulators. The lack of literature regarding the prescribing of analgesics following pediatric surgery continues the uncertainty of selecting the appropriate analgesics. Exploring data from a commercial insurance database, Van Cleve et al. investigated opioid prescribing patterns for ambulatory pediatric surgery in the United States from 2007 to 2014 and found that the type of analgesic prescription varies signifi- cantly by age and pro- cedure [121]. Acetaminophen with codeine was the most common drug for infants (63.8%), while acetaminophen with hydrocodone was the most common analgesic prescription for teens (53.6%). Both medic- ations were the predominant drugs used for all surgical encounters. The author's findings have added much needed information to improve postoperative care in ambulatory surgical patients.

The use of supraglottic airway (SGA) devices in airway management in children is becoming more popular among clinicians due to fewer peri-operative airway complications compared to tracheal intubation [122]. A meta-analysis of randomized controlled trials compared the LMA Supreme (Teleflex; Triangle park, NC USA) with the i-gel (Inter- surgical, Wokingham UK) and LMA ProSeal (Teleflex; Triangle park, NC USA) in children [123]. The primary outcome was oropharyngeal leak pressure (OLP) which is used as a marker for airway seal. The authors reported that use of the LMA Supreme was associated with similar oropharyngeal leak pressures (mean OLP difference of 1.57 cmH2O, P = 0.29) with the LMA ProSeal and the i-gel (mean OLP difference of 1.18 cmH2O, P = 0.48). The results suggest that the LMA Supreme is a possible alternative to the LMA ProSeal and i-gel [124].

The laryngeal mask airway is widely used in pediatric airway management with the flexible LMA popular for surgery involving the face. The insertion technique for FLMA is to advance until resistance is felt; however, proper positioning in children is challenging due to the anatomy of the airway [125]. In a prospective observational study, Lee et al. determined the FLMA insertion depth by examining the re- lationships between insertion depth and age, body weight, and height, in 154 children scheduled for ophthalmic surgery. After the induction of anesthesia, the FLMA placement was guided by the change in intracuff pressure monitored by a manometer. The position was assessed using a fiberoptic bronchoscope and the depth was recorded at the end of surgical procedure. In all patients, the FLMA was placed successfully in the first attempt. Following linear regression analysis, the insertion depth can be best predicted by height and weight (r² = 0.78) resulting in the formula: insertion depth of FLMA (cm) = 7.0 + 0.04 × height (cm) + 0.05 × weight (kg) [126]. In children, the resistance of the FLMA may be difficult to sense suggesting continuous monitoring of intracuff pressure may be useful.

The use of regional anesthesia techniques in the pediatric popula- tion is expanding; however, the optimal dose of local anesthetics is still primarily unknown [127]. In a dose-ranging study, Raof et al. inves- tigated the effect of dexmedetomidine on the potency of bupivacaine for transversus abdominis plane (TAP) block in pediatric patients un- dergoing hernia repair or hydrolecotomy [128]. Sixty patients aged 1 to 4 years received TAP blocks with either 0.125% bupivacaine, 1 mL/kg or 0.125% bupivacaine with 2 μg/kg dexmedetomidine, 1 mL/kg. Hemodynamic parameters were assessed for sixty seconds following surgical incision and compared to baseline recording. If the heart rate and mean blood pressure was > 20% of pre-incision values, the concen- tration of bupivacaine administered to the next patient would in- crease by 0.02% and vice versa if the parameters were less than pre- incision values. The minimum local anesthetic concentration of bupi- vacaine was 0.0899% in patients in the local anesthetic group com- pared to 0.0550% bupivacaine in the bupivacaine plus dexmedetomi- dine group (P < 0.001). In addition, the total postoperative morphine consumption was less in the bupivacaine plus dexmedetomidine group (0.11 ± 0.02 mg/kg) compared to the bupivacaine group alone (0.17 ± 0.04 mg/kg, P = 0.001). The addition of 2 μg/kg of dexam- metomidine reduced the minimum local anesthetic concentration of bupivacaine used for a TAP block in children undergoing inguinal hernia repair.

Ultrasound guidance allows direct visualization of nerves and can be useful in placing peripheral nerve blocks with low volumes. Successful ultrasound-guided infraclavicular plexus block in adults has been achieved with as little as 14 mL of lidocaine [129] to as much as 35 mL [130]. The use of ultrasonography to place peripheral nerve blocks has become an integral part of pain management in pediatric anesthesia [131]. In a randomized double-blinded clinical trial, Ince et al. compared bupivacaine 0.5% solution with 2% lidocaine (1:200 K epinephrine) in volumes of either 0.25 mL/kg or 0.5 mL/kg in pediatric patients undergoing emergent or elective arm, forearm, or hand sur- geries [132]. The duration of sensory and motor blockade and post- operative pain scores were recorded. Patients reported motor block duration of 168 ± 16 min in the low volume group compared to 268 ± 15 min in the high-volume group (P ≤ 0.001). Sensory an- algesia and postoperative pain scores assessed with the Wong-Baker Face Scale were not different among groups. Infraclavicular block success in pediatric patients can be achieved with lower volumes of local anesthetic using ultrasound guidance during needle localization [133].

The role of ultrasound in pediatric pain management is increasing due to its tolerability among children [134,135]. In a patient with ia- trogenic lateral femoral cutaneous nerve (LFCN) injury, Coraci et al. performed bilateral ultrasound evaluation of the LFCN which allowed identification of the lesion site and guided proper treatment [136]. The use of ultrasound as an additional tool for pediatric pain management is
useful in clinical settings.

5. Cardiac anesthesia

Cardiac surgery under cardiopulmonary bypass (CPB) may cause abnormal perfusion leading to local kidney ischemia hypoxia injury which may progress to acute kidney injury (AKI) in up to 30% of cardiac patients [137]. Strategies to limit AKI include the maintenance of renal perfusion and intravascular volume, avoiding high chloride intravenous fluids, and limiting the use of cardiopulmonary bypass. The deterioration of the kidney function is reflected by a reduction in the glomerular filtration rate. Conventional monitoring of the serum creatinine levels is performed to assess renal function but may take up to 48 h to detect [138]. Dexmedetomidine, a selective α-2 adrenoceptor agonist, has been reported to improve hemodynamic stability providing sedation following cardiac surgery and reduce the effects of postoperative lung and brain injury [139–141]. Zhai et al. investigated the effect of dexmedetomidine on renal function in patients undergoing cardiac valve replacement under cardiopulmonary bypass. Seventy-two patients were randomized to either dexmedetomidine (0.6 μg·kg⁻¹) or normal saline 15 min before anesthesia induction. Kidney function tests and biomarkers were performed prior to anesthesia induction, immediately after surgery, 12 h, 24 h, and 72 h after the procedure. Total urine output during the operation was recorded. Compared to the control group, the levels of serum urea nitrogen and creatinine were signifi-cantly lower in the dexmedetomidine group [142]. The increase in urine output was similar to a report by Leino et al. who demonstrated that intravenous dexme-detomidine increases urine output in patients scheduled for elective coronary artery bypass grafting [143]. The use of dexmedetomidine in patients undergoing cardiac valve replacement under CPB may lessen renal injury and decrease the incidence of acute kidney injury.

Comparisons in outcomes between total intravenous anesthesia or inhalation methods for various surgical procedures including cardiac surgery have been made [144–146]. Inhalation anesthetics may have cardioprotective properties and choice of anesthetic agent may reduce complications [147]. In a systemic review, Dib et al. compared the use of inhalation versus intravenous anesthetics for adults undergoing on-pump or off pump coronary artery bypass grafting [148]. The GRADE instrument was used to rate the overall quality of the trials [149]. Assessing 58 studies, two trials that demonstrated the use of sevoflurane showed a statistically significant reduction in death within 180 to 365 days of surgery (on-pump), RR 4.10, 95% CI 1.42 to 11.79; \( P = 0.009 \). Moreover, when compared to propofol, sevoflurane favoured less inotropic (RR 1.51, 95% CI 1.04 to 2.22; \( P = 0.03 \)) and vasoconstrictive (RR 1.51, 95% CI 1.04 to 2.22; \( P = 0.03 \)) support after coronary artery bypass grafting on-pump. The encouraging report of the high quality of evidence in this review suggests that sevoflurane has advantages when compared to intravenous anesthesia in coronary artery bypass grafting.

Patient selection and neuromonitoring may minimize the risk of ischemic strokes in patients undergoing CABG and carotid endarterectomy (CEA) procedures. The order in which CABG and CEA are performed may also increase morbidity. For example, CEA performed prior to CABG may increase the risk of myocardial infarction [150] where performing a CEA after CABG may lead to an increased risk of perioperative strokes [151,152]. The most important concern that is expressed during patient evaluation is postprocedure pain requiring analgesic medication. Intravenous opioids are routinely used to alleviate postoperative pain following CABG surgery but are limited by their adverse effects [153]. As a part of multimodal postoperative analgesia regimen, analgesics such as paracetamol and tramadol are commonly used as analgesic adjuncts after cardiac surgery to lower overall opioid requirements. Altun et al. compared the effects of oral tramadol with paracetamol on morphine consumption in patients undergoing CABG. As part of their postoperative pain management, all patients received patient-controlled analgesia (PCA) of morphine with boluses of 1 mg every 15 min. Patients were allocated to receive paracetamol + tramadol (Zaldiarc; 325 mg paracetamol, 37.5 mg tramadol) or identical matching placebo tablets. The cumulative morphine consumption, the total number of PCA demands, and boluses were lower in the tramadol + paracetamol group compared to the control group (\( P < 0.01 \)). The total morphine (mg) consumed as rescue analgesia was lower in the combination group (2.37 ± 0.52) compared to the control group (5.06 ± 1.0, \( P < 0.001 \)). The authors concluded that tramadol plus paracetamol combination as part of the PCA analgesia regimen reduces morphine requirements up to 50% after CABG compared to morphine PCA alone [154].

The occurrence of atrial fibrillation is a common complication after cardiac surgery and is associated with mortality [155,156]. Calcium channel antagonists and digitalis are routinely used to prevent postoperative atrial fibrillation however they have unwanted side effects such as bradycardia [157]. The American College of Cardiology Foundation/American Heart Association practice guideline for coronary artery bypass grafting recommends the use of perioperative beta-blockers to reduce the incidence of atrial fibrillation [158]. Previous literature reports the use of an ultra-short acting beta blocker, lidocaineflurane, significantly reducing the incidence of atrial fibrillation after cardiac surgery [159]. Tamura et al. conducted a meta-analysis on the prevention of atrial fibrillation after cardiac surgery using low dose lidocaineflurane. A total of six randomized trials consisting of 571 patients were included in the review. The incidence of atrial fibrillation within 1 week after surgery was significantly lower in the lidocaineflurane group then in the control group (OR 0.27; 95% CI 0.18-0.42; \( P = 0.001 \)). There was no difference between groups in-hospital mortality and complications occurred in 3 of the 6 trials, (0.7 vs 3.0%; OR, 0.45; 95% CI, 0.07–2.74; \( P = 0.39 \); and 4.5 vs 9.7%; OR, 0.45; 95% CI, 0.16–1.23; \( P = 0.12 \), respectively). Low-dose lidocaineflurane may help to prevent atrial fibrillation after cardiac surgery with further larger randomized control trials needed to evaluate patient safety [160].

6. Other clinically important studies in the journal in 2017

Supplemental oxygen delivery can be accomplished by a nasopharyngeal catheter or a naso cannula. King et al. investigated hypoxemia in patients undergoing intravenous general anesthesia for gastrointestinal endoscopy procedures [161]. Sixty patients were randomized to receive supplemental oxygen by either a standard nasal cannula or a nasopharyngeal catheter. Patients in the nasopharyngeal catheter group were less likely to experience a clinically significant oxygen desaturation (< 92%) event (3/27; 11.0% versus 12/30; 40.0%, \( P = 0.001 \)). Moreover, the number of airway assist maneuvers were less in patients who received the nasopharyngeal catheter (4/27; 14.8% versus 17/30; 56.7%, \( P = 0.001 \)).

The incidence of postoperative nausea and vomiting following surgery is still the leading complaint despite all the attempts to reduce the occurrence of this unpleasant side effect [162]. The incidence of PONV is 25% to 30% with women 4.6 times more likely to experience PONV than men [163–165]. The type of surgery is also known to be a risk factor for PONV; the incidence is particularly high in laparoscopic surgery [166]. In a prospective, randomized, double-blind, controlled trial Mishra et al. investigated the perioperative administration of 5% dextrose in reducing the occurrence of PONV in laparoscopic cholecystectomy [167]. One hundred patients were randomized to receive either normal saline or 5% dextrose preoperatively. Forty-seven patients experience PONV within 24 h of surgery. Fourteen patients experienced PONV compared to 33 patients in the normal saline group, 28% vs 66%, \( P = 0.001 \). Moreover, the administration of a single dose of rescue antiemetic medication was less frequent in the 5% dextrose...
group compared to the control group, \(P = 0.002\). The authors concluded that the perioperative administration of 5% dextrose can be helpful in reducing PONV following laparoscopic surgery.

The superiority of sugammadex compared to neostigmine has been well established in reversing rocuronium induced neuromuscular blockade [168,169]. Compared to neostigmine, sugammadex provides a faster reversal of neuromuscular blockade with a less likely occurrence of postoperative adverse effects [170,171]. Carron et al. performed a meta-analysis demonstrating that sugammadex accelerates time to discharge from the operating room to postanesthesia care unit and less noticeable from postanesthesia care unit to the surgical ward compared with neostigmine [172]. The suggested recommended dose of sugammadex ranges from 2 mg/kg for superficial blocks and in situations of high dose rocuronium the dose can be as much as 16 mg/kg.

In children, the suggested dose is 2 mg/kg. Sagun et al. presented a case where a 7-year-old child was accidently given 4.5 mg/kg of sugammadex causing chest wall rigidity [173]. With oxygen saturation and heart rate decreasing, 5 mg of rocuronium was given and the patient was intubated. Although it has been suggested to wait 24 h before re-administering rocuronium following sugammadex administration [174], this case adds to the literature where rocuronium was given within minutes after sugammadex and provided neuromuscular blockade [175]. Eskander et al. reported the occurrence of bronchospasms immediately after sugammadex administration during general anesthesia with desflurane maintenance. The authors suggest that anesthesia providers should be cautious with the co-administration of desflurane and sugammadex [176].

The number of orthopaedic surgeries, such as total hip and total knee arthroscopies has increased year after year and is projected to grow several folds in the next decade [177]. Patients over age 65 account for the majority of surgeries and are at increased risk of developing postoperative cognitive dysfunction [178,179]. In addition to increasing age, the choice of anesthetic, surgery related factors and acute postoperative pain have been correlated with temporary cognitive decline [180–182]. In a randomized double-blind controlled trial, Lu et al. evaluated the effect of parecoxib sodium pre-treatment with dexmedetomidine on elderly postoperative cognitive dysfunction after shoulder surgery. All patients received intravenously parecoxib sodium 40 mg and dexmedetomidine at a dose of 0.5 μg/kg over 15 min, followed by a continuous infusion at a rate of 0.5 μg/kg/h until the end of surgery. Patients were divided into 2 groups: sufentanil (0.04 μg/kg/h) and sufentanil (0.04 μg/kg/h) plus dexmedetomidine (0.06 μg/kg/h). The mini-mental status exam was measured 1 day before surgery and 1, 2, and 7 days following surgery. The authors reported that the incidence of postoperative cognitive dysfunction during the 7 days after surgery in patients who received sufentanil and sufentanil and dexmedetomidine groups was respectively 17.1% and 6.7%. Moreover, compared to the sufentanil group, the pain scores at rest and upon movement were lower in the first 48 h after surgery in the sufentanil and dexmedetomidine group. The improvement in postoperative pain may be a contributing factor for the reduction in postoperative cognitive dysfunction reported by these patients with further studies needed to support this interesting topic [183]. Sleep disturbances following surgery is a common occurrence and has been shown to affect cognitive performance [184]. In a prospective study involving 139 patients over the age of 65, Fan et al. compared 1 mg oral melatonin to placebo on ameliorating early postoperative cognitive decline in elderly patients undergoing hip arthroplasty. Patients who received exogenous melatonin experienced improvement in sleep quality and better performance on the mini-mental status exam compared to placebo suggesting a role of melatonin in improving cognitive dysfunction [185].

Nonsteroidal anti-inflammatory medications (NSAIDs) provide pain relief by disrupting prostaglandin E2 induced inflammation and are frequently a part of the opioid-sparing multimodal management of postoperative pain [186,187]. A meta-analysis of eight randomized controlled trials explored the role of NSAIDs in reducing postoperative pain at different time periods following lumbar spine surgery. Pain scores were summarized at three-time periods: 0 to 6 h, 12 h, and 24 h following surgery. Compared to the placebo group, the NSAID group reported lower pain scores at all three-time periods, \(SMD = −0.2, 95\% CI −0.98 to −0.45, 12 = 70.2\%, P < 0.0001\). In a subgroup analysis exploring COX-1 and COX-2 inhibitors, the reported pain scores were lower compared to placebo (COX-1: \(SMD = −0.45, 95\% CI −0.45 to 0.09; COX-2: SMD = −0.59, 95\% CI −1.21 to 0.03\). The authors concluded that NSAIDs showed significantly better pain management than placebo particularly in the COX-2 group [188]. In patients with chronic pain, the importance of utilizing non-opioid analgesic alternatives to opioid medication has led to novel treatments in pain management. White et al. describes the use of an FDA approved high intensity cold laser therapy to alleviate postoperative surgical pain in patients who had become addicted to prescription opioid-containing analgesic medication. Following 8 to 12 treatment sessions over a 4-week period, patients were able to discontinue their opioid analgesics and resume their daily activities. [189].

A number of clinically impactful studies and reviews were published in Journal of Clinical Anesthesia in 2017. We highlighted the advances published last year that has expanded our knowledge and advanced the field of clinical anesthesia. The extensive and practical knowledge published in the journal will improve the safety and outcomes for our patients.

Conflict of interest

The authors have no conflict of interest to disclose.

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