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湖上春来似画图，乱峰围绕水平铺。　　　唐　白居易

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主编之言

胸部手术麻醉

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胸部外科手术通常指在胸腔内器官的操作，包括肺部肿瘤切除术，肺叶切除术，全肺切除术，气管外科手术，肺移植术，食道手术，纵隔手术等。

开胸手术操作复杂且手术难度较大，手术中外科医生施行肺、气管、食道、纵隔等手术会给患者带来较大病理生理改变和创伤，严重者影响其心脏功能；于此同时麻醉医生需要保证患者通气顺畅，血氧适当和生命体征稳定，这非常考验麻醉医生的知识、临床经验、技能和麻醉管理水平。

安全顺利地完成开胸手术以及术后病患的无痛，无感染，迅速的心肺和其他器官功能恢复，除了外科医生的能力，与围术期麻醉医生的工作息息相关。

术前麻醉评估是开胸手术安全的第一步，包括病患呼吸、循环系统的生理病理变化，合并疾病以及其他器官系统的功能改变，对于麻醉以及手术创伤的适应和承受能力，病患对其手术的理解，配合和同意等。只有我们对患者的心、肺功能及合并疾病进行仔细评估，以及确定手术的涉及部位范围后，才能制定个体化麻醉方案，最大程度地保证患者的围手术期安全。

术中的麻醉管理对手术的成功尤其重要。根据不同病患的疾病和器官功能变化选择麻醉药物，麻醉深度，单肺通气，液体使用量，氧气量。生命体征指标的维持和监测以及与胸外科医生的良好沟通至关重要；手术和麻醉意外，低氧血症的紧急应对和即时处理等等，对麻醉医生来说仍时觉艰巨棘手。

手术完毕后麻醉恢复期应延续监护患者的呼吸循环功能，防止各种原因导致的并发症，如：呼吸道阻塞，肺水肿，低氧血症，高低血压，低温，意识功能受损和静脉血栓形成。

胸部手术后，手术切口疼痛使患者不敢深呼吸，易致肺部感染甚至呼吸功能衰竭。因此术后镇痛极其重要。术后给予充分镇痛有利于早期咳嗽排痰、改善肺功能、早日活动、缩短住院时间。目前主张术后多模式复合用药镇痛方法，静脉镇痛药镇痛以及胸部硬膜外神经阻滞镇痛。此外，椎旁阻滞、持续肋间神经阻滞等也时有用于开胸手术后镇痛。

随着胸外科的迅速发展，高难度手术比例日益增多，对麻醉医师的能力和技术提出了越来越高的要求。提高胸外科患者围术期安全性并加速患者的术后康复，依然任重道远！

本期专栏

Intraoperative Management of Hypoxemia during One-lung Ventilation: What is New?

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Abstract

Hypoxemia during one-lung ventilation (OLV) occurs frequently. It is a challenge all thoracic anesthesiologists will have to face and deal with. A thorough understanding of the physiology of oxygen delivery and tissue utilization is paramount in optimizing these patients during OLV. Oxygen delivery is recently discovered to be not correlated directly with peripheral oxygen saturation during OLV. Though the traditional means such as increasing FiO2, applying PEEP, adjusting I:E ratio, recruiting more alveoli to participate in oxygenation, and minimizing shunt are still important, the importance of hemoglobin concentration and cardiac output is

more emphasized in minimizing hypoxia at tissue level. We as the anesthesiologists will need to individualize the appropriate level of hemoglobin, assess the need for augmentation of cardiac output based on individual patients, and balance the relationship of oxygen supply and demand in order to optimize the clinical outcomes.

Keywords

Hypoxia, Hypoxemia, Oxygen delivery, One-lung ventilation, Thoracic anesthesia

Background

One-lung ventilation (OLV), facilitated by either a double-lumen tube (DLT), bronchial blocker, or other techniques, is utilized to exclude ventilation to the operative thorax in various cardiothoracic surgical procedures [1, 2, 3]. OLV leads to an obligatory shunt as circulatory perfusion to the operative, non ventilated lung is mostly maintained [2, 3]. Although hypoxic pulmonary vasoconstriction (HPV) redirects a portion of this shunt to the ventilated side [2,4] and modern anesthetic agents impair HPV to a lesser degree [2,4], about 4–10% of patients will still experience a transcutaneous oxygen saturation of less than 90% [1,2]. This level of oxygen desaturation usually triggers anesthesia providers' intervention due to concerns that organ system and cellular functions may be compromised or injured by the reduction in oxygen delivery [1, 2]. The traditional interventions usually include an increase in inspired fraction of oxygen (FiO2), a recruitment maneuver, an increase in positive end expiratory pressure (PEEP) to the ventilated lung, adjustment of inhalation: exhalation (I:E) ratio, and suctioning of the endotracheal tube [2]. If all these maneuvers fail to improve the peripheral oxygen saturation to an acceptable level (which is dependent upon the individual patient's medical condition and the providers' assessment of the situation), a low-level continuous positive airway pressure (CPAP) may be considered to be applied to the operative lung, after discussion with the surgery team [1, 2]. Resumption of intermittent two-lung ventilation sometimes becomes the last resort to maintain acceptable oxygen saturation level [1, 2, 4]. In recent decades, differential lung ventilation (DLV) is being utilized by some clinical anesthesia providers [5]. Keep in mind that among these corrective steps, each potentially has negative consequences/complications that may be overlooked. The anesthesia providers may develop a higher level of anxiety and discomfort towards a low peripheral oxygen saturation. Furthermore, oxygen delivery is not only dependent upon saturation but rather considered in context of hemoglobin level and more importantly cardiac output (CO) [2, 5]. Therefore, hypoxemia reflected by peripheral oxygen saturation readings will result in degrees of tissue level hypoxia that are highly patient-dependent. This review will briefly discuss: the factors determining tissue hypoxemia during OLV; the critical level of oxygen delivery; differential lung ventilation; and the optimal range of pulse oximetry.

Determinants of hypoxemia during OLV

Hypoxemia is traditionally defined as oxygen saturation lower than 90%, while Hypoxia is defined as inadequate oxygen level at the targeted tissues and organs. Hypoxia can be medically classified into four types: hypoxic hypoxia, anemic hypoxia, stagnant hypoxia, and histotoxic hypoxia [6]. Hypoxia is painless and signs and symptoms can be individually various. Hypoxemia during OLV is mainly attributable to the shunting process, which usually improves with time as long as HPV is mechanistically intact.

Oxygen delivery (DO2) is calculated as following: DO2= CO*[Hb*SaO2*1.34 + (0.003*PaO2)].

Based on this formula, we can obviously tell that oxygen delivery is largely determined by hemoglobin concentration, CO, and hemoglobin saturation (SaO2) [1, 2]. Any decline of these factors will decrease oxygen delivery (DO2) and will potentially cause end organ dysfunctions. This formula also suggests that decreased CO will decrease DO2, and that reduced hemoglobin level and/or hemoglobin saturation can be compensated by increased CO. Further extrapolating this will unveil that an oxygen saturation of less than 90% can be offset by normal or higher than normal CO. So theoretically we may need to focus on more than simple SpO2 when considering DO2, we may need to target an oxygen saturation in the clinical context of hemoglobin and cardiac output so global oxygen delivery will meet or exceed the physiological demand. Local and regional microvascular tone, tissue edema, and dissolved oxygen content (to a much lesser degree) can also significantly influence the rate that transported oxygen will be able to reach the mitochondria of target organs [2]. During OLV, the factors in the formula affected include hemoglobin saturation and dissolved oxygen content. Basically, optimizing ventilation, improving oxygenation at the ventilated lung, and minimizing the shunt will be critical to maintain oxygen delivery during OLV.

The critical level of oxygen delivery

The paucity of large-scale clinical investigations in the perioperative and thoracic surgery setting makes this question very difficult to answer. There is lack of studies assessing the minimum tolerable level of hypoxemia during OLV, or the consequence of the “transient but multiple” intraoperative hypoxemia on clinical outcomes, such as incidence of pulmonary complications, surgical infection, renal insufficiency, myocardial dysfunction, or postoperative cognitive dysfunction, and length of hospital/ICU stay. Hypoxemia is a common issue in all patients undergoing general anesthesia. Roughly 6.8% of surgical patients will experience a peripheral saturation lower than 90%, and 3.5% of surgical patients experience peripheral saturation lower than 85% for 2 min or longer [2]. Tissue hypoxia is driven by oxygen consumption (VO2)/DO2) mismatch. There usually exists a safety margin under normal physiologic circumstances where VO2 is relatively independent of DO2 via an increased extraction until a critical VO2/DO2 mismatch is reached, at which point hypoxia will ensue [2]. The VO2/DO2 relationship is organ and context specific and various factors such as temperature, intercurrent illness, and anesthetic agents can influence the critical value of VO2/DO2 mismatch [2]. General anesthesia per se can reduce VO2, thus creating a larger safety margin intraoperatively. Studies have shown that brief episodes of profound hypoxemia to a saturation of 50–70% in healthy humans are well tolerated without lasting consequences [7]. The range of 50-70% is far below the comfort and acceptance zones during OLV in patients of acute surgical stress and chronic comorbid conditions. A mildly hypoxic environment might be an emerging therapy applied to treat various illnesses from mitochondrial disease to spinal cord injury [2]. Studies seemed to indicate that short episodes of moderate (80–90% saturation) hypoxic exposures are well tolerated in awake patients with various comorbidities [2]. Hypoxemia during OLV is largely due to intrapulmonary shunt. DO2 was not well correlated with SaO2 during OLV. VO2/DO2 ratio of 0.3 does not seem to cause harm and continues to meet the oxygen requirements of the body.

Differential lung ventilation (DLV)

As mentioned above, traditionally hypoxemia during OLV is managed with increasing FiO2, More PEEP, higher I:E ratio, suctioning of endotracheal tube, recruiting more alveoli to participate in oxygenation, low level continuous positive airway pressure (CPAP) to the non-ventilated lung, and intermittent two lung ventilation. Here we discuss a technique as an alternative for CPAP or intermittent two lung ventilation [5]. DLV has been reported as a rescue strategy for patients with unilateral lung pathology [5]. However, these are mostly case reports or small case series. OLV involves anatomical and physiological separation of each lung into separate units, and is used in thoracic surgical procedures to either facilitate lung surgeries or to improve surgical exposure during other intrathoracic procedures [8]. Berg et al studied 30 patients and found that the use of DLV technique during OLV may improve patient's oxygenation better than CPAP to the non-ventilated lung. DLV may be applied when CPAP has failed during OLV [8], as a rescue strategy. Nakamori et al also found that DLV technique using two single-lumen tubes had several advantages in terms of safety and efficacy over the conventional double-lumen tube during the long period of DLV use [9].

What is the optimal range of pulse oximetry?

There is no consensus in regards to the optimal range of pulse oximetry. However, the trend is more and more acceptable to have a lower pulse oximetry reading. It is up to the anesthesiologist who will take care of the specific patient to determine the best range of acceptable oxygen saturation for the specific patient with unique pathophysiological conditions. And we should and could evaluate oxygen delivery to important vital organs selectively and continuously [2]. Beasley et al also proved that targeting SpO2 in the range of 92-96% may be more preferable to 94-98% [10]. It seems to be well tolerated when SpO2 is transiently in the range of 85-90% [2]. Regardless, it is very likely that most anesthesia providers will continue to maintain oxygen saturation SpO2 greater or equal to 90% [2].

Conclusion

Oxygen delivery in the status of general anesthesia during OLV is very complicated. Many factors, such as hemoglobin, cardiac output, and oxygen saturation, are all critical in maintaining adequate oxygen delivery. During OLV, optimizing ventilation and improving oxygenation at the ventilated lung while minimizing the shunt will be critical to maintain oxygen saturation and oxygen delivery. If oxygen delivery does not exceed oxygen consumption, cellular and tissue hypoxia will ensue. Though studies showed episodes of transient profound hypoxemia to 50–70% oxygen saturation in healthy patients are well tolerated [7], this range is beyond most anesthesia providers' comfort zone. Pulse oximetry reading in the range of 85–90%, with adequate cardiac output and hemoglobin level, will be more practical targets for the anesthesiologists. And most anesthesiologists will make all efforts to maintain SpO2 over 90% with all traditional measures, such as increased FiO2, increased I:E ratio, higher PEEP, to achieve adequate minute ventilation and oxygen saturation.

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The History of Double-Lumen Tube

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Abstract

Airway management is a landmark of medical modernization. Lung isolation with double-lumen tube is a critical development in thoracic surgery. Lung isolation can be achieved with various equipment in current anesthesia practice. The techniques for lung isolation have been evolving for the last century. This article briefly reviewed the history of Double-lumen tube and its importance in thoracic surgery. Newer and better technology will be developed and integrated into anesthetic management in the future.

Key words

Airway, Double lumen tube, Lung isolation, Bronchial blocker

The history of first airway management probably goes back to the year of 1543 when Belgian anatomist Andreas Vesalius performed a preliminary tracheotomy on a pig with reed or cane as a tube placed into the trachea and artificially ventilated by blowing down the tube. After slow advancement over the next 300 years, simultaneous developments in equipment and techniques facilitated evolution of the double lumen tube accompanying thoracic surgery and anesthesia advancement.

Freidrich Trendelenburg as assistant surgeon in Berlin produced the first inflatable cuffed tube with delicate double-walled Indian rubber tube surrounding slightly curved metal tracheotomy tube in 1869 [1]. It was placed through tracheostomy and the cuff prevented aspiration of blood and debris during surgical procedures of the upper respiratory tract. Surgeon William Macewen devised the very 1st orotracheal tube made with flexible metal to administer anesthetic with a sponge collar in 1880 [2]. The endotracheal tube was introduced by finger touch with a sponge occupying the laryngopharynx to prevent aspiration. Although physician Victor Eisenmenger was probably the first to use an inflatable cuff attached to an orotracheal tube in 1893, the cuffed orotracheal tube was not popularized till 1933 by head and neck surgeon Franz Kuhn who was the first to suggest the use of suction catheters down endotracheal tubes [3, 4].

Double-lumen tube (DLT) was initially developed in the physiology laboratory and progressed slowly and introduced into clinical practice over the course of the last century. Renowned physiologists Eduard Pflüger and Claude Bernard studied gas exchange with bronchospirometry in dogs. They designed a lung isolation catheter to separate the airways into two lungs while Wolffberg performed the study of how gases crossed into the blood from the lung using the catheter. It is the first conceptualized 'One Lung' ventilation in 1871 and essentially constituted an early example of endobronchial single-lumen tube [5]. Physiologists Head, Wolffberg, and Werigo performed further pulmonary physiology studies on dogs by intubating the left and right main bronchi separately using separate tubes. Head cleverly designed probably the first precursor of modern-day double lumen tube with two cannulas - a short tracheal cannula and a longer curved metal endobronchial one with an inflatable balloon while experimenting differential spirometry physiology in dogs and rabbits in 1889 [6]. Following this work, Werigo described a coaxial double-lumen tracheostomy cannula for dogs in 1892, which was later adapted by physiologists Hermann von Schrötter and Adolf Loewy in 1905 in devising the first double-lumen endobronchial catheter to achieve airway separation on humans while studying pulmonary hemodynamics and measuring cardiac output [7].

Since the first successful pneumonectomy for tuberculosis was performed in multiple stages by Macewen in 1895, high mortality rate remained a major challenge following surgery. Preoperative assessment to predict postoperative outcome was performed by physiologist Hans Christian Jacobaeus using invasive bronchoscopic catheterization on isolated lung in 1932 to allow unilateral bronchospirometry. Together with HC Jacobaeus, Dr. Paul Frenckner designed rigid metal coaxial double-lumen bronchoscope with a cuff at the distal end to cannulate either bronchus in 1933 [8]. Not only it measured regional ventilation but also provided information about regional perfusion. However, the technique never gained widespread popularity because of its technical difficulty and invasive nature. With emerging new material of rubber and plastic, left-sided latex rubber DLT for bronchospirometry was designed by surgeon Paul Gebauer in 1939 and William Zavod in 1940 [9]. The steel plate in its tip to guide positioning under X-ray was challenged to manipulate with inaccurate measurement due to high resistance.

Bjork and Carlens developed an improved left-side DLT with carinal hook in 1949 again for bronchospirometric studies and provided a significant role in anesthesia for thoracic surgery [10]. The tube provided better control of ventilation with separation of the two lungs and prevented spillover of secretion while maintaining stability. The tube is molded to the shape of the trachea with a long left main bronchus tube and shorter tracheal tube terminating above the carina and a carinal hook to facilitate correct position. The Bjork/Carlens DLT was shaped anatomically with side-by-side 2 “D-shaped” tracheal and bronchial tubes on the cross section and round tracheal part of the tube externally. DLT is blindly inserted with a bronchial tube first negotiated beyond the vocal cord with the help of curved metal stylet in it followed by 180° counterclockwise turning to bring the hook anterior and pass it beyond the vocal cord. The moistened silk thread slipknot, which tied the carinal hook to the tube preventing it from getting trapped at the vocal cords, was released after passing the tube through the larynx. The metal stylet was withdrawn followed by the tube rotating back 90° clockwise to bring the bronchial tube leftward and the hook rightward. The tube was pushed down the left main bronchus until resistance met with the hook hinging on the carina to provide stability and prevent tube advancing too far down into the unilateral bronchus without the need for radiograph for proper tube positioning. The left bronchus tube had anatomically angled distal bevel allowing easy entry into the left main bronchus and it was sealed off with a cuff on distal end. The right tracheal tube had an opening for ventilation and above this was the tracheal cuff. Its clinical potential was quickly realized and was introduced for the first time for resection of a tuberculous abscess in the same year. Since then, the value of the double lumen tubes has become widely appreciated in anesthesia for surgeries involving thorax, chest, mediastinum, and major vessels including aorta. Although a major advance, it complicated left pneumonectomy when the tube needed to be withdrawn to tracheal leading to ventilation difficulties. Together with increased risk of carina hook being truncated during surgery, other limitations from difficulty of intubation along with inadequate suction and high airflow resistance led to further attempt to improve on Carlens design.

With the introduction of a "slotted" cuff near the distal end of a single lumen tube by Green and Gordon in 1955 and 1957 [11, 12], it has made practical possible with right endobronchial intubation. White in 1960 designed a right DLT with carinal hook and slit endobronchial cuff with orifice overlying right upper lobe bronchus [13]. The placement of the right-sided double lumen tube is similar to Carlens left DLT with opposite orientation. The bronchial cuff is gently inflated until no air leak can be heard when the right lung is ventilated. A two-way union devised by Salt and White 1959 was connected to the DLT to allow both lungs ventilated simultaneously or individually with quick and easy control of the gas flow. It also permits suction secretions from one lung while ventilating the other lung [14, 15].

Around the same time Roger Bryce-Smith simplified left DLT tube by removing the carinal hook but adding pilot tubes for cuff inflation for easier placement and manipulation in 1959. He also re-oriented the tracheal and bronchial portion of the tracheal part anteroposteriorly in the anatomical position with less trauma to the vocal cords on insertion compared to Carlens side-by-side DLT. However tracheal opening of the tube sitting over the anterior aspect of the carina rather than the right main bronchus made suction difficult.

Frank Robertshaw combined features of Carlens’ side-by-side lumen, Green-Gordon’s slotted bronchial cuff of the right-sided tube, and Bryce-Smith’s pilot tubes for cuff inflation into the rubber walled tubes in 1962. This prototype tube increased lumens diameter and had undergone trial and error over two and half years including considerable experimentation with the curve of the tube. Emerging new cheaper rubber compound made the tube slightly firmer and less easily damaged by boiling. He finalized his design of left-sided tube posteriorly angled at 45° related to carina and right-sided slotted cuff tube at an angle of 20° at the carina. The Robertshaw tube not only allowed large bore suction but also proved less resistance to airflow [17]. His choice of blue colored bronchial cuff continued to this day because it contrasts well with the pink bronchial mucosa. The significant development of the Robertshaw DLT tubes established widespread clinical practice. While addressing the problems of cuff herniation and mucosal damage from red rubber reaction and rigidity, manufacture has changed from rubber to plastic polyvinyl chloride (PVC) based on the Robertshaw design. Disposable plastic Robertshaw DLT has been developed and used since the 1980s.

Modern DLT based on the design by Robertshaw advances with modifications. The right-sided Broncho-Cath DLT has a unique S shaped bronchial cuff that increases the area of the right bronchial orifice [18].

Patients with very short-right mainstem bronchus may benefit from Cliny® right-sided DLT featuring two ventilation slots with a long oblique bronchial cuff [19]. In contrast, Sher-I-Bronch developed two bronchial cuffs on right-sided DLT, one above and one below the slot with distance of 13 to 14 mm long in between for ventilation of the right upper lobe bronchus for anatomic variations.

Fuji Systems developed Silbroncho DLT made from 100% silicone with flexible wire-reinforced short endobronchial tip. This feature decreases kinking and allows X-ray verification of the DLT placement [20].

Dr. Sunit Ghosh invented Papworth BiVent tube in 2008 with two side-by-side D-shaped lumens which split into a fork that fits onto the carina with bronchial blocker being inserted down the lumen to isolate the lung without FOB guidance. It may facilitate lung isolation by anesthesiologists who occasionally perform OLV [21, 22].

Correct position of DLT has always concerned clinical practitioners during initial placement, subsequent reposition, and during surgical manipulation causing malposition and dislodgement. Confirmation of correction position advanced from fluoroscopy, ultrasound, bronchoscopy to fiberoptic bronchoscopy. VivaSight™ with continuous visualization of the airway with camera initially was developed for the single-lumen tube by inventors including James Simon in 2010 and has been evaluated in the following years [23]. A high-resolution (76,800 pixels) 2 mm camera with light source is embedded between the tracheal and bronchial cuffs of the VivaSight™ DLT with a field of view of 100° diagonal with flushing system for in situ cleaning of the camera due to heavy secretions.

DLT has its limitations in small patients, lesion along pathway of DLT, difficult airway, or critically ill patients with single-lumen endotracheal tube (ET) placed not tolerating brief tube exchanging, etc. Bronchial blocker and intentional mainstem are alternative methods to achieve lung isolation and provide one-lung ventilation for these patients. Bronchial blockers can use single-lumen endotracheal tube (ET) with intraluminal or extraluminal ballooned catheter such as Univent, Arndt, Cohen, or EZ-blocker although they tend to deflate the isolated lung slowly. Fiberoptic bronchoscopy is often used to facilitate the bronchial blocker placement and adjust position when dislodged or misaligned.

In summary, DLTs were introduced from early animal and human physiology experiments and have evolved into clinical practice (Table 1). These developments will continue with new technology and material in the modern era with real-time visualization, built-in suctioning capacity, easily converting to single-lumen tube, and minimized airway trauma.

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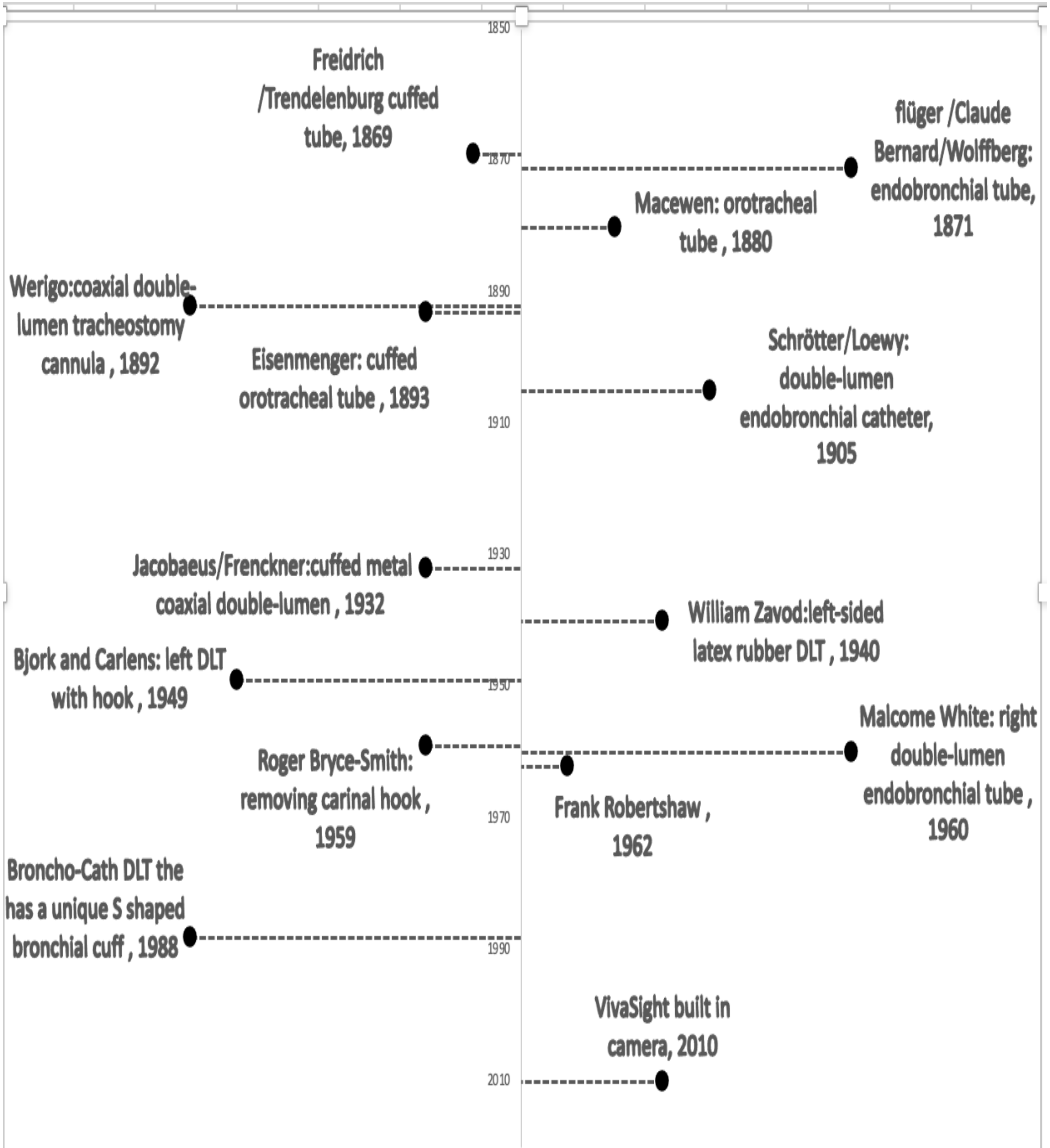

Table 1. Timeline of double lumen tube development

What you see is not always what you get. Controversies on video-assisted laryngoscopy

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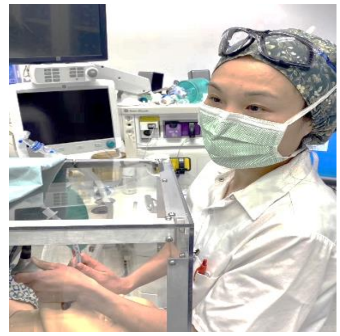


Video-assisted laryngoscopy (VL) was invented in 2000 by Dr. John Pacey. Superior glottis visualization and ease to learn have surged VL popularity ever since for 2 decades. Some airway experts even advocate VL replacing traditional direct laryngoscopy (DL) completely for intubation. Debate aside, there are limitations associated with VL. One of them is apparently underappreciated and worthy of discussion.

It is not uncommon to encounter the situation that an endotracheal tube (ETT) cannot be inserted into the trachea despite a good view on the VL screen. (1) Not being aware of this limitation creates a false sense of security when anesthesiologists are dealing with a difficult airway. Airway injury and complications ensue when the anesthesiologists fixate on repeating the futile intubation attempts, under the delusion that "what you see are what you get". The truth cannot be any further.

Before discussing the underlying reason for the VL limitation, revisiting the fundamental mechanism of DL is warranted. To visualize the glottis, it is important to align the 3 axes of the mouth, pharynx, and larynx. After sniffing position, tongue displacement toward the left, the Macintosh blade is then inserted further into the oral pharynx and lifted as leverage to expose the glottis to sight. If a Miller blade is utilized, tongue displacement is not indicated. Therefore, the passage for ETT insertion is created linear, as it follows the trajectory of eyesight from above the patient's upper incisors to the glottis.

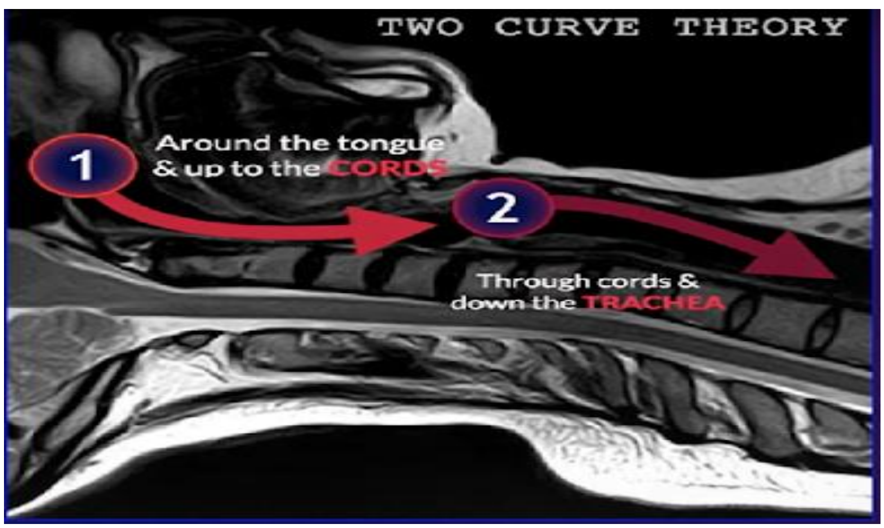
Another important contribution of DL facilities intubation can be explained by the 2-curve theory (2), which divides the patient's upper airway into a primary curve (from teeth to vocal cords) and then a secondary curve (from vocal cords to carina). The vocal cords are the inflection point between the primary and secondary curves. It is the most critical point for intubation. (see figure) DL not only aligns the 3 axes as mentioned above, more importantly, it actively flattens the inflection point and makes it more straightened out. Therefore, once the ETT has reached the glottic opening, passing through it along the secondary curve encounters less tortuosity.

Despite the optimal sniffing position and DL techniques, the rate of successful DL is about 85%. Unable to secure the airway has been the primary anesthesia complication for decades. Compared to DL, VL revolutionized laryngoscopy by two key elements, 1) the built-in camera in the blade; 2) hyperangulation of the blade (about 60 degrees). This hyperangulation is a double-edged sword. It facilitates the visualization of glottis at the expense of being more difficult to intubate. The blade of VL is not able to actively align the 3 axes of the upper airway, and more importantly, there is no flattening of the inflection point of VL compared to DL. Therefore, the trajectory of ETT is not linear. Instead, it must follow the primary curve of the upper airway and then climb over the inflection point and finally accommodate the secondary curve. That is the root cause of the limitation of VL: What you see is not always what you get.

In clinical practice, there are some tips to help with this situation, in an acronym CUP2 Holder.

1) Curve of the style matters.
2) Pull back the scope 1-2 cm.
3) Pull stylet 1-2 cm while simultaneously keep advancing ETT through the glottis.
4) Hold ETT at the distal end instead of the middle of ETT like the traditional DL.

    1) The closer the curve of the style matches the primary curve of the patient, the easier it is to intubate.
    2) Pulling back the laryngoscope slightly gives more room to intubate at the small compromise of the glottic view on the screen.
    3) When the ETT tip is in the vicinity of VC, ask a helper to slightly pull back the stylet while simultaneously advancing the ETT through the VC. The style pulling creates a subtle upward momentum of the ETT tip.
    4) Holding the ETT more distal translates into a more efficient maneuver of the tip of ETT.



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Extubation Criteria: When should you pull the tube?

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According to the Fourth National Audit Project (NAP4) of the Royal College of Anesthetists and the Difficult Airway Society, major airway complications occurred during emergence or in recovery in approximately one third of the reported cases relating to anesthesia [1, 2]. Factors contributing to these major adverse events included poor airway management strategies, inadequate assessment of risk factors for airway difficulty, and overall failure to plan [1, 3]. Since the introduction of the Difficult Airway Algorithm by the American Society of Anesthesiologists in 1993, which has traditionally focused heavily on intubating and securing the airway, several authors have noted a significant reduction in the number of severe outcomes related to tracheal intubation [1,2,4,5]. During the same period, there has not been a significant decrease in the rate of severe airway adverse events related to extubation [3, 4, 6]. One study by Asai et. al even found that the incidence of respiratory complications associated with tracheal extubation was 7.4% higher than during tracheal intubation [6].

While there is no consensus on the definition for extubation failure, it has traditionally been defined as the need for reintubation within 24-72 hours of a planned extubation [7, 8, 9,10]. However, this does not differentiate between two distinct subcategories of extubation failure. More recently, several authors have used the definition of "Inability to tolerate removal of the endotracheal tube," for extubation failure [3, 7]. This is in contrast to weaning failure, which is defined as "inability to tolerate spontaneous ventilation without mechanical support" [3, 7]. Rates of extubation failure in the operating room and recovery is reported at 0.1-0.45% with certain types of procedures, specifically endoscopy and various head and neck procedures, reporting significantly higher reintubation rates [3,8,11]. In contrast, extubation and weaning failure in the ICU is reported at much higher rates of 2-25% [3,8,10]. Regardless of location, reintubation typically occurs within 2 hours of planned extubation and rarely occurs more than 24 hours after [8]. According to a 2005 analysis of the ASA Closed Claims Project, nearly one in six deaths related to anesthesia (17%) occurred after extubation in the operating room or PACU [4].

Factors that increase the risk for extubation failure can be divided into two categories: patient factors and surgical factors. Patient factors include anatomic abnormalities of the head and neck; conditions such as obesity and/or obstructive sleep apnea; respiratory muscle weakness such as myasthenia gravis, amyotrophic lateral sclerosis (ALS), or muscular dystrophies; permanent respiratory insufficiency which may require supplemental oxygen at home due to COPD, interstitial lung disease, or restrictive lung disease; pregnancy; rheumatoid arthritis which may involve deviation of the larynx, arthritis of the cricoarytenoid joints, laryngeal tumors, and limited TMJ motion; and Parkinson's disease which may involve laryngeal tremor, vocal fold bowing, and abnormal glottic opening and closing. Surgical risk factors include surgeries of the head and neck, cervical spine, upper airway, maxillofacial procedures, and obstetrics. Duration of surgery is also a factor with longer surgeries being at higher risk for extubation failure [3,7,11].

There are four general techniques for extubation: awake, deep, staged, or delayed. Each has associated risks and benefits.

> *Awake extubation*: Removal of the endotracheal tube occurs when the patient is "fully awake" with return of airway reflexes. Benefits of this technique include return of airway tone, reflexes, and respiratory drive which allows the patient to maintain their own airway. Disadvantages include patient discomfort and agitation which can lead to throat pain, possible pulling of lines, and disruption of surgical sutures as well as other patient or provider harm. This technique may be favored in patients with obesity, obstructive sleep apnea, or other conditions that place them at increased risk for airway obstruction, as well as in patients with anatomic abnormalities of the head or neck which may make reintubation more challenging.

> *Deep extubation*: Removal of the tracheal tube occurs before return of airway reflexes. Benefits of this technique include possible decreased incidence of coughing, bucking, and hemodynamic effects of tracheal tube movement. Deep extubation is associated with an increased risk of upper airway obstruction and is contraindicated when mask ventilation is likely to be difficult, there is an increased risk of aspiration, history of difficult intubation, or suspected airway edema [11]. This technique may be favored in patients undergoing head and neck surgery where coughing and bucking at extubation may cause disruption of sutures leading to bleeding and hematoma formation as well as at surgical centers with rapid turnover and PACU staff experienced with recovering patients after deep extubation.

> *Staged extubation*: Replacement of the tracheal tube with another airway device which may be less stimulating to the patient while also providing some insurance against airway obstruction or a conduit to facilitate rapid reintubation. Replacement devices include laryngeal mask airway, airway exchange catheter, or elective tracheostomy.

> *Delayed extubation*: Deferring extubation in order to optimize hemodynamic, respiratory, metabolic, and logistical factors. This may be the safest choice in unstable patients or when the time of day or location do not provide adequate equipment or support personnel to facilitate safe extubation. It is generally recommended to have the same level of support equipment and personnel available at both intubation and extubation.

Extubation Guidelines and Algorithms

For routine extubation of the normal airway, similar criteria, parameters, and expected values are mentioned by multiple authors [7, 8, 9,12,13,14]. They include the following:

Stable vital signs: stable heart rate, blood pressure, respiratory rate, oxygen saturation, and temperature within accepted ranges relative to the patient's baseline values

Adequate reversal of neuromuscular blockade: Typical goals include four strong twitches on train-of-four testing and sustained tetany at 50Hz. Strong handgrip and unassisted head lift for >5 seconds has also been described. It is important to note that even with four strong twitches on ToF, up to 70% of receptors can still be blocked by residual neuromuscular blocking agents.

Adequate respiratory mechanics: spontaneous respiratory effort and adequate tidal volume which some sources list as 5ml/kg, though closer to 3ml/kg, especially in obese patients, is likely adequate. Negative inspiratory force of -20cmH2O or better is also listed, though this is more commonly measured in the ICU than in the operating room.

Acceptable arterial blood gas on 40% FiO2: Can be done if readily available with goal pH >7.3, PaO2>60mmHg and PaCO2<50mmHg. Again, this is more commonly measured in the ICU. End Tidal CO2 is sometimes used as a surrogate for PaCO2, though the reliability of this is questionable.

Cuff leak test and airway inspection: Recommended if there is increased risk or concern for airway edema.

If performing an awake extubation, the patient should be awake, alert, and able to follow commands. Sustained eye opening may be substituted for pediatric patients and patients unable to understand commands. There should also be evidence of return of airway reflexes such as swallowing, cough, or gag reflex. If performing a deep extubation, these signs should be absent.

Guidelines for Extubation of the Difficult Airway

2022 ASA Practice Guidelines for Management of the Difficult Airway: Latest update of the guidelines that provide more extensive guidelines for extubation than previous iterations. They include having a preformulated strategy for extubation and subsequent airway management depending on the surgery or procedure, other perioperative circumstances, condition of the patient, and skills and preferences of the clinician; assessing patient readiness for extubation; ensuring that a skilled individual is present to assist with extubation when feasible; selecting an appropriate time and location for extubation when possible; assessing the merits and feasibility of short-term use of an airway exchange catheter and/or supraglottic airway that can serve as a guide for expedited reintubation; evaluating the risks and benefits of an elective surgical tracheostomy; evaluating the risks and benefits of an awake extubation versus extubation before the return of consciousness; using supplemental oxygen throughout the extubation process whenever feasible; and assessing the clinical factors that may produce an adverse impact on ventilation after the patient has been extubated [15].

The guidelines can be summarized by the mnemonic OPERA

- O: Oxygen – Give supplemental oxygen whenever feasible
- P: Plan – Have a plan for extubation and post-extubation airway management, as well as awareness of clinical factors that may have an adverse impact on post-extubation ventilation
- E: Extubation technique – Consider the merits of awake, asleep, or staged extubation, as well as surgical tracheostomy
- R: Readiness – Assess patient readiness for extubation
- A: Available – Select the right time and place so that help is available

2012 Difficult Airway Society Guidelines for the Management of Tracheal Extubation: Guidelines that ". . . discuss the problems arising during extubation and recovery and promote a strategic, stepwise approach to extubation" [2]. A basic extubation algorithm is described, with specialized sub-algorithms for low-risk versus at-risk extubations, as well as detailed descriptions of several advanced and staged extubation techniques [2]. The four steps of the algorithm are as follows:

Step 1: Plan Extubation – Assess for airway risk factors such as known difficult airway, airway deterioration, restricted airway access, obesity, OSA, or aspiration risk; as well as general risk factors such as baseline cardiovascular instability, impaired respiratory function, neurological or neuromuscular impairment, metabolic abnormalities, special surgical requirements, and/or special medical conditions.

Step 2: Prepare for Extubation – Optimize patient and other factors and ultimately select the low-risk vs. at-risk algorithm depending partially on the factors found in Step 1 and partially on real-time evaluation. Optimization includes correction of cardiovascular instability, neuromuscular blockade reversal, adequate fluid balance, adequate analgesia, and optimization of temperature, acid/base status, electrolytes and coagulation status, as well as ensuring an appropriate location with skilled assistance, monitoring, and equipment available. Real-time assessment includes an upper airway assessment for edema, blood clots, trauma, foreign bodies, and airway distortion, preferably under direct or indirect laryngoscopy; larynx assessment via cuff leak test; and lower airway assessment which may require chest radiography in addition to evaluation of respiratory mechanics and auscultation.

Step 3: Perform Extubation – Done according to the low-risk vs. at-risk algorithm. General guidelines applicable to both algorithms include minimizing interruption of oxygen delivery to the patient's lungs via pre-oxygenation; proper positioning such as supine, reverse Trendelenburg, or left side down depending on patient risk factors; suctioning of the airway prior to extubation to remove secretions; utilizing alveolar recruitment maneuvers; placing a bite block; and avoiding sequelae of airway stimulation. Pharmacologic agents that may be used to attenuate the effects of airway stimulation include lidocaine, which may reduce coughing and can be administered topically at intubation, into the cuff of the endotracheal tube, or intravenously before extubation; opioids such as remifentanil, which can suppress the cough reflex; and ketamine, beta blockers, calcium channel blockers, magnesium, or clonidine which can all be used to attenuate cardiovascular and respiratory changes associated with extubation [16].

According to the low-risk algorithm, the clinician must choose between a deep extubation vs. an awake extubation. According to the at-risk algorithm, the clinician must first determine whether or not it is safe to remove the endotracheal tube. If yes, an awake extubation vs. an advanced technique such as a laryngeal mask exchange, remifentanil infusion, or airway catheter exchange should be chosen. If not, the choice must be made between postponing extubation or tracheostomy.

Step 4: Post-extubation care – Close monitoring in recovery of levels of consciousness, vital signs, pain scores, and concerning airway signs such as stridor, agitation, and obstructed breathing problems. Signs of surgical complications such as increased drain losses, decreased flap perfusion, airway bleeding, and expanding hematomas should also be monitored closely. It is also important to remember that life-threatening complications following extubation are not restricted to the immediate postoperative period. For example, mediastinitis secondary to airway perforation or other airway injury often presents with severe throat pain, deep cervical pain, chest pain, dysphagia, fever, or crepitus after the patient has left the PACU and returned to their hospital room.

Advanced Extubation Techniques

The Difficult Airway Society Guidelines describe several different advanced extubation techniques in detail. The first is replacement of an endotracheal tube with a laryngeal mask airway, also referred to as the Bailey Maneuver. When the patient is at a deep plane of anesthesia and breathing 100% oxygen, a laryngeal mask airway should be deflated (if possible) and placed in the mouth between the endotracheal tube and the palate under laryngoscopy with the tip of the LMA properly positioned over the upper esophageal sphincter. Once properly placed, the LMA should be inflated, the endotracheal tube cuff deflated, and then the endotracheal tube removed while maintaining positive pressure. At this point the circuit should be switched from the endotracheal tube to the LMA. Benefits of this technique include maintaining a patent, unstimulated airway for emergence with an emergence profile reportedly superior to both awake or deep extubation [17, 18, 19]. This technique may be beneficial in patients with increased risk for bronchospasm, such as severe asthma, with concurrent risk for obstruction such as history of obstructive sleep apnea and/or obesity. It should be avoided in patients in whom reintubation would be difficult or if there is an increased risk of regurgitation.

Another technique described is the remifentanil extubation technique. Remifentanil can be used to suppress cough and cardiovascular changes upon extubation, allowing for a smooth and comfortable emergence. Other anesthetic agents, such as volatile anesthetic, nitrous oxide, or IV infusion should be stopped once the remifentanil infusion has been started and with enough time left before the end of the procedure to allow for adequate washout or elimination. Ventilation should be continued and extubation should not be performed until the patient opens their eyes to command and is maintaining adequate spontaneous respiration. The challenge of this technique is titrating the remifentanil infusion to avoid apnea or hypoventilation while maintaining an adequate depth of anesthesia. It is also important to remember that remifentanil has no long-term analgesic effects, but can still be antagonized with naloxone if necessary. Patients who may benefit from this technique include those undergoing septorhinoplasty where awake extubation should be performed since positive pressure ventilation with face mask is contraindicated, but coughing and bucking can disrupt surgical sutures.

A third advanced extubation technique described involves leaving a catheter in the airway after extubation, such as a bougie or airway exchange catheter, to facilitate rapid reintubation or jet ventilation if a hollow catheter is used. Placement of this catheter should occur through the endotracheal tube just prior to extubation, and extubation should be performed carefully to ensure the catheter tip remains mid trachea at all times. The duration of time this catheter should remain in place is not specified, though one study by Mort et. al. noted the duration to be a range of 5 minutes to 72 hours with a mean of 3.9 hours post-extubation [20]. Evidence shows a significantly increased first-pass success rate of reintubation with this technique (87% vs. 14%) as well as decreased rates of complications during reintubation including hypoxemia, bradycardia, and multiple intubation attempts [20]. Patient tolerance of this technique varies, though there is some evidence that smaller bore catheters tend to be less stimulating to the airway [21]. Of note, utilizing the Cook airway exchange catheter in this manner is an off-label use, but Cook makes a specific staged-extubation catheter set that is available outside the United States [8, 22]. This technique may be beneficial in patients with significant comorbidities that necessitated an awake fiberoptic intubation.

Extubation in Children

Differences in psychological development, ability to follow commands, and anatomical differences necessitate a different set of extubation criteria for children. Templeton et. all found that of nine commonly utilized criteria for awake extubation in infants and children, five were positively associated with successful intubation: Eye opening, facial grimace, conjugate gaze, purposeful movement, and tidal volume > 5ml/kg. While none of these five criteria was superior to the others, the presence of greater than one of the predictors conferred a stepwise increase in the likelihood for successful extubation. With only one of the predictors present there was an 88.3% chance for successful extubation, but with all five they found a 100% chance for success. The greatest increase occurred between 2 and 3 factors, with an increase from 88% to 96% chance for successful extubation [23].

Summary

Extubation is an elective procedure, and a preformulated plan should always be in place before attempting extubation. Evaluation of patient readiness for extubation and optimization should be performed and include stable vital signs, reversal of neuromuscular blockade, adequate respiratory mechanics, suctioning of secretions and placement of bite block. Blood gas evaluation and airway inspection may be performed if there are concerns for laboratory abnormalities or airway edema. If performing an awake extubation, the patient should be awake, alert, and able to follow commands, with return of airway protective reflexes. If performing a deep extubation, airway protective reflexes should be absent to avoid an increased risk of laryngospasm. While complications encountered during basic extubation of the normal airway are typically minor, a small but significant number have serious consequences [2].

For extubation of the difficult airway, the 2022 update of the ASA Guidelines for Management of the Difficult Airway provides expanded extubation guidelines emphasizing supplemental oxygen throughout the procedure, having a plan for extubation and post-extubation airway management, selecting the appropriate extubation technique given the patient's status and comorbidities, ensuring patient readiness for extubation, and selecting an appropriate time and location to perform the extubation where appropriate equipment and personnel are available [15]. The Difficult Airway Society Guidelines for the management of tracheal extubation, published in 2012, provides a step-wise approach to extubation emphasizing planning, preparation, clear identification of "at-risk" patients, and the use of adjunct equipment and techniques as appropriate. Specific advanced extubation techniques described in the Difficult Airway Society Guidelines include replacement of the endotracheal tube with a laryngeal mask airway prior to extubation, known as the Bailey maneuver; extubation under a continuous remifentanil infusion; and exchanging the endotracheal tube with an airway exchange catheter to allow extubation but with a device to facilitate rapid reintubation during the immediate post-extubation period [2].

Current existing guidelines do not specifically address extubation of the pediatric airway and adaptation of the guidelines to pediatric patients is impractical in some cases. Recent research has suggested that certain commonly used extubation criteria in children are associated with higher successful extubation rates [23]. These include eye opening, facial grimace, conjugate gaze, purposeful movement, and tidal volume >5 ml/kg. None of the criteria was found to be superior, but the presence of one or more had a step-wise increase in the likelihood of success. The largest increase occurred between the presence of two and three of the relevant criteria where the likelihood of success increased from 88.4% to 96.3%.

While extubation is successful the majority of the time in the operating room, complications are commonly associated with extubation and a significant number of serious complications have been reported. There has recently been an increased focus on providing more robust guidance, training, and skills in regards to extubation. However, further research is needed to determine the impact of these guidelines, as well as their applicability to special populations.

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单肺通气中的困难气道管理

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Abstract

单肺通气在胸腔手术中常用于协助暴露视野，通常会使用双腔管或者阻塞导管来进行肺隔离。但这在疑似或已知困难气道的病人当中会极具挑战性。本文将通过回顾文献来讨论最新的 ASA 困难气道指南，术前评估，和各种针对困难气道肺隔离的技术和替代方法。

关键词：困难气道，单肺通气（肺隔离）双腔管 阻塞导管

2022 ASA 困难气道管理指南

Dr. Zhao Yang

2022 年 1 月 ASA 更新了 2013 年出版的困难气道管理指南（图 1）[1]。新的版本建议在气道管理的全程和术后拔管过程中辅助给氧，包括考虑全程使用低或高流量鼻导管给氧，头高位，以及应用无创通气进行预氧合。而且还着重强调了在麻醉诱导后插管失败时应尽早寻求帮助和限制使用不同器械和技术的次数，在通气充足但无法插管时要考虑是否将病人唤醒。尤其是在之后出现无法通气的紧急情况下要特别注意时间的流逝，在准备实施有创气道的同时考虑使用其它替代方法 ，包括但不限于视频辅助喉镜，不同的喉镜片，可协助插管的声门上气道装置，纤维支气管镜，气管内插管导引器，光导管芯，光棒，刚性导管芯以及从外部纠正喉部的位置等。关于有创气道的建立，选项除了外科环甲膜切开术，环甲膜穿刺合并喷射通气，逆行气管插管，气管切开和刚性支气管镜外，首次提出考虑实施体外膜肺氧合（ECMO）。新一版的指南多次出现并强调了限制插管的次数和注意缺氧的时间以避免不可逆的脑损伤，这在危急的情况下往往容易被忽略 。

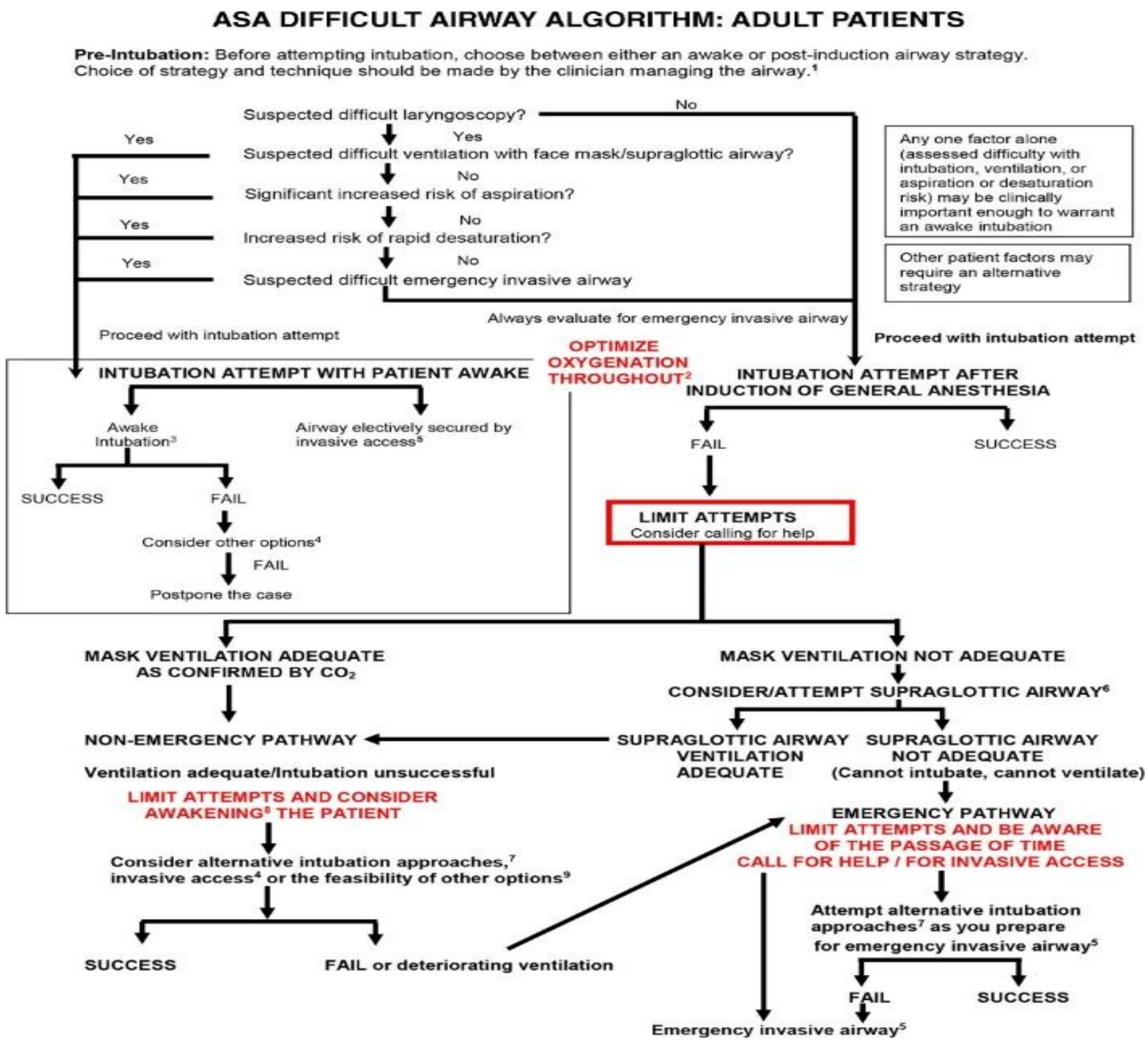

图 1 2022 年 ASA 困难气道管理指南 [1]

术前评估

目前对于单肺通气的困难气道术前评估并没有明确的标准，但是如果病人存在困难气道的病史或者危险因素通常预示着单肺通气尤其是双腔气管插管会极具挑战性。术前评估气道的方法除了常用的面部和下颌解剖特征外 [2]， 新一版的困难气道指南还提到了使用术前超声评估皮肤舌骨间距，舌体积和皮肤会厌间距 [1]。此外术前床旁经鼻内镜检查，影像学和断层扫描也被运用于术前气道评估 [3]。针对于单肺通气的气道评估，还应当包括气管和支气管解剖和病变。因为气管和支气管的移位，压迫和占位病变往往会排除使用双腔管的可能性 [4,5]。

根据最新的 ASA 困难气道指南，如果术前评估可能会出现喉镜显露困难，但是没有面罩或者声门上气道通气困难，同时没有误吸和快速氧饱和下降的风险以及紧急有创性气道建立困难的病

人，可以尝试在全麻诱导后进行插管。如果对任何一个上述条件有疑虑，应当考虑在病人清醒状况下插管或建立有创气道[1]。对于困难气道的病人来说，建立气道往往是首要目标，然后再考虑怎样进行单肺通气。

双腔管和困难气道

双腔管，尤其是左侧双腔管最常被用于单肺通气。其特点包括能够快速和有效地进行单肺和双肺通气之间的转变，拥有相对较大的内径有利于吸引出血和分泌物，以及进行支气管镜检查。右侧双腔管较少被使用，但有时被用于左肺手术，尤其是左主支气管的病变。由于相对较短的右主支气管和右上肺支气管开口位置的变异性，放置右侧双腔管更具挑战性。

常用的双腔管比普通气管内导管硬度更高并且管径更大。即使是常用于成人的最小的 35Fr 双腔管的外径为 11.5 毫米，和普通 8.5 毫米气管内导管的外径相当。这使得放置双腔管，尤其在疑似困难气道的情况下难度进一步增加，而且还增加了气囊损伤的机率[6]。为了防止气囊（尤其是气管气囊）受损，可以考虑使用牙套，润滑气囊和视频辅助喉镜辅助插管[7,8]。对于术前疑似困难气道的病人，有很多临床病例报道成功使用各种视频辅助喉镜如 Glidescope (Verathon, Seattle, WA)[9,10]，McGrath (Aircraft Medical, Edinburgh, UK)[11,12]和 Airtraq (Prodol, Viscaya, Spain)[13]来辅助放置双腔管。虽然视频辅助喉镜的技术日新月异，有些作者仍然认为直接使用纤维支气管镜放置双腔管为“金标准”[5,14]。很多时候可视喉镜可以清楚地暴露声门， 但是仍然不足以引导成功地放置双腔管。遇到这种情况可以考虑使用纤维支气管镜通过双腔管的支气管腔作为可视管芯，同时在可视喉镜的引导下以增加双腔管放置的成功率[15]。

如果术前评估放置双腔管的失败机率较大，这时候应当把成功建立气道作为首要目标。当然和外科团队的术前讨论也至关重要，包括是否必须要实施单肺通气，是否必须要使用双腔管和考虑其他替代方法如阻塞导管或者间歇性呼吸暂停的可行性。如果经讨论后仍然决定双腔管为必需，可以遵循 ASA 困难气道指南进行普通气管插管，然后使用气道替换导管引导双腔管的放置。双腔管的长度依管径大小和不同的生产商从 40-45 厘米不等[16]。考虑到替换导管需要在牙龈线以下 20-25 厘米，所以用于置换双腔管的导管长度需要至少 70 厘米以上。替换导管需为软性尖端以防止支气管和气道的损伤，而且管腔应为中空以进行紧急喷射通气（通常为 15-50psi[17]）。在放置过程中应当充分润滑，而且要防止导管过深（超过牙龈线 25 厘米）以避免气道损伤和需要喷射通气时造成气压伤[18,19]。理想状况下，双腔管置换应当在视频辅助喉镜的引导下完成。在置换过程中，双腔管往往会在声门位置遇到阻力，可以考虑适当旋转双腔管（有作者推荐 90 度逆时针[5]）以帮助其顺利通过声门。

除了传统的 PVC 材质的双腔管外，新型的双腔管可能在困难气道管理中更有优势。如 FuJi Silbroncho 双腔管（Fuji Systems）为硅胶材质并且使用钢丝增强（图 2a）。和普通双腔管相比尖端呈锥形，质地更软并且可塑性更强，从而降低气道损伤的可能性[20]，而且在双腔管置换时更易于通过声门[21]。VivaSight-DL 双腔管 （Ambu）在主气管腔的前端内置光源和摄像头可以

用于实时监测双腔管的位置（图 2b），有利于初始的放置和后续术中的确认。同任何可视设备一样，临床使用中视野会受到分泌物或者血液的影响。

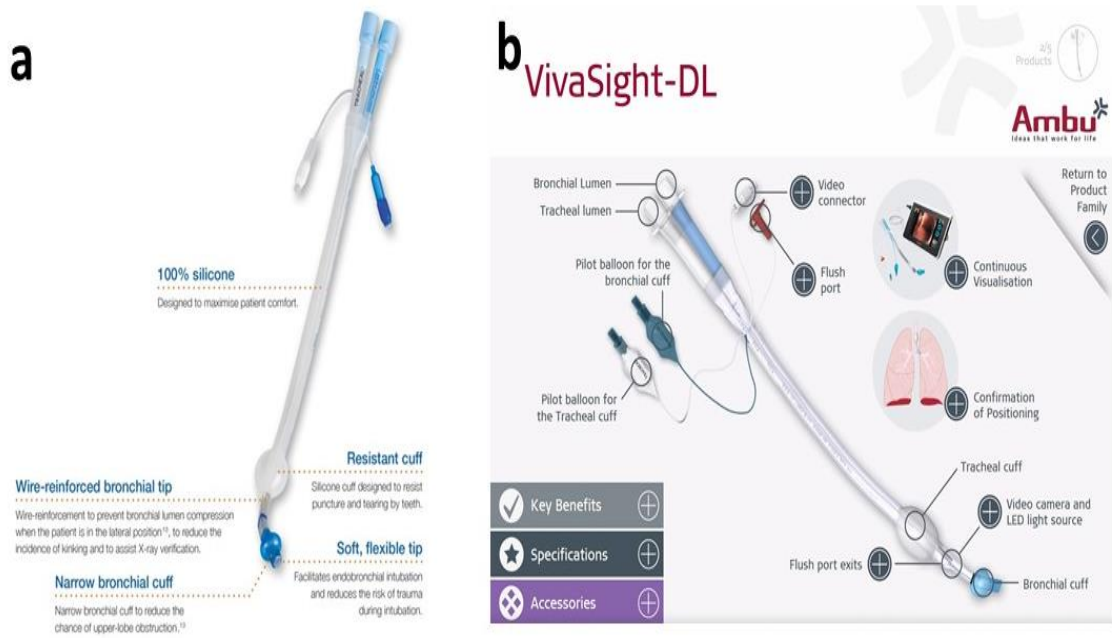

图 2: a, Fuji Silbroncho 双腔管 （Imaco.com）; b, VivaSight-DL （@Ambu_UK）

阻塞导管

如果术前评估发现经单腔管替换双腔管风险过大或者没有合适大小的双腔管（儿童或者成人个体过小），只能经鼻插管或张口度不足[22,23]，气管切开术后，气管或支气管占位病变不适宜放置双腔管，或者术中需要选择性阻断特定肺叶，这时候需要首先使用单腔管建立气道，然后选择使用阻塞导管来进行肺隔离[5]。传统上认为阻塞导管不易使用而且需要经常调整位置，而且和双腔管相比，肺隔离效果不好并且肺塌陷需要较长的时间。然而 2016 年的一项包含 40 位患者的随机对照研究表明，使用阻塞导管的肺塌陷质量和所需时长均优于左侧双腔管，而且外科医生并不能够区分肺隔离使用的是哪一种方法[24]。当然这和操作者的经验还有对特定器材的熟悉程度有关。还有研究表明阻塞导管更利于特定肺叶阻断时的氧合[25]，并且能降低气道损伤的几率[26]。一般来说阻塞导管安全性很高，但是也会出现罕见的并发症包括被手术吻合器切断[27]，阻塞系统故障[28]和移位造成气道阻塞等[29,30]。

常用的阻塞导管有 Fuji Uni-Blocker (Fuji systems), Arndt blocker (Cook Medical) 和 Cohen 尖端偏转型 blocker (Cook Medical)。这些阻塞导管都需要在可视纤维支气管镜的引导下放置入被隔离的单侧支气管（或特定肺叶）。和传统的阻塞导管不同，EZ Blocker (Teleflex Medical) 尖端分叉并拥有两个不同颜色的气囊用于选择性阻断通气（图 3a）。正因如此，单侧的管腔较常规阻塞导

管更小，使得对隔离侧吸引或给氧更加困难。使用中建议短暂断开呼吸机管路使得肺完全塌陷，然后再对隔离侧气囊充气，这样可以确保肺塌陷并且缩短所需时间。和前文所提到的 VivaSight 双腔管一样， VivaSight 单腔管同样在其远端内置光源和摄像头。如果合并使用 VivaSight EB 阻塞导管（Ambu）可用于引导其放置并持续监测阻塞导管的位置 （图 3b）。

阻塞导管管径均在 7-9 Fr，相当于外径为 2-3 毫米之间。考虑到需要和纤维支气管镜（常用为 4-5 毫米）共享单腔管腔，所以一般来说最少需要放置 8.0 的单腔管。此外在气管切开的患者中，通过气切套管使用阻塞导管往往是最佳方案[5,31]。

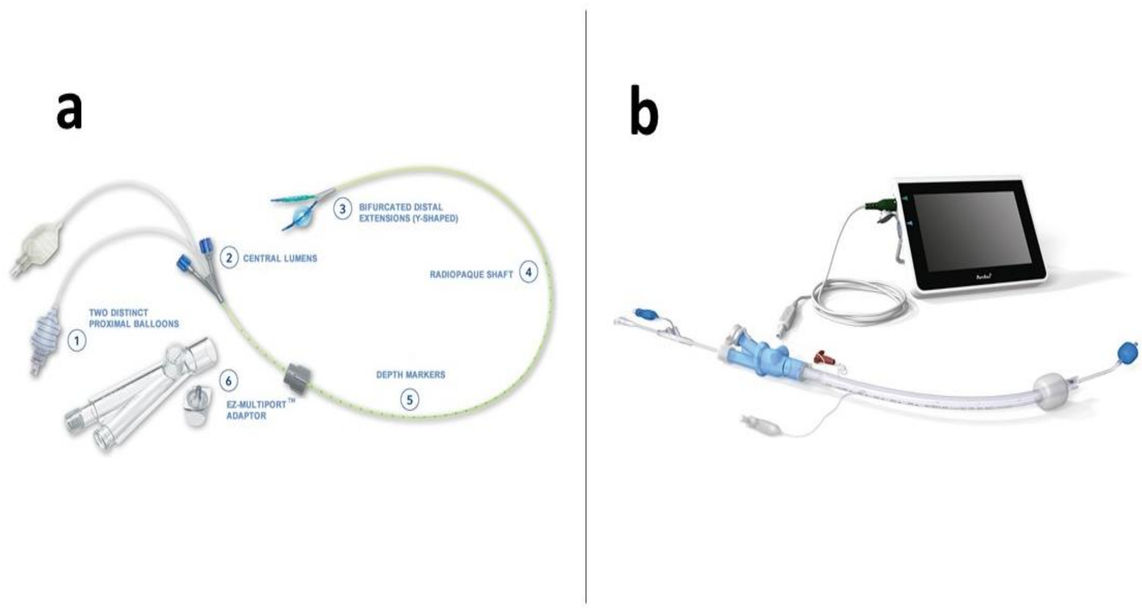

图 3：两种新型阻塞导管（a）EZ Blocker (Teleflex.com); （b）VivaSight-EB (ambo.co.uk)

其他替代方法

紧急情况下，可以有意地将单腔管放入支气管中来进行单侧通气，这在儿童中很常见。但是普通的单腔管由于气囊较大并且和远端距离较远，容易造成肺叶阻塞（尤其是右上叶）。FuJi Systems 推出了一种硅胶材质的钢丝增强单腔管（WRETT，图 4），长度较一般的单腔管更长（40 厘米），气囊较小并且距顶端很近，可以用于支气管通气。

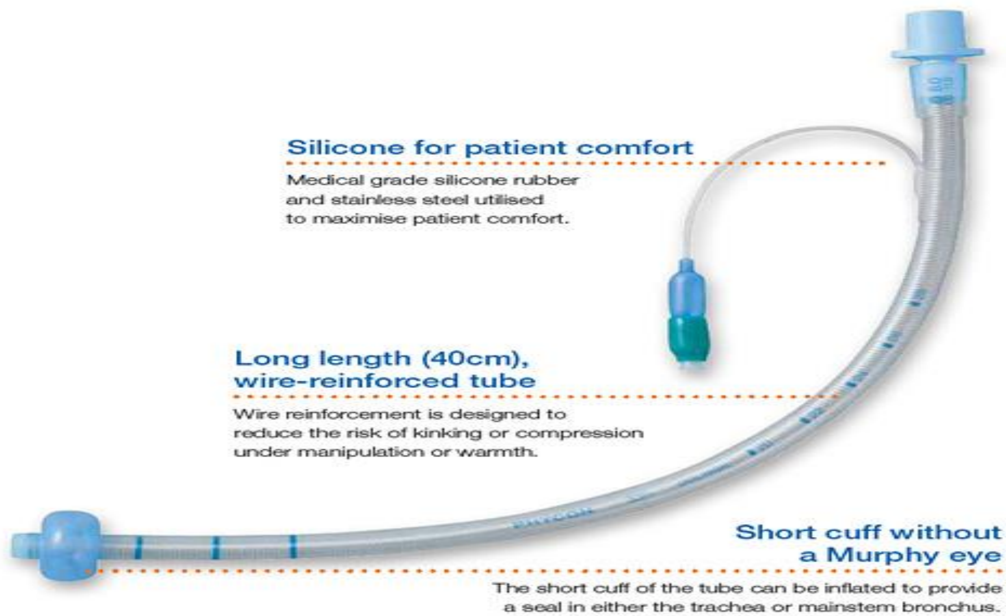

图 4：FuJi 钢丝增强单腔管 WRETT （ambuusa.com）

总结

困难气道术中管理的首要目标是建立气道。困难气道同时需要单肺通气传统上最安全的方法是经鼻或者经口清醒插管，然后再使用阻塞导管实现肺隔离[4,32]。随着各种可视技术的发展和新设备的出现，很多时候双腔管可以在全麻诱导后经可视喉镜或合并纤维支气管镜的帮助下安全地放置，或者诱导后通过单腔管合并阻塞导管或者置换为双腔管来实现肺隔离。对于气管切开术后的病人，可以通过气切套管放置阻塞导管。在无法通气和无法插管的极端情况下，除去建立有创气道外还可以考虑使用 ECMO。

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Anesthetic considerations in pediatric thoracoscopic procedures

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Abstract

Advances in thoracoscopic equipment and surgical techniques made possible thoracoscopic repair of some congenital abnormalities such as congenital esophageal atresia/tracheoesophageal fistula and congenital diaphragmatic hernia. It is very challenging for pediatric anesthesiologists to manage these patients going through the surgical procedures perioperatively. Preoperatively, thorough preparation including fasting, gastrointestinal decompression, maintaining normothermia, infection prevention/management, oxygen supplementation, assisted ventilation if needed, hemodynamic optimization, and application of pulmonary surfactant if indicated. Intraoperatively, adoption of "Low-pressure slow insufflation technique", management of hypoxemia, hypercarbia, hypothermia and potential pulmonary hypertension.

Postoperatively, delicate weaning of mechanical ventilatory support and comprehensive metabolic and hemodynamic control will achieve a smooth recovery and good clinical outcome.

Key words:
Thoracoscopic procedure, neonate, congenital esophageal atresia, tracheoesophageal fistula, congenital diaphragmatic hernia

I. Background

Advances in medical techniques and equipment in recent decades, primarily miniaturization of equipment, have enabled minimally invasive surgery (MIS) to be increasingly used in the pediatric population. Believed almost impossible two decades ago, the repair of certain congenital abnormalities in neonates, such as congenital esophageal atresia/tracheoesophageal fistula (EA/TEF) and congenital diaphragmatic hernia (CDH), are now commonly repaired by thoracoscopic procedures [1, 2, 3]. MIS has the advantages of causing less trauma to the rib cage, resulting in less postoperative pain to the patient, faster recovery, shorter hospital stay, and lower incidences of scoliosis caused by thoracic and papillary asymmetry and rib fusion [1,3,4,5]. Parents and their families are gradually more in favor of minimally invasive surgical management of these abnormalities [6]. More importantly, the thoracoscopic management of these neonatal congenital diseases could lead to better clinical outcomes [1, 2, 3]. Thus, the growth in pediatric thoracoscopic surgery has been enormous. This trend also poses challenges to the anesthesia providers because these thoracoscopic procedures in neonates demand very delicate/meticulous perioperative management.

II. Anesthetic challenges in pediatric/neonatal thoracoscopic surgery

The challenges of managing neonatal patients for their thoracoscopic procedures come from the following reasons. The small size and immature physiological systems of neonates. The pulmonary functions in neonate are far away from maturity, yet the thoracoscopic procedures pose a direct negative impact on the respiratory function. The principal physiological impasse in thoracoscopic surgery results from intraoperative CO2 insufflation, which limits lung excursions and decreases lung compliance. In addition to the risks of hypoxemia and hypercarbia secondary to CO2 insufflation, venous return to the heart can also be compromised resulting in a reduction in cardiac output. The appropriate minute ventilation volume is critical. Hyperventilation can potentially lead to the V/Q ratio mismatch, and thus, further aggravate the ventilation and oxygenation problem. Also, high tidal volume automatic ventilation perioperatively may cause damages to the neonatal lungs. The inhaled anesthetic agents may inhibit hypoxic pulmonary vasoconstriction, which is a very important feature maintaining V/Q balance and minimizing shunting. And, the neonates can easily develop hypothermia, if the inhaled air is not heated and humidified [3, 4].

III. Preoperative considerations:

CDH is a syndrome that includes pulmonary hypoplasia, lung immaturity, left heart hypoplasia, and persistent pulmonary hypertension of the newborn [3, 7]. CDH is commonly believed to be a physiological emergency rather than a surgical emergency. There are 5 EA/TEF subtypes as illustrated in Figure 1, with Type III being the most common subtype [3]. Many patients with EA/TEF probably also suffer from aspiration or aspiration pneumonia as well as electrolyte disturbances. Currently, there are no widely accepted criteria to assess the suitability of neonates for thoracoscopic surgery. Detailed preoperative preparation in principle includes fasting and gastrointestinal decompression, maintaining normothermia, infection prevention/management, oxygen supplementation, assisted ventilation if needed, hemodynamic optimization, and application of pulmonary surfactant if indicated. These patients should always be closely monitored and assessed to provide the best assessment/optimization of the preoperative conditions possible [3, 8].

IV. Intraoperative considerations

1. Adoption of "Low-pressure slow insufflation technique"

Continuous insufflation of CO_2 to establish artificial pneumothorax frequently increases the intrathoracic pressure and potentially causes clinical presentations similar to tension pneumothorax. Thoracoscopy can frequently lead to hypercapnia and acidosis if high insufflation pressures are used [3,9,10]. We have demonstrated this problem can be overcome by minimizing the insufflation pressure required to maintain the pneumothorax [10, 11]. The insufflation pressure is gradually and slowly increased to 4–6 mmHg with the CO_2 flow rate controlled at 1–2 L/minute. This technique allows the neonate more time to adapt to the gradual CO_2 insufflation-induced pneumothorax, reducing the impact on respiratory and circulatory functions. In our experience, this technique was effective at minimizing the potential adverse effects of pneumothorax on the respiratory and circulatory systems [3].

2. Management of intraoperative hypoxemia

FiO_2 was adjusted according to oxygenation status. The literature does not seem to provide consensus as to the ideal FiO_2 in these neonates during induction and maintenance of general anesthesia. Some studies have shown that neonates should not receive 100% oxygen to avoid oxidative injury. However, a too low FiO_2 may be problematic because it can lead to hypoxemia [12]. We recommend maintaining oxygen saturations at less than or equal to 96% to prevent both hyper- and hypoxemia. Thus, the FiO_2 during thoracoscopy was maintained at 60–80%, which was adjusted as needed based on the ventilation and oxygenation status. The respiratory frequency was adjusted according to $PETCO_2$ and $PaCO_2$, usually set at 30–35 breaths /minute. The I:E ratio was set at 1:1 to 1.5 to allow enough time for adequate exhalation. If hypoxemia and/or hypercapnia occurred, mechanical obstruction of the ETT must first be ruled out. Frequent airway suction can often correct this problem. Intermittent lung expansion may be needed. If somehow the ventilation and oxygenation status does not improve with these maneuvers, bilateral two-lung ventilation should be resumed until the etiology of hypoxemia is identified and resolved. Strategies for the purposes of preventing and treating hypoxemia included airway suctioning to remove secretions, adjustment of respiratory parameters such as adjusting the I:E ratio, increasing FiO_2, applying positive end-expiratory pressure (PEEP), alveolar recruitment with a Valsalva maneuver, and bronchodilator therapy [3].

3. Management of intraoperative hypercapnia

Intraoperative hypercarbia can occur largely due to CO_2 insufflation and is usually treated by hyperventilation. Some studies have reported that infants who undergo thoracoscopic surgery are more likely to develop hypercapnia [13, 14]. Other investigators have found that with careful patient selection and the use of low insufflating pressures and alternative ventilatory strategies, many neonates can be safely managed during thoracoscopic repair of their congenital lesions [13, 15, 16].

4. Management of hypothermia

The temperature regulating mechanisms in neonates are well known to be immature. The etiologies for this hypothermia include blood loss during surgery, low ambient temperatures in the OR, cold fluids (both irrigation and intravenous), and continuous insufflation of a large amount of cold CO2 without humidification into the thoracic cavity. Some or all of these can contribute to a decrease in body temperature intraoperatively. Hypothermia can potentially increase the incidence of surgical complications and increase oxygen consumption [3, 17]. Pre-warming the OR by increasing the OR room temperature settings, using forced-air warming devices, a radiant warmer, and fluid warmers are all important means in the prevention and treatment of hypothermia.

5. Endotracheal tube obstruction

If the tracheal tube is obstructed, we need to suction the ETT frequently to correct this problem. After repeated suctioning and no improvement in ventilation, the ETT should be replaced and ventilation will often be improved [3].

6. Pulmonary hypertension

CDH distinctive features are pulmonary hypoplasia and postnatal pulmonary hypertension. However, the pathogenesis of pulmonary hypertension has not been fully clarified yet [18, 19, 20]. In addition, the degree of postnatal respiratory and cardiovascular compromise are key determinants of prognosis [21, 22]. We reported a neonate who developed persistent pulmonary hypertension postoperatively [3].

V. Postoperative considerations

Postoperative management should include admission of all neonate patients to the NICU, these patients should remain intubated and mechanically ventilated. The neonates should also be closely monitored. Delicate comprehensive postoperative management will allow for early intervention to treat any potential hemodynamic, respiratory, or surgical complications in the NICU [3].

Summary

Many factors determine the success of thoracoscopic procedures in neonates. Thorough preoperative assessment and preparations, meticulous intraoperative management by adopting well established strategies including precise airway and respiratory management, “low pressure-slow insufflation technique” to create an artificial pneumothorax, the use of PCV with peak airway pressure maintained at 20–25 mmHg, maintaining the respiratory rate at 35–55 times/minute, FiO2 at 60–80%, I:E ratio at 1:1–1.5, and intermittent ETT suctioning to clear airway secretions, maintaining normal hemodynamic parameters, and maintenance of normovolemia and normothermia.

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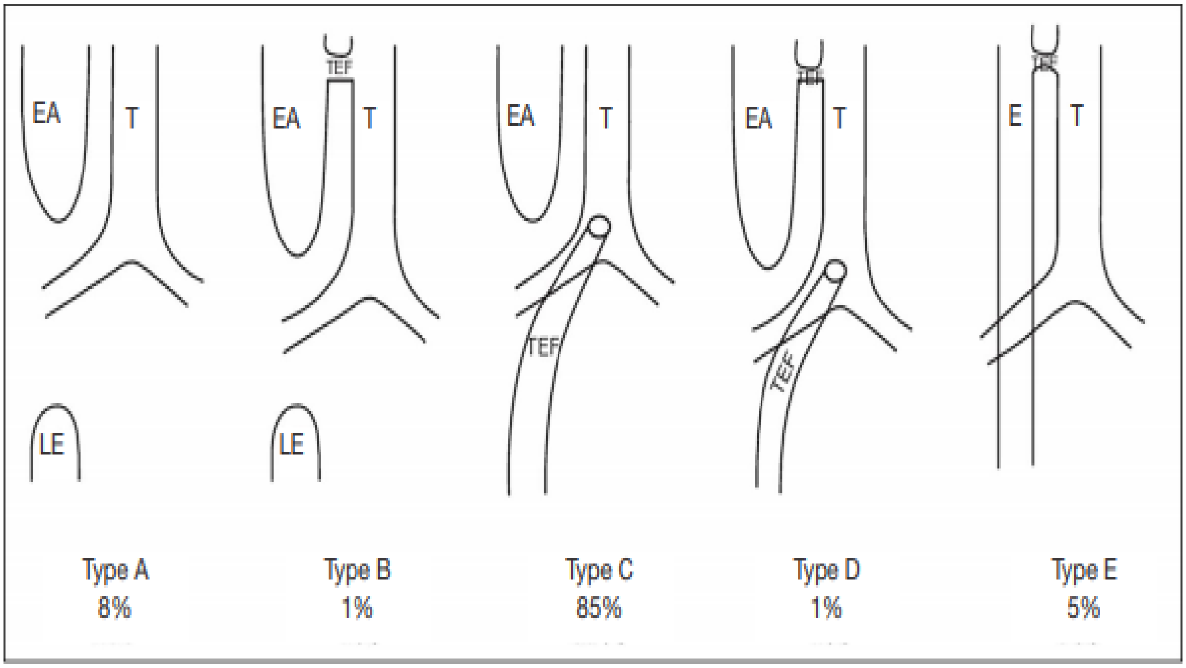

Figure 1. The subtypes of esophageal atresia/tracheoesophageal fistula (EA/TEF) and their rate of occurrence.

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The Laryngeal Mask Airway: Expanding Use Beyond Routine Spontaneous Ventilation for Surgery

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Summary: The article discusses the advancements of the laryngeal mask airway (LMA) and its routine and non-routine uses. It analyzes the risk of aspiration with the LMA compared with the endotracheal tube. It also reviews whether mechanical ventilation is safe with the new generation of LMAs.

Introduction

The laryngeal mask airway (LMA) was invented in 1983 by Archie Brain, MD as an alternative airway device to the facemask and endotracheal tube (ETT) [1]. Since the establishment of the classical LMA, the device has undergone multiple improvements and modifications (Table 1). The LMA can provide a better quality of ventilation over a mask alone and with less instrumentation to the airway than tracheal intubation.[2] Advantages of the LMA include the ease of use and less injury to airway tissues than ETTs, although trauma can result from forceful use of LMAs [3–6]. With the LMA, there are fewer hemodynamic disturbances and postoperative complications than with an ETT [2]. The LMA has been widely used in surgery requiring general anesthesia and as a rescue device for difficult airways [7]. In the updated difficult airway algorithm, developed by the American Society of Anesthesiologists, the LMA is a priority apparatus for emergency noninvasive airway access.[7] Many clinical investigations and research have demonstrated that the LMA is a safe and reliable airway device [2,6,8,9]. However, debate continues regarding non-standardized use of the LMA in clinical settings, including with positive pressure ventilation (PPV) and muscle relaxants, in laparoscopic surgery, and with obese patients (Table 2). Concerns regarding LMA use can be categorized as follows: (1) inadequate seal of the LMA due to malposition; (2) airway injuries ranging from throat discomfort to permanent tissue damage; (3) aspiration risk; (4) safety of mechanical ventilation as opposed to spontaneous ventilation; and (5) safety in obese patients. Non-routine uses of the LMA and potential safety issues will be discussed in this review.

LMA Placement and size selection

The LMA may be easily placed following induction of general anesthesia, with or without a muscle relaxant [10]. In a study by Hemmerling et al., the success rate of first attempt insertion was 92% with the use of muscle relaxant versus 89% without muscle relaxant [10]. If the LMA size selected is too small, it may not create an adequate seal, leading to leakage, which may result in insufficient ventilation [11]. If the device is too large, it may lead to reduced adaptability, also resulting in a poor seal or leak. This may also result in soft tissue, lingual nerve injury, or even pharyngeal damage if it was forcefully placed. Size 4 and 5 LMAs are appropriate in most average female and male adults, respectively. In a study by Asai et al., leaks were reduced with placement of the larger size LMAs in both males and females [11]. Minimal inflation volumes were used to create an adequate seal, resulting in less pressure measured on the pharynx [11]. Brimacombe et al. investigated pharyngolaryngeal complaints in 300 patients comparing LMA use with low cuff volumes and LMA with high cuff volumes and finding a higher incidence of sore throat and dysphagia in the latter group [3]. In a prospective study of 5,264 patients, Higgins et al. found that the incidence of a sore throat with an ETT versus an LMA was 45.4% and 17.5% of patients, respectively [4]. Although the incidence of a sore throat may be higher with ETTs compared with LMAs, inappropriate LMA size and high cuff pressures may also contribute to significant pharyngolaryngeal complications; thus, importance should be placed more on minimizing intracuff volume [4–6, 11]. In a Cochrane review, Mathew et al. pooled 15 randomized controlled trials with 2,242 patients to assess whether it was better to remove the LMA under deep anesthesia or when patients are awake. The review concluded that there was not sufficient high-quality evidence to determine if one method was superior to the other [12].

Aspiration risk with LMA

A frequent concern regarding LMA use is the risk for aspiration, particularly when PPV is applied. The most common contraindications to LMA placement include patients at risk of aspiration such as during pregnancy, trauma, preexisting gastroparesis, intestinal obstruction, or emergency surgery in nonfasted patients. Table 3 provides an overview of absolute and relative contraindications to the LMA. In appropriately fasted patients, several studies have identified the risk of aspiration with an LMA is extremely low [8, 9]. Brimacombe et al. revealed the incidence of pulmonary aspiration with an LMA to be 2 per 10,000 compared with 1.7 per 10,000 for an ETT and facemask, in a similar patient cohort [9]. In a study performed by Bernardini and Natalini with 65,712 surgical procedures, including 2,517 laparoscopic surgeries and major abdominal surgeries, there was no significant difference in the rate of aspiration for the classic LMA in comparison with an ETT while using PPV [8]. In a meta-analysis, Park et al. compared second-generation LMAs to ETTs in 1,433 patients undergoing laparoscopic surgery and found no difference in oropharyngeal leak pressure, gastric insufflation, or aspiration [6]. The lack of difference in oropharyngeal leak pressure suggests a degree of airway protection and sufficient mechanical ventilation even against an insufflated abdomen [6]. LMAs have been successful in laparoscopic procedures, but caution with use is warranted. Second-generation devices may be more appropriate for laparoscopic surgery with higher oropharyngeal seal pressure and gastric suction port [6].

Some second-generation LMAs contain a gastric channel for placement of an orogastric tube to prevent aspiration (Table 1). In a large observational study, 700 appropriately fasted patients underwent general anesthesia for cesarean section with the LMA Supreme™ [15]. There were no reported cases of aspiration using the LMA Supreme™ with placement of an orogastric tube through the gastric port [15].

Positive inspiratory pressure greater than 15 cm H_2O has been suggested to lead to incompetence of the lower esophageal sphincter and result in insufflation of air into the stomach with the potential for aspiration [16]. Devitt et al. assessed the leak fractions, measured from subtracting expiratory volume from inspiratory volume divided by inspiratory volume, and gastric insufflation comparing classical LMAs versus standard endotracheal intubation at various inspiratory pressures. The leak fraction increased with increasing positive pressure delivered through the LMA and remained low and unchanged in the ETTs. At an inspired pressure of 15 cm H_2O, the gastric insufflation with LMA use was 2.1%, while it was 35.4% with a pressure of 30 cm H_2O [17]. In a Cochrane review comparing the ProSeal™ LMA, a second-generation LMA with a gastric suction port and a posterior cuff for an improved seal, with Classical LMA with PPV, Qamarul Hoda et al. concluded that there was no significant difference in rates of regurgitation [18]. Both older and newer generations of the LMA have been successfully used without clinical signs of aspiration if inspiratory pressures are limited to 15 cm H_2O or lower [17, 18].

Spontaneous ventilation vs. Mechanical ventilation

A benefit of LMA use is that it is less stimulating to a patient than an ETT; therefore, less anesthesia is often required [19]. Due to increasing comfort with use and the development of a new generation of devices, LMAs are routinely used safely with mechanical ventilation [18, 21–24]. Radke et al. assessed the redistribution of ventilation by using electrical impedance tomography in patients undergoing general anesthesia with an LMA [22]. They observed no redistribution of ventilation with patients breathing spontaneously, and found ventral redistribution under both pressure-controlled ventilation (PCV) and pressure support ventilation (PSV) [22]. Consequences of ventral distribution of ventilation include increased dead space and atelectasis [21, 24]. The use of volume control ventilation (VCV) with an LMA results in less compliance and higher peak inspiratory pressures compared to PCV. PCV is a newer mode of ventilation that limits the inspired pressure to maintain a set tidal volume [22]. End-tidal carbon dioxide was higher, tidal volumes were smaller, and oxygen saturation was lower in patients undergoing spontaneous breathing (SB) compared to PCV, VCV, and PSV modes [21, 23]. Brimacombe and Keller found improved oxygenation and ventilation with the LMA by using PSV compared with continuous positive airway pressure (CPAP) [21].

There was no difference in gastric insufflation, airway or cardiovascular complications, or problems ventilating patients in a study by Keller et al. comparing spontaneous ventilation to PPV [24]. In a Cochrane review, the classic LMA was compared to the ProSeal™ LMA undergoing PPV [18]. The ProSeal™ LMA had a better seal, suggesting that it may be more suitable for PPV; however, overall the quality of evidence was low [18]. In a randomized controlled trial, Capdevila et al. examined various modes of ventilation, VCV, PSV, and SB, on emergence time and intraoperative ventilation [23]. Time to classic LMA removal was prolonged in patients undergoing VCV compared with PSV or SB [23].

Obesity and LMA

Another area of controversy is LMA use in obese patients. Physiological changes seen in obese patients make them a challenging population, including a restrictive lung pattern due to abdominal contents limiting diaphragm motion and yielding less respiratory compliance.[20] Insufflation during laparoscopic procedures can further impair lung compliance and make ventilation difficult [20]. Cheong et al. found that in patients with a body mass index (BMI) over 30, there was a 2.5 times increased risk of having ventilatory problems [26]. Zoremba et al. assessed postoperative lung function and saturations in obese patients (BMI 30 to 35) undergoing minor peripheral surgery with a ProSeal LMA™ vs. ETT [27] and found ventilation was adequate in both groups while postoperative pulmonary complications were decreased in the LMA group [27]. Keller et al. showed that the ProSeal™ LMA was temporarily effective in ventilating obese patients with a BMI >35 prior to intubation [28]. Although second-generation LMAs have been used in obese patients, further studies should be done to investigate the safety of LMA use in obese patients.

Summary

LMA design has evolved and clinical use has expanded significantly in recent decades. Evidence suggests that LMA use is safe with mechanical ventilation in appropriately fasted patients while minimizing the inspiratory pressures applied. Second-generation devices may minimize leak and limit gastric insufflation compared to first-generation LMAs. Muscle relaxant may be considered and has been shown to facilitate LMA insertion and mechanical ventilation. Application of LMA in obese patient remains controversial. Studies have proved successful ventilation of obese patients with a BMI below 30. However, in patients with higher BMIs, ventilation may be impaired due to physiologic changes in obesity. The LMA should always be considered as a rescue device for difficult ventilation or intubation, regardless of patient size. Appropriate LMA indications continue to be debated. It is important to recognize the potential complications and relative contraindications to the LMA and adjust a clinical algorithm, which would optimize the use of the LMA in airway management.

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Table 1: Evolution of the Laryngeal Mask Airway (LMA) [1, 6 *]

Name	Type	Image	Material	Advantages	Disadvantages
LMA Classic	First generation		Silicone	Original design, less pharyngolaryngeal trauma, respiratory problems vs. ETT, rescue device	Low OSP,[†] increased cost with processing
LMA Unique	First generation		Polyvinyl chloride	Disposable form of classical LMA	Low OSP
LMA Fastrach			Polyvinyl chloride and silicone	Intubating LMA to guide blind, difficult intubations	Bulky, no pediatric sizes, increased cost of processing
LMA Flexible			Polyvinyl chloride and silicone	Wire-reinforced tubing, head and neck procedures	Low OSP, increased cost with processing
LMA ProSeal	Second generation		Silicone	Gastric suction port, built in bite block, high OSP	Bulky, folding of mask can obstruct the gastric port, increased cost of processing
LMA Supreme	Second generation.		Polyvinyl chloride	Disposable version of ProSeal LMA	Bulky, folding of mask can obstruct the gastric port

*More supraglottic devices exist. This table includes first- and second-generation devices discussed in the review.
†OSP: oropharyngeal seal pressure. Lower OSP increases gastric insufflation and risk of aspiration.[1]

Table 2. Summary of Non-Standard Uses of the Laryngeal Mask Airway (LMA)

Non-standard use	Concerns	Conclusions
Mechanical ventilation compared to spontaneous ventilation	Gastric insufflation, aspiration with high inspiratory pressures Inability to self-regulate anesthesia depth	Adequate ventilation can be achieved with various ventilator modes Minimize inspiratory pressures to decrease risk of gastric aspiration
Use of muscle relaxant	Facilitate mechanical ventilation	May benefit LMA insertion and surgeries
Laparoscopic surgery	Aspiration risk with insufflated abdomen	Likely acceptable in properly fasted patients with second-generation devices
Obese patients	Poor pulmonary compliance Ventilation difficulty	Acceptable for certain degrees of obese patients, further study warranted prior to recommendation for routine use in morbid obesity Successful as a temporary rescue device

Table 3. Absolute and Relative Contraindications to LMA [8, 9, 13, 14]

Absolute Contraindications	Relative Contraindications
Trauma	Major abdominal surgery
Non-fasted patients	Pregnancy >14 weeks
Bowel obstruction	Prone position
Emergency surgery	Airway surgery
Delayed gastric emptying	Laparoscopic surgery
	Obesity, BMI >30
	Decreased lung compliance with PIP >20 cm H_2O
	Altered mental status

BMI = body mass index; LMA = laryngeal mask airway; PIP = peak inspiratory pressure

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麻醉医生职业生涯中的精神，心理健康讨论

苗宁 MD

CASA 的线上"麻醉医生职业精神，心理健康讨论会"在曹锡清会长的倡导下于 3/27/2022 19:00 在 Zoom 上举行。这一次大家聊的主要话题是针对麻醉医生职业工作中出现意外的医疗事故后，麻醉医生作为第二受害者（second victim）展开的讨论。 大家从如何寻求医院专业部门的介入，科室同行们的帮助，家庭的支持，心理医生疏导，最后自我恢复给予了真诚的见解和建议。

本期由彭勇刚、王谧医生主持并讲述各自的亲身经历。会议并邀请了两位分别来自纽约精神健康中心和加州大学 Davis 分校精神科的常晓莺和夏国华医生从职业角度谈谈他们对 second victim 事件后如何应对的看法、体会和经验。

彭勇刚教授谈到此次会议的重点：

1. 麻醉医生的职业特点：节奏快，压力大，工作负荷重。大多数麻醉医生均期望每天的工作可控，平稳，围术期病患安全。
2. 麻醉医生的职业压力和心力交瘁现象：越来越多的人已认识到麻醉工作为高危职业之一。而麻醉医生日积月累超负荷的临床工作，科研教学负担，大多以牺牲家庭团聚、疏忽健身锻炼和适当身体休息为代价。研究表明高达 50%以上的麻醉医生有不同程度的身心疲惫。

3. 什么是第二受害者（second victim）？自 2000 年 Dr. Albert Wu 提出这一现象之后，得到国际上越来越多的医生审视并日益重视此一概念。无论是外科手术意外或是我们麻醉医生的判断和操作失误导致病患出现并发症或死亡，不仅对患者和其家人造成难以弥补的伤害和痛苦，涉事医生也可因此事件身心受创，甚至怀疑自己的临床知识和技能水平，出现职业倦怠，服务质量降低并可能继发更多的不良事件等等。这些身心受创的医务人员被认为是第二受害者 Second victim。

4. 寻求心理疏通和帮助： 出现不良事件时，麻醉医生如何有效寻求各级人员的及时帮助，尽快走出心理"阴影"极为重要。但目前如何改善职业环境和减低精神压力的方法和策略还有所欠缺，没有共识。

5. 调节生活节奏： 工作重要，但不应忽视家庭和自身健康；适度对生活步骤做多方位调节，以便达到心情舒畅、身体康健、家庭和睦的平衡。

随后彭勇刚教授实例讲述麻醉工作的危险，不良麻醉后果以及对麻醉医生生涯的巨大影响。一位病患以蛛网膜下腔出血合并脑血管瘤入院，在介入放射科全麻下拟行血管瘤填塞术。术前病患有高血压，高血脂和糖尿病。全麻诱导后血压明显降低，换班住院医生将预先配置的 phenylephrine 400mcg/ml 误作 40mcg/ml 使用，抽取几毫升药液分次 IV 推注后，患者出现急性高血压，以致脑血管瘤破裂而后死亡。事发后，涉事的麻醉主治医生和住院医生都经受了强烈的心理创伤和负疚感。由此后，医院的 phenylephrine 剂量全部由药剂科统一规范化为 100mcg/ml 以避免再次类似事件的发生。这些麻醉医生除了接受心理疏导和治疗，主治医生也换了工作。

王谧医生通过她亲手接管的一个病患实例讲述了一起悲剧手术病例。一位严重主动脉狭窄（AS）老年男性病患需做伤口清创术并实施皮瓣移植覆盖开放性伤口。术前病患并无明显 AS 的临床症状和体征，功能活动良好。麻醉前放置动脉导管以监测麻醉中的血压变化，由于手术时间较长， 先后有三位麻醉主治医生交接经手。最后一班麻醉医生完成手术后发现病患烦躁不安且自行拔管, 患者随之出现心脏骤停，虽经全力抢救，病患仍然宣告不治。所有介入的麻醉医生均体验了第二受害者的经历。

王谧医生随后向大家讲述了作为 second victim 事件发生后介入医生身心受创并逐渐恢复的六个经典阶段。

第一阶段：场景，心情混乱。麻醉医生多半自我询问：这事为何和如何发生的？
第二阶段：强迫性想法。大多会反复自问：我错过了什么重要诊断和抢救步骤？我能够怎么做会有不同的结果？
第三阶段：逐渐恢复个人的诚信和勇气。这个阶段大多数人会想：其他人怎么看此事或我会有多大的问题？
第四阶段：忍受其他人长时的质询。这时会想：接下来会发生什么？会让我失去工作或行医执照吗？
第五阶段：获得专门人员的情绪疏导。大多数人这时会想：我可以在哪里寻求帮助？我个人出了什么问题？
第六阶段：可能有三个不同的结果：

1. 修正自我，以利再战。许多人经此不良事件后“吃一堑，长一智”，吸取教训，获得新的知识和技能，避免以后再犯相似错误。此阶段恢复得好的经典例子是麻浩波医生。他曾经遇到一例困难气道的病患，病人经抢救恢复正常，但他一直在琢磨如何改进气管插管方法。最近他拿到了一个革新气道方法的研究经费可更进一步培训教育住院医生。
2. “生存下来”。虽然有时还会对发生的不良事件感觉内疚，但更多的时候更关注如何避免再次发生不良事件。大多数人经此阶段“放下包袱，继续前行”。
3. 退出行业，离开此职场。少数医生身心不能承受如此之重而转换职业或提前退休。这也是一种“生存”方法。

在两位主持人开场病例讨论之后，许多麻醉医生都分享了各自工作上的第二受害者的经历和亲身体验，以及如何战胜"自我"走出误区，继续前行的各种经验教训。

姚东东医生认为所有经历病患不良反应的医生均为 Second victim。即使由于工作疏忽而导致病患的不良结果的事件，介入医生一方面应该受到相应的处罚，但另一方面也不应疏忽其作为 Second victim 而应得到的心理安抚和帮衬。

刘恒意医生指出麻醉医生工作中严重疏忽少见。我们工作的重点在于如何在围术期保持病人稳定的生命体征以及避免造成病患的不良事件。一旦发生不良后果， 大家应提高作为 Second victim 的"阈值"，即：寻求医院专业人员的疏导，同行间的相互支持，家庭的理解和慰藉以及对自身能力的磨练和基本信任。

张晓燕医生根据个人在男性为主的私立医院工作并成为"工作伙伴"的工作经历告诫大家：自身知识和技能要过硬；遇到不合理的事情要善于与同事们及时合理沟通，勇于向上级反映，通过改变系统规划而使之逐渐合理和公平。如果遇到进入法律诉讼的案例，在与病人和家人沟通前，要与医院的"危险管理委员会"成员和律师预先沟通，并与外科医生一起面对病人。生命可贵，自我胜任力、自信心和心理复原力尤为重要。只有自强和战胜自我，才能走出笼罩的阴影。

楼燕勤医生认为不良事件发生后，医院有雇员帮协项目（employee assistance program）或者医生身心健康委员会（physician wellbeing committee），涉事医生应尽早寻求帮助；同行们应有爱心，理解和分享当事人的感受，伸出温暖的双手抚慰，耐心聆听他们的积怨，询问需要如何帮助等等；如果必要，涉事医生可以请假休息，可能会让自己解脱暂时的压力和避免精力不集中再出差错；家庭的理解和支持总是最好的疗伤之法；如果这些救助后，当事人仍然精神萎靡，失眠倦怠，这时应当借助于心理医生的疏导，行为或药物治疗以尽快恢复健康的心态，从 second victim 的漩涡中"脱困"。

王景平医生讲述所在医院一例加压输血导致病患空气栓塞死亡病例，麻醉科和医院对于涉事医生的救助和疏导，并且麻醉科输血系统改进避免了不良结果的再次发生；他讲述了另一个病例由于新到麻醉医生不熟悉麻醉机，青少年病患气管插管后不能机械通气导致病人死亡。事发当天此麻醉医生由于内疚，自己静脉注射过量 Propofol 自杀身亡。所以，王景平医生认为事故发生后，当事医生一定要及时寻求救助和疏导，尽早讲出心中的内疚、恐惧、不安和烦闷，才能尽早从 second victim 的不良情绪中走出逆境。

根据以上麻醉医生们的发言，彭勇刚教授请两位心理医生做专业评述。

夏国华医生敬佩麻醉医生对工作的精益求精，专业知识丰富，麻醉技能熟练以及对病患安全的细致照顾，但大多医生身心疲惫，对自身身心健康的兼顾差强人意。如何改善这些问题？他同意以上医生们的经验，不良事件后当事人出现的精神和心理变化，得到治疗过程越早越好。除了

心理治疗，影响工作者需药物治疗以恢复心情和功能；他强调调整工作和生活节奏是一长期目标，要尽量兼顾工作、家庭、生活和健康，才能让患者满意，自我心情舒畅，圆满完成工作。如有人寻求心理医生帮助，夏医生还"自告奋勇"愿意帮助大家。

常晓莺医生认为医生是人而非神，尽管主观严格要求自我，客观还是时有犯错。她介绍不良事件后，当事人情绪化反应多种多样，如创伤后应激障碍（PTSD），沮丧，伤心，忧郁，焦虑，记忆减退，睡眠困难，精力难以集中，名誉受损，肌痛和倦怠等等。最好的办法就是尽早得到各种帮助、疏导和专业医生的治疗。她讲述一位具有 27 年工龄，经验丰富的护士由于一次注射 Calcium chloride 剂量错误导致一名婴儿死亡。事发后她被医院开除，罚款和 4 年的观察期。之后她做了所有努力仍然无一医院录用，最后自杀身亡。常医生提醒大家要牢记自己的个人权利-即需要被他人尊重对待的权力，尤其是出现不良事件后。此外，同行间的支持以及家人的支持尤为重要。

讨论会后，曹锡清会长感谢两位心理医生的辛勤付出，彭勇刚和王谧医生的主持和病例分享。她提出麻醉记录要认真，详尽仔细，负责照顾病人，监测生命体征的即时改变；不良事件后要及时与麻醉科主任和医院的危险管理部门讨论；与患者家人的谈话要有技巧和证人；之后医院的发病率与死亡率（M/M）病案讨论和事故的根源和分析（Roots cause analysis RCA）一般就事不对人。其目的为避免以后类似犯错。

彭勇刚教授最后总结。勉励大家努力工作外，麻醉医生的生活质量需要自己去追求创造，学会自我保护意识， 保障身体和身心的健康。 坚持健身习惯和动力，平衡生活和工作。调节生活节奏，寻求必要的心理疏通和帮助。 只有体力充足，精力充沛和心态淡定，才能过好平凡生活的每一天。原本计划还谈谈麻醉医生每日面临的压力和心力交瘁以及如何应对的问题，由于时间受限，只好下次有时间再谈这一大家共同关心的话题了。

再见，下次再聊！

CASA – 新青年联合讲座信息

CASA-新青年联合产科麻醉急症处理系列讲座圆满结束

新青年网络家园

产科麻醉危急症处理一直是广大中基层医院最棘手的问题，为帮助广大中国麻醉科同道提升产科麻醉危机管理能力，华人麻醉医学会（CASA）与新青年麻醉论坛（www.xqnmz.com）联合举办了产科麻醉急症处理系列公开课讲座。

本次系列讲座共十五讲，从 2021 年 3 月 6 日第一讲开始，2022 年 2 月 19 日最后一讲结束，历时一年，得到国内外众多麻醉、产科学专家的鼎力支持！截止今日累计观看直播和回放的人数已经超过 274 万人次，深受广大中国麻醉科医生的欢迎，相信本次活动能够帮助大家提高产科急症处理的知识和能力，最终达到提高患者安全的目的。

在此向所有国内外无私分享的讲者致敬！也感谢所有喜爱和收看本次系列讲座的麻醉科同道们，更要感谢华人麻醉医学会（CASA）与新青年麻醉论坛（www.xqnmz.com）众多工作人员的大量幕后工作！

产科麻醉急症处理系列公开课目录：

- 第一讲 姚尚龙：中国产科麻醉挑战和对策
- 第二讲 黄建宏：产科麻醉应急手册应用
- 第三讲 李师阳：植入胎盘麻醉管理
- 第四讲 徐铭军：羊水栓塞，过敏反应
- 第五讲 左明章：产科困难气道
- 第六讲 黄佳鹏：孕产妇心跳骤停
- 第七讲 李韵平：硬膜外的问题和对策
- 第八讲 陶为科：产科输血管理
- 第九讲 李金蕾：局麻中毒
- 第十讲 张砡：孕产妇危象：甲状腺危象，高血压危象，酮症酸中毒
- 第十一讲 王景平：如何开展模拟演练
- 第十二讲 曹锡清：产科全麻，即刻剖宫产
- 第十三讲 彭勇刚：ECMO 在产科麻醉急症的应用
- 第十四讲 胡灵群：主动脉狭窄分娩管理
- 第十五讲 郑勤田：胎盘早剥，脐带脱落，宫缩乏力，子宫内翻

2022 CASA-新青年继续联合网络公开课

争鸣原地

The performance of the anesthesiologist in current clinical practice

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Brief Anesthesia history

Anesthesiology is a relatively young profession in comparison to other specialty of medicine that continues to evolve. Modern anesthesia originated from the discovery of two inhalational agents- ether and chloroform in 1846. Over next two centuries, innovations anesthetic techniques rapidly expanded including the endotracheal intubation for establishing artificial airway , handheld laryngoscope, different blade morphology, anesthetic delivery system, advances in inhalational and intravenous anesthetics, neuromuscular blocking drugs and the addition of regional nerve block are some of the classic example of invaluable anesthetic advancement , which provided important modalities for innovative surgeries to be safely performed. It is clear that modern medicine would not be possible without the field of anesthesiology [1].

From mid-nineteenth century in the USA, a shortage of suitable anesthetists and the reluctance of physicians to transition their career to become an anesthesiologist , encouraged nurses to take care of the surgical patients under supervision of surgeons. Nurse Anesthetists have been providing anesthesia care to patients for more than 150 years [1-3] and were among the first specialty nurses to require continuing education. The first formal training program in nurse anesthesia education began in 1909. The American Association of Nurse Anesthetists (AANA) founded in 1931 and implemented a certification program for certified registered nurse anesthetists (CRNA) in 1957. More recently, legislative changes have allowed CRNA to independently practice anesthesia in 16 states in the USA [2]. In 2021, there are more than 57000 CRNAs in the USA and together with anesthesiologists, currently provide more than 40 million anesthetic procedures performed annually in the civilian and military setting throughout the United States [3].

As surgical procedures became more complex, it demands anesthetic techniques to be improved to meet the challenge maintaining patient's intraoperative hemodynamic stability and safety. Due to fast growth of anesthesia profession, and physicians gradually realized the importance of safe anesthesia for surgery and started to campaign for anesthesia to be performed by physicians in 1910 [1, 4-5]. The first residency program for anesthesia in the US was established in 1927, 18 years after the establishment of the nurse anesthetist's program. The first class of anesthesia residency was established and some alumni went on to become anesthesia department heads, including Virginia Apgar [6]. The American Society of Anesthesiologists (ASA) was soon founded in 1936 and the American board of anesthesiology (ABA) separated from the American board of surgery to become an independent organization in 1940. Within five years, both nurses and MDs recognized the need to create a formal society. In 2021, there are more than 50000 anesthesiologists practicing in the United States.

For many years, there has been a continued debate between CRNAs and MDs with regard to scope of practice, independence, education and organization. Some MDs argue that CRNA are not physicians, they did not receive qualified credential practice independently. Not like physicians, CRNA did not go to medical school, attend a four-year intensive postgraduate medical education in residency or take the written and oral Board exams. While some MDs may feel threatened their career opportunities, we should realize that CRNA programs have a comprehensive training program for nurse anesthetists. A CRNA requires a bachelor’s degree in nursing (or an equivalent degree) is required for admission to nurse anesthesia programs. All training programs require being at the graduate level, awarding at least a master’s degree, and will support doctoral education for entry into practice in near future [3]. Anesthesiologist society also changed certification requirements. After written and oral certificates, Anesthesiologist mandate to participate in the Maintenance of Certification of Anesthesia program (MOCA) to maintain up-to-date education and training.

The research determines that the United States is persistently experiencing a shortage of anesthesia providers, both anesthesiologists and CRNAs, and these two professional groups have been providing complementary services as part of integrated team to provide safe anesthesia for our patients [7]. However, what are the differences, Anesthesiologists vs CRNA? Other than the educational background and training requirement, title, and potential supervision required for CRNAs, the methodology process of putting a patient under anesthesia is the same for both nurse anesthetists and anesthesiologists.

There has been controversy in the field of anesthesia regarding whether anesthesiologists or CRNAs provide safer and more cost effective care. The multiple evidence showed that both 30-day mortality rate and mortality rate after complications (failure-to-rescue) were lower when anesthesiologists directed anesthesia care [8]. In 2014, ASA pointed out that physician anesthesiologists complete nearly double the education and 10 times the clinical training of CRNA and comprehensive evidence-based review found CRNA care not equal to physician anesthesiologist-led care. ASA also indicated the studies that a nurse anesthetist is as safe and effective as patient-centered, physician-led anesthesia care did not include any randomized controlled trials (RCT); not provide care to the same type of patients as physician anesthesiologists; and a study was at “high risk” for bias because of being funded by a nursing advocacy organization.

One study showed that anesthesiologists achieved a modestly higher mean overall score than CRNAs (66.6% ± 11.7 [range = 41.7%–86.7%] vs 59.9% ± 10.2 [range = 38.3%–80.4%] $P < 0.01$) in managing acute emergencies [10]. Some people believe, although overall scores for anesthesiologists are higher than CRNAs, there is no significant difference in the quality of care when the anesthetic is delivered by a CRNAs or by an anesthesiologist (the conclusion needs more data to confirm the fact) [9-10]. Dr. Mazurek also suggests what if AANA and ASA created a joint anesthesia conference to discuss the future of anesthesia and current concerns regarding anesthesia care, perioperative care team models, etc. Anesthesiologist could accomplish more, instead of battling each other because both professions are all on the same team working toward a common purpose [9].

What should we do as an anesthesiologist to keep ourselves invincible in the field of anesthesia? Are there any ways to assess ourselves to keep our knowledge and skill updated, and to enhance our responsibility to the patient?

Traditional graduate medical education (GME) presents only clinical evaluation and standardized testing. They may not reflect the ability to solve clinical problems [11]. In 1999, Accreditation Council for Graduate Medical Education (ACGME) published an outcome project for the general competency for the resident program. ASA quickly adopted the concept applied to the residency program. As for today, anesthesiologists can still use the assessment tool for self-evaluation.

Assessment for anesthesiologist

Competence: habit of life-long learning [11-15]
1. Medical knowledge
2. Patient care
3. Professionalism
4. Communication and interpersonal skills
5. Practice-based learning and improvements
6. Anesthesiologist skill measurements

Assessment methods

Medical knowledge

1. Cognitive outcome: Adequate knowledge of biomedical, clinical, epidemiological, biomechanical, social and behavioral science to make effective clinical judgements
2. Skill-based (psychomotor) outcome: single skill, such as airway management (mask ventilation, intubation), spinal/epidural anesthesia, central IV insertion, ACLS guidelines
3. Affective (Attitudinal) outcome: learning how to apply the knowledge, skills and procedures into effective patient care in a multidisciplinary team (nontechnical skills such as communication, situational awareness, task distribution and leadership)
4. Knowledge-based examinations, board certification, maintenance of certification process

Patient Care

1. Patient history and physical exam

2. Lab/tests
3. Perioperative patient safety
    a. Sequentially and efficiently induce anesthesia
    b. Maintain vigilance and observe patients
    c. Interpret monitoring data, chart reviews
    d. Conduct a rapid logical assessment
    e. Make swift decision

Professionalism

1. Professional responsibilities based on ethical principles. Anesthesiologist must be altruistic and respectful, keeping the best interests of the patient
2. Sensitive to a diverse patient population
3. Working with colleagues to serve the best interests of the patient, honor patient boundaries, accept personal errors, and avoid substances that interfere judgment

Communication/interpersonal skills

1. Communicate with patients and other professionals
2. Document and synthesize H/P exam finding effectively, Produce a differential diagnosis and management plan

Practice-based learning and improvements

1. Growth in skills and insight coming with experience
2. Able to interpret the meaning of different types of data
3. Apply clinical decision rules
4. Use information technology to gather evidence to support/modify clinical decisions
5. Able to implement practice-based improvement by tracking outcomes and ↓ medical errors

Anesthesiologist skills measurements

1. Technical skills: Breadth and depth of medical knowledge
   Procedure skills
2. Non-technical skills: Interpersonal and communication skill
   Professionalism skill

In summary, an anesthesiologist's self-assessment and the assessment following the guidelines play a pivotal role in enhancing the knowledge and skills for the anesthesiologist's performance in the operating room. With advanced technology and accessibility for the disease treatment, the need for anesthesia management will not be limited to surgical procedure, but extended to many offsite locations. We, anesthesiologists, will work with CRNA side by side in the long run in the future. How we can maintain our position on academics and clinical skill at the front line is the topic we are focusing on currently and in the future.

We welcome every anesthesiologist to join the discussion on this issue and welcome the constructive debate in elevated the level of our profession.

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住院医生择业参考要点

CASA 成员分享职业心得

杨钊 MD

四月十日晚，CASA 特别为住院医师和年轻医师举办了线上会议，着重介绍了各种麻醉亚科培训，找工作的注意事项，私人医院和大学医院执业的区别以及年轻住院医师关心的 J1 身份问题。本人有幸和来自 UT Southwestern 的仲巍教授共同主持了本次会议。首先回顾了近年来麻醉医生的平均收入，数据显示最近五年没有显著的增长，然后简单介绍了大学医院和私人执业的多种不同形式。接着来自加州的楼燕勤前辈以'麻醉医生如何执业'为题的演讲给大家深入浅出地分析了各种执业形式的利弊，而且分享了她本人在执业中遇到的多种问题和如何应对的宝贵经验。

各位与会者尤其是执业多年的医师纷纷表示希望能在自己当年找工作的时候能得到楼老师的指点，并且建议楼老师办一个专场演讲能有更多的时间来深入讨论。楼老师精心的准备和非常敬业地多次排练给我们留下了深刻的印象。

由于现在越来越多的年轻医生使用 J1 签证，前年刚刚毕业的张扬医生给大家介绍了多种 J1 豁免的方式以及申请的时间线，并且强调了及早递交申请的重要性。

University of Virginia 麻醉系副主任左志义给大家介绍了在大学医院执业的情况，尤其是怎样平衡临床和科研，以及职业规划和晋升。他鼓励大家如果对科研和教学有兴趣，应当考虑在大学医院执业。最后的公开讨论由来自各亚专业的多位医师给大家介绍各个专业的特点。

现在 Arkansas 执业的陈轶男医生给大家介绍了疼痛专业训练和执业的情况，并且介绍了她自己怎样申请 J1 豁免。

Beth Israel Deaconess 产科麻醉主任李韵平教授给大家介绍了产科麻醉已经是 ACGME 认证的亚专业培训，而且讲解了培训的必要性以及之后工作中的优势。

加州 Cedars-Sinai Hospital 的林永健医生给大家分享了自己为什么选择疼痛专科，此外还讲述了他们科室由于新冠疫情的影响从'fee for service'成为医院雇员的经历。

短短的两个小时的线上会议由于大家精彩的演讲和提问不得不超时了将近三十分钟，另外还有多位医生没有机会和大家分享他们的经验。CASA 将会尽快组织下一次线上会议给大家进一步互相交流的机会。

麻醉医师如何择业？公立/私营？雇员/合同工/合伙人？

楼燕勤医师， 美国麻醉执业执照医师
橙郡尔湾区多点日间外科门诊手术中心

(一) 出发点在哪儿？

麻醉医师如何择业？

收入之考量： 人人都想? 决策最重要
会说出来?
什么时候说?
怎样说？

地理位置, 气候? 家乡?
文化风俗? 各种社交活动可能性?
家庭生活
孩子教育与机会
社区文化与支持系统
配偶工作机会
生活指数

工作轻松与舒适度？
时间有规律?
名气大? 信誉好?
风险/安全性?保险费?
有科研？
有带教？
有亚专科?
能兼顾临床与上述： 安全性？
团队风气?
职称(现在与将来)?
职业升级制度?
发展潜力?

公立医院和私立医院： 自主性?
独立性?

创业性?
稳定性?
流动性?

(二) 研究公立与私立医院特色

公立医院	私立医院
教学医院	大、中、小
非教学医院	教会医院
附属医院	专科医院
非附属医院	门诊手术中心
County hospital 市政府医院	个人诊所
Veteran hospital	连锁店：门诊/化验室等
Some university hospital	赢利性公司
Army hospital	非赢利性公司
	基金会形式
	家族企业形式

公立医院与带教医院特点：
可兼顾多方面
理论教育机会多
基本工资偏低
可有其他来源(科研基金及咨询者)
接触练习新技术机会多
医疗支持庞大
职业风险小

雇用模式：
雇员 (医院雇员，公司雇员)
合同工
合伙人

(三) 雇用过程

聘请与雇用过程	申请方法和方式	会谈	雇用合同
申请	邮件	电话	雇用的性质 (雇用工，合同工，合伙人等)
面谈	电话	面谈(个别，团体)	雇用主和被雇用者的责任与义务

合同	会议	正式与非正式	被雇者的资质要求
试用期	猎头公司		雇用期限
正式工	关系介绍		报酬与福利
	广告		具体工作的职责
			试用期与转正
			Proctoring/ mentoring ：伴带病例
			中止/解除合同方法与步骤(雇主与雇员)
			雇主与雇员的权利与义务

(四)　各种雇用模式特点及利与弊

A．雇员模式特点： 工资 (W2) ，收入稳定，有保障
扣除预付各种税(联邦税，州税，Medicare 等)
福利：医疗保险，职业保险，人寿保险，退休计划，病假日，行医费用少
非医疗杂活少：不管病人来源，争取合同，行医报价、收费、追账…

教学医院或退伍军人医院： 常有带教，科研及临床任务
团队支持强大
复杂罕见病例集中
新技术方法及理论提高优势

公立医院或教学医院： 到手钱少，收入偏低
不能更灵活避税

私立医院: 团队可能偏小， 支持力相对弱
常需独当一面。病假：无。休假： 长短不一，需看合同。
若是 Fee for service: 休假=无收入
年底有可能有奖金

B. 合伙人模式特点、利与弊： 股份制
Buy in
成为股东时的时间: 变异大
理论上：有利共享有难同当
事实上：一言难尽
结构及分配系统起重要关键作用

结构： 公司可以是 LLP 或 Corp
需要律师，会计师，收费部门/公司，行政管理等开支, 费用分担
团队管理与决策决定取决于股东股权的投票

需要有人代表团体与外界打交道
行政工作/帐务工作/工作量分配/日常事务/排班
在金钱面前:　矛盾容易激化
分配核算审查审记: 不易执行
很多因素涉及商业管理
医生本身常缺乏概念与经验/精力
收入与工作量/签约单位的支付率/收帐单位质量与实效相关
运行不当有时会有负数
年底分红
将变成股东时的挑战：　变成股东后相当部分人都想剥削新入者
分配制度合理建立与修正改善：重要
系统好易留住人员并激励互助
目前：有存在但趋势下滑
福利：股东合同定
需各自负责保险 (医疗，职业，退休计划，人寿，受伤等)
各自负责各种税务，减税较灵活广泛
福利自我安排：妥当计划长远得益多
分担团体的责任风险

C． 独立合同工模式特点、利与弊：　工作天时间灵活
工作量不定
收入波动性
需很大适应力
信誉经验人脉

固定型：　属管理公司雇用
所做工作的收入与账务公司所有
公司按小时付医生或按特定计算方法工分制付
责任与义务按合同
无任何福利。一切均医生自己负责
双方都有权中止合同
公司具更大权力。可以无理由解除合约

流动型: 按需要和可行性使用合同工(如 locum tenant)

收入可能可以较高
需旅行住不同地方
常会进入不是特别规范化的医疗环境
保险等由公司负责
风险可能会高
需较强独立工作能力

多点流动型: 按需要和可行性使用合同工(如 locum tenant，per diem)

保险等由公司负责或自己负责
风险可能会较高
需较强独立工作能力
需较强的环境/人员适应能力
需较强的工作量,收入波动耐受力

总结：

各人应按自己的个人和家庭情况综合考虑
明确自己的目标和期望
病人与医疗安全作为工作首要考虑
接受工作前仔细调查与比较
公立/私立及各个模式均有其特点与利弊
竞争都激烈，需德智体/规培技能咨询能力过硬
主人翁态度与团队精神合作
保障发扬病人安全与质量风气

趋势：

越来越多变成杂交型雇员模式
受雇于医院或大公司
但报酬系统则有独立合同工或工资制
福利基本由个体承担，自己安排
责任范围扩大
团体：医生，专业护士，医生助理组成逐渐取代只有医生团队模式

借鉴方面：

建立建全良好的框架结构
明确的道德伦理条理
本行内组织结构行政系统条理化

有明确的职责分工与义务
员工激励制度
公平透明的财政制度
周期性监督机制
周期性监督机制保障病人安全医生安全
医疗质控，继续教育，团队成员同质化
必须参与医院各种委员会工作
参与医院安全政策法规措施建立改善
建立成员成长管理与咨询能力梯台
目的地: 病人安全体验良好；麻醉医生工作愉快报酬得体;其他各科医师诚意合作；医院安全，医疗质量/效率/效益高。整个医疗环境风气良好。

横看成岭侧成峰，远近高低各不同。　唐. 苏轼

摄影：汪红　MD　CASA 华人麻醉医生群

中国医生援外见闻

疫情下的巴巴多斯，我的医疗援外经历

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2020 年底，中国新冠疫情得到有效控制，世界疫情却在爆发蔓延。12 月 25 日，作为第 5 批援巴巴多斯中国医疗队队员，我们从重庆出发，一路逆行，带着对医疗援外、白衣外交的担当和使命，带着对异国他乡、阳光沙滩的好奇和向往，也暗含着些许对严峻疫情、未知任务的担忧和迷惘，踏上去往加勒比海岸岛国巴巴多斯的征途，开始了为期 1 年的援外医疗任务。

这注定是一次今生难忘的工作经历，也是一段荡涤心灵的人生历练。身处陌生的异乡岛国，带着对周遭的敏锐触觉，我深深体会到尽管社会制度、经济发展、气候环境、历史文化、人种民族、疫情应对等等各不相同，然而人们对美好生活的向往与追求，对爱和友谊的看重与珍惜，对困苦人生的无奈与挣扎，对战争疫情的反对与抗争都是相似相通的。人生百苦，总要带着阳光微笑面对，在好好活着的当下探寻人生的意义和生命的奥妙。

巴巴多斯：西印度群岛的疗养院

巴巴多斯，我执行援外任务的目的地，曾先后是西班牙、葡萄牙和英国殖民地的加勒比岛国，这个名字来源于葡萄牙语，意指"遍地都是野生的像长着胡子的无花果树"。在百度百科可以查到这样的描述："位于东加勒比海小安的列斯群岛最东端，四周为海洋环绕，面积大约 430 平方公里，人口约 28.8 万，首都为布里其顿。属热带海洋性气候区，7-11 月为雨季， 2-3 月为旱季，常有飓风，气温变化不大，通常在 23°C-30°C 之间。巴巴多斯独立于 1966 年 11 月 30 日，有稳固的民主政体，曾是英联邦成员，英语为官方语言和通用语。岛上居民 80%以上为非洲黑人后裔，4%为欧洲后裔，2017 年人均寿命为 75.5 岁，人口增长率 0.28%，居民多信奉基督教。巴巴多斯的经济以甘蔗种植和加工、朗姆酒、旅游业为主，是全球著名离岸金融中心和加勒比海旅游胜地"。看着这样的描述，长期生活在内陆城市的我们虽没有具体概念，却不由对旅游海岛心向往之。然而很多年轻的中国人听说巴巴多斯却是因为它是美国著名流行歌手天后蕾哈娜的故乡（由于蕾哈娜带给巴巴多斯的影响力和贡献度，2008 年巴巴多斯把她的生日也即每年的 2 月 22 日定为"蕾哈娜日"。2021 年 11 月 30 号巴巴多斯宣布改制成为共和国的当天，授予了蕾哈

娜“民族英雄”的称号）。

记得在援外培训时，老师介绍巴巴多斯的国土面积说到“与我们重庆市九龙坡区差不多大”，顿时让我们有了一种形象感和亲切感。但是千万别小看这个袖珍岛国，首先在政治上她是一个敢于在国际舞台发言表达自己独立观点的国家。印象很深刻的是有一个 BBC 记者采访巴巴多斯女总理米娅·莫特利的视频，BBC 记者称加勒比地区是美国的“后花园”，莫特利马上纠正道：“我们是邻居，你这样说会造成错误印象”。BBC 记者紧接着敏感地“挑拨”起中国与巴巴多斯的关系，称网络上有人说巴巴多斯在讨好中国。莫特利反驳道：“我们在 1977 年就与中华人民共和国建立了外交关系，已经 44 年了，说我们讨好中国意味着不知道我们从哪里来，要做什么。当今世界每个国家都需要与其他国家建立联系，中国是一个世界大国，不与中国联系是愚蠢的。”她还说：“只关注非洲和加勒比地区，而不认可中国在欧洲和北大西洋国家中扮演的角色，这就有点虚伪了。说明我们只是被看成了棋子，而不是具有平等能力，能够决定自己命运的国家。”更重要的是在经济发展上，巴巴多斯人民自独立以来，选择自尊自强而非自暴自弃，深刻认识国情，并虚心向其他国家学习，及时调整本国产业结构大力发展经济，经过几十年的努力，在 2009 年被国际货币基金组织评为了发达国家，创造了发展奇迹。自此巴巴多斯成为了拉丁美洲第 1 个发达国家，同时也是世界上第 1 个以黑人为主体的发达国家，这种发展成就非常了不起，巴巴多斯人以此为骄傲。根据相关数据显示，2020 年巴巴多斯人均 GDP 高达 1.52 万美元，而我中国才 1.05 万美元，人均 GDP 比巴巴多斯少了近 3 万人民币。岛上政治环境稳定，基础设施完善，交通电信便

利，商业服务良好；巴巴多斯居民住着舒适的房屋，享受着安全的环境，拥有着良好的医疗和教育资源，生活水平优质，待人友善平和。国民整体教育水平较高，全国人口不到 30 万，却有好几所大学，实行大中小学免费义务教育，国民素质较高。卫生状况良好，医疗水平较高，公立医院及诊所实行免费医疗。作为一个充满热带风情的岛国，这里风光秀丽，气候宜人，热情好客，美食琳琅，每年都有众多游客特别是欧美居民慕名而来。自每年的感恩节开始到次年的 5 月份，巴巴多斯是他们的避寒天堂，被誉为"西印度群岛的疗养院"、"北美洲的后花园"。

疫情下的巴巴多斯

新冠肺炎疫情自 2020 年席卷全球，作为旅游胜地的巴巴多斯也不能幸免。从 2020 年 3 月巴巴多斯报道第一例新冠阳性患者开始，一直到 2020 年结束，巴巴多斯总共确诊 300 多例阳性患者。在女强人莫特利总理领导的政府有序的管理下，巴巴多斯的公共防疫措施做得很细致，控制聚会人数，公共场所佩戴口罩，保持社交距离，超市商场等入口安放测体温，酒精等手消毒设施很快普及开来，总体疫情控制较好。然而我们第 5 批"援巴医疗队"到达时正值新一波疫情高峰施虐巴巴多斯，短短 1 周时间，总病例数翻倍还不止，政府也因此及时采取了严厉的"宵禁"和 "封锁"政策，还有入境游客的隔离政策和核酸检测规定。2021 年经历过一波又一波的疫情袭击，巴巴多斯的确诊病例数随之不断增加，到我们结束援外任务的 2022 年 3 月，新冠阳性病例达到 58000 人，死亡人数超过 300 人，整个卫生和防疫系统经受着巨大的考验。

同世界上许多国家一样，新冠疫情对巴巴多斯的经济造成了空前的影响，几乎所有行业的业绩都严重下滑，这当中又以旅游业和酒店业首当其冲。由于不得不暂时关停经济以保护生命，政

府财政收入减少，额外支出增加，失业人数超过数万，老百姓的日常生活和安全也面临挑战。作为在岛上生活了一年多的居民，我们最直观的体会就是物价的上涨以及生活物资选择的减少，同样的一袋 20 磅重进口亚洲大米，最开始只要 70 多巴币，而后来要花费接近 100 巴币，而且还常有断货、有钱也买不到的情况出现。作为一个非常依赖休闲旅游产业的岛国，在疫情防控和复产复工的选择和决策方面，政府不得不多次调整以免国家经济财政发生不可承受的崩溃局面，之前为了控制疫情采取的"宵禁"政策、"封锁"政策以及游客入境隔离政策等都逐步放开甚至取消，旅游酒店业逐步恢复，酒吧酒馆等允许开张，不得不慢慢接受了与病毒共存的事实。正如莫特利总理所说："人民首先要工作挣钱吃饭活下来"，这就是赤裸裸的现实和不得不做出的选择。2021 年上半年和下半年相比，在我们每天从驻地到医院上下班的路上和路边的海滩上，看到后期的白人游客数量明显增多，很多都是男女老少全家出动，没有戴口罩，也没有保持社交距离，一副悠闲享受的度假风，仿佛疫情这件事根本不存在，与天天佩戴防护口罩保持警惕的我们生活在完全不同的两个世界。

然而，即使在新冠疫情的严峻影响之下，巴巴多斯仍然在独立自主的发展道路上坚定不移地前进着。2021 年 10 月 12 日，现任总督桑德拉.梅森被提名为巴巴多斯第 1 任总统候选人，于 10 月 20 日当选，并于 2021 年 11 月 30 日正式就职为巴巴多斯第一任总统，英国查尔斯王子出席了在布里奇墩的宣誓仪式。于是，就在庆祝独立 55 周年之际，巴巴多斯成为世界上最年轻的一个独立共和国，这一刻，等了 400 多年。

伊丽莎白女王医院

我援外工作的医院——伊丽莎白女王医院（以下简称 QEH），其历史甚至久于巴巴多斯独立建国，是巴巴多斯还在英国的统治下修建的规模最大、级别最高、条件最好的公立医院，也是整个加勒比海的医疗中心，同时还是西印度群岛大学 Cave Hill 分校的附属教学医院。 QEH 成立于 1964 年 11 月 14 日，面向整个加勒比地区患者提供医疗服务，也是西印度大学医学院的教学基地。自成立以来，医院的床位从最初的 464 张扩大到目前的 600 张，开设有急诊科、内科、外科、妇产科、耳鼻喉科、儿科、眼科等临床科室以及病理科、放射影像科、肿瘤科、检验科、药房等医技科室。其中外科设有神经外科、心胸外科、普外科、泌尿外科、骨科、微创外科等 6 个专业组。总的来说，在整个加勒比海岸都是专业比较齐全，实力比较雄厚的。

然而，虽然是全国最大最好的公立医院，但 QEH 的基础设施较为陈旧，60 年代初建院的门诊住院综合大楼仍然是现在的医院主体建筑，继续发挥着不可替代的作用，这在被世人称为"基建狂魔"的中国各大型医院简直难以想象。 可是从另外一个角度平心而论，能够使用近 60 年而不被淘汰，也可见当时英国理念和设计的合理性和先进性。在大型医疗设备方面，在 2012 年蕾哈娜捐赠核医学设备之前，QEH 没有核医学的内容，而且至今没有核磁共振仪、PET-CT、双能 x 线骨密度仪、射频消融仪等设备。在药品和医用耗材方面，由于全部需要进口，加之公费医疗政策与有限医疗财政预算的矛盾，时常会出现常用基本药品和耗材供应不足、"高档"药品和耗材根本就没有的情况。所谓"巧妇难为无米之炊"，没有了必需的药品、耗材和检查，很多的医疗服务需要患者等待，很多的技术和检查根本就无法开展。

巴巴多斯整体上承袭了英国的医疗体制和医疗文化，医生是精英人士，非常受社会和患者的尊重，这一点即使是作为外国医生的我们在临床诊疗活动以及与当地人的日常生活交流中也深有感触和体会，这种感觉让人非常愉悦，难以忘怀。在巴巴多斯，大约每千人拥有医生 1.8 人，因此从医患比来说巴巴多斯似乎是不缺医生的，然而事实却是相当一部分医生在私立医院或者诊所工作，这些医生的诊疗服务是需要支付高昂的费用的，对于普通老百姓可望而不可即。而提供免费医疗的公立医院人力资源还是非常的不足。QEH 高年资的顾问医师大多数是在英美、加拿大等西方发达国家获得培训，还有不少甚至拥有这些国家的行医执照，因此当地医生的医疗技术都是比较规范的，而且基本知识基本技能也比较扎实，总体医疗水平相对较高。医疗文化及公费医疗政策等多种因素使得巴巴多斯的医患关系也非常融洽，很少有医患矛盾见诸报端。

作为医疗队的麻醉医生，我每天工作的地点是 QEH 麻醉科手术室。麻醉科手术室在住院大楼的 3 楼，是全院外科的枢纽，目前有全院最多的顾问医师 9 人，副顾问麻醉医师 2 人， 住院医师 8-10 人，他们还有专门的麻醉助手 12 人，是全院最大的科室。 此外还有西印度大学的实习医师，来自德国、英国、特多、牙买加等地。麻醉科负责总共 8 个手术间、7 张麻醉恢复室床

位，6 张外科 ICU 床位的全部麻醉、恢复以及 ICU 临床管理工作。8 个手术间中，2 个手术间为单独的妇产科专用手术间，在 2 楼，但自 2021 年 1 月巴巴多斯新冠疫情爆发以来，妇产科专用手术间调整为专门接诊"新冠"阳性病人的手术间。3 楼有共 6 个手术间，6 号手术间为眼科专用手术间，5 号手术间为心胸外科专用手术间，3 号手术间为急诊专用手术间，其余 1、2、4 号 3 个手术间根据不同手术日安排为骨科、普外科、泌尿外科、耳鼻喉科、神经外科、颌面烧伤外科等科室的手术间。疫情之前手术室每日手术量约 30-40 台，疫情之后择期手术量明显减少， 疫情高峰时段甚至暂停择期手术，主要完成急诊以及限期手术。

我们的医疗援外任务

众所周知，对外援助是大国外交的重要抓手之一，其好坏不仅影响受援国所获得的实际利益，更是直接与援助国的国家形象、国际信誉、自身利益等密切相关。中国援外医疗队是我国政府向受援国提供的官方无偿对外医疗援助项目，自 1963 年中国政府应邀向阿尔及利亚派遣第一支援外医疗队以来，中国医疗界开始了履行国际人道主义义务的伟大历史使命，更是掀开了中国同第三世界国家合作的新局面。经过几十年的发展，中国医疗队逐渐成为一块代表着中国医疗水平和国家形象的金字招牌。

记得首批援巴巴多斯中国医疗队队长、肝胆科医生罗诗樵曾经说过"如果说中国援助非洲等发展中国家的医疗队算是中国援外医疗 1.0 版，那么在巴巴多斯这样的中等发达国家进行医疗援助就是援外医疗的 2.0 版。"显然，这当中包含着对中国医疗队精神的传承，更有着不同制度国情和经济文化背景下沟通和行为方式的不同。

对加勒比海岸国家进行医疗援助是为了兑现 2013 年 6 月习近平主席在访问加勒比地区所做出的承诺："中国将加大对加勒比国家经济发展支持力度，向加勒比地区派遣 100 名医疗队员，"也即是"1+100+100+1000"援助加勒比计划。2014 年 6 月原国家卫生计生委向原重庆市卫生计生委下达独立组派中国援巴巴多斯医疗队的任务。2 年后，第 1 批援巴巴多斯中国医疗队从重庆出发抵巴执行任务，截止 2021 年 3 月，重庆市已经派出 5 批医疗队赴巴巴多斯执行国家卫生援外任务，共计 44 人次，涉及 14 个临床专业，每一批医疗队均圆满完成党和国家赋予的援外任务，获得了巴巴多斯政府、受援医院及当地患者的高度肯定和真诚感谢，就国际援外医疗服务交出了配得上称为 2.0 版的"中国方案"。

来自发展中国家的医护人员在具有良好医疗基础的中等发达国家开展医疗工作，如何得到当地同行的信服？如何获得当地患者的认可？如何帮助当地提升医疗水平？如何展示中国特色技术？这是从组建这只医疗队开始就必须考虑的问题，经过从长计议，重庆市卫生健康委将援巴巴多斯中国医疗队定位为体现中国高级医疗专家水平的新型医疗队，精心组织，择优选员，该支医疗队由三甲教学医院重医附一院牵头承派，全市三甲医院派员配合，队员全部是能熟练应用英语

进行专业和生活交流、可以独当一面开展诊疗技术的各科室中青年骨干，并在国内获得了内容丰富全面的援外知识培训和强化英语集训。

打开工作局面并不容易，语言的壁垒加上对中国和中国医疗水平不够了解，傲慢与偏见是客观存在的，难免对我们的能力有所怀疑。从第 1 批医疗队开始，所有的队员们充分发扬“不畏艰苦、甘于奉献、救死扶伤、大爱无疆”的中国医疗队精神，调整心态，摆正姿态，不卑不亢、谦逊有礼，下沉临床一线，从细节开始展示，在临床医疗工作中主动参与诊疗、积极发表意见。虽然我们名叫援外医疗队，但从不自视甚高，坐等他们求援，而是抱持平等交流沟通，相互学习借鉴的真诚态度一点点融入，“行家一出手，就知有没有”，当当地医生听过几次意见、见识过几次手术麻醉等操作之后，就对我们的水平有了了解，快速上手独立担责的工作局面就此打开。同时，我们始终坚持“授人以鱼不如授人以渔”的理念，发挥队员成长于各大教学医院的传统教学优势，对各个层面的医学生和医生进行多种形式的教学活动，除了讲授知识，还手把手的教，潜移默化、以身垂范的影响，力争为当地留下一支不走的医疗队。从主动努力融入到关键时候展现实力，从最初受到质疑到最后不可或缺，援巴巴多斯中国医疗队真正在 QEH 扎下了根。从第 2 批队员开始，在巴方的强烈要求下，医疗队的工作任期从原定的每批次半年延长至一年；从 2017 年开始，由中方设立的医疗奖学金项目持续资助 QEH 的年轻医生赴中国进修（近 2 年因为疫情的原因不得已而中断）；而在不久的将来，巴巴多斯还期望与中国合作建立医疗耗材生产企业，提升巴巴多斯的医疗器材制造水平。

我的异乡工作与生活

虽然之前有在美国临床访问学习的经历，但是在不同医疗制度、不同语言环境下完全独立担当责任麻醉医师却是完全不同的概念和体验。因为一言一行、一针一嘱都不只是我自己，还代表着国家形象代表着中国麻醉水平，在水平并不低的 QEH 与不同种族不同肤色的异国麻醉精英同台竞技，把控患者的麻醉期生与死，斟酌患者的围术期舒与适，这对我的医疗技术和应对心理都是极大的挑战。

由于国情和制度的差异，在巴巴多斯，小到建立静脉通道、配置药品、安置胃管、主导手术体位摆放、大到进行术前心脏超声检查等均需要麻醉医生自己完成。按照我们国内习惯的标准，QEH 的手术患者术前检查非常不完善，一般的病人最多有血常规和心电图检查，没有国内常规的生化检查、输血前检查和凝血功能检查，除特殊病人外也没有常规的心肺影像学检查。没有电子病历系统，有的是不同颜色五花八门书写样式的手写病历。另一方面，由于巴巴多斯产糖，老百姓也喜好甜油食物，所以肥胖患者多，合并症多，高血压、糖尿病控制欠佳，而且由于术前等待时间长，患者的一般情况差，特别是骨科创伤患者术前准备较差。此外巴巴多斯不像国内基本要分成人医院和儿童医院，QEH 还要负责收治很多婴幼儿患者等。

上述种种都是我作为一个 “新人”必须尽快适应的环境和应对的难题。刚了解到这一情况对于事事力求完美和需要掌控感的我来说难免紧张和不安，然而向来积极阳光的性格还是很快让自己担忧的心情冷静下来。既来之，则安之，抱着多看多听、学习潜心、不懂就问、虚心请教的“出国进修”心态我进入了麻醉科工作。上临床的第一天对于环境、药品和耗材的陌生是首要难题。麻醉科印度裔主任库玛顾问医师用他那浓厚而亲切的印度腔英语和欢快的笑声很大程度缓解了我的陌生感和紧张情绪。他对我表示了欢迎，带我熟悉了 3 楼手术间的环境，也宽慰我说不用着急，等我自己觉得舒适有把握的时候再单独排我管理手术间的麻醉，此前都会安排其他的医生和我一起，这让我觉得温暖而备受鼓舞，也对他们对患者负责的风格产生钦佩。快速熟悉手术间内的环境，了解物品摆放是学习的第一步。通过热情友好的麻醉助手组长莫瑞先生的介绍，我知道了手术间的基本配备。每个房间的麻醉机、监护仪、暖风机齐全，还有可视化喉镜、超声等可以使用，但是微量输注泵等仍相对欠缺，所以他们的全麻绝大多数以吸入麻醉维持，仅在诱导的时候使用静脉麻醉药。麻醉耗材及药品全部为进口，同一种药品或者耗材可能有多个规格和不同的生产国，偶尔也能在麻醉车里发现过期的药品和耗材，所用的药品特别是术后镇痛类与国内差距较大。

一向对自己沟通能力比较自信的我未曾想到英语听说对于刚到巴巴多斯的我会也是一大难题。科室的每位医生护士，每一个麻醉助手，每一个病人他们的口音都不同，而且更要命的是他们有很多当地人特有的说法和缩写，不经过专门解释压根儿就不懂，特别是手术台上的外科医生之间的交流或者外科医生与洗手护士之间的交流，有时候感觉他们根本就不是在说英语。这让我不免有些挫败感。好在他们都很体谅我，每次跟我说的时候特别注意发音和语速，多跟同事交流，不懂就厚脸皮多说几次“Pardon me？”多问病人情况，多听当地广播，多找邻居‘拉家常’，渐渐地就不再觉得语言是沟通的障碍了。

麻醉科同事的热情帮助让我很快适应新环境进入了良好的工作状态，库玛主任看到我的适应能力后，在我进入科室的第三周就开始排班让我独立负责病人的麻醉，让我有点受宠若惊，同时也更加自信从容地按规范做好麻醉，保障手术患者的安全。随着工作的推进和大家的熟悉，我也尽力展示我们中国麻醉医生的优势，特别是超声引导下的各种神经阻滞，从颈部到腿部，几次操作展示之后，他们从经验丰富的顾问医师到好奇新手的实习宝宝都想学习，每次我操作的时候总会站在身后问个不停。后来麻醉科唯一一台超声仪坏掉而不能再实施这些技术时，顾问医师盖斯金和搜博两人还会专门带上他们自己的便携式超声仪让我示教或者让我指导他们操作与他们进行探讨。特别是我从国内带过来的连续神经阻滞术后镇痛技术用于骨科患者，他们从来没有用过，一经展示，马上在科室传开来，纷纷向我咨询，要求下次做的时候一定要提前给他们讲，充分表达了他们对新事物的好学态度。

由于疫情的影响，麻醉科手术室的运行执行特殊管理模式，所有手术室医护人员也对疫情防控都比较重视。进入手术室的所有病人均有 2 次以上的流行病学询问并记录，同时会完成 COVID19-PCR 检测，需要有阴性结果才能进入 3 楼主手术室内手术。病人在交换大厅交接进入手术室时，需要核查患者的体温等信息。同时确认患者手术麻醉以及恢复全程带好口罩（除非要进行气管插管等打开气道操作）。麻醉医生在麻醉方式选择上根据患者病情尽量选择区域麻醉为主，不打开患者的气道。如果实在需要进行气管插管等操作时也有较强自我保护意识，会采取戴面屏、医用防护口罩、最大程度减少患者呛咳、缩短操作和暴露时间、使用面巾纸及纱布遮挡等措施。然而随着疫情在巴巴多斯的加剧，不同的外科病房也出现有住院病人感染的情况，甚至有些医护人员也有感染。好在所有麻醉医生都很谨慎，几乎应该是戴口罩执行得最好的巴巴多斯人。我们因为所有医疗队员过着同食同居的集体生活，卫健委领导也把"零感染"作为我们必须达到的目标，所以在手术室内一直都至少是二级防护穿戴，吃饭喝水也刻意选择与同事们不同的就餐时间，快速搞定后立马带好口罩做好手卫生。后期疫情的加剧导致医疗资源的严重挤兑，相当数量的麻醉医生要去新冠肺炎阳性病人隔离点工作，所以手术室一度只能应对急诊病人，我每天也和他们一样做着急危重症，对于整个麻醉手术抢救机制诸如紧急配血取血等也有了不同的锻炼和见识，一切都回到了手工时代。

在这里每天的麻醉工作量虽然与国内相比少了很多，但是因为这种公费医疗的体制和繁琐的甚至有点死板的处理流程，使得工作效率与国内相比低下很多。经常会有因为各种原因停手术的情况出现：房间空调不能调到医生喜欢的温度——停手术；洗手护士要下班——停手术；突然没有手术需要的耗材——停手术；外科医生做一台比较长时间的手术累了——停手术；手术室护士觉得患者的核酸检测结果时间太久了没有安全感——停手术。让人惊喜的是患者几乎都很淡定坦然地接受，很少有抱怨或者医患矛盾出现。当然，麻醉医生有更大的发言权，也可以到时间想下班而停掉手术，更不用说术前检查未完善、主刀医生未按时出现等，这一点使得在 QEH 麻醉医生和外科医生的地位与国内相比几乎掉了个个。外科医生为了保证第二天的手术能顺利进行不被停掉，通常头一天都会主动跟麻醉医师沟通患者的情况，也让我有了不同的体验和享受了充分被尊重的感觉。因为我几乎不停手术，所以绝大部分跟我搭档过的外科医生特别是住院医生都非常喜欢我，他们经常说 QEH 如果有更多像我这样的麻醉医生就好了。跟当地同事们深入交流，就会发现当地医生都非常清楚这样的管理和运行机制存在问题，但是他们到最后也只会感叹"money"！而没有更好解决办法。对于当地医生来说，QEH 的工作只是他们锻炼自己升成顾问医师赢得声誉的必经通道，这里只是挣得他们养家糊口的那一部分收入，一旦有机会，几乎所有的顾问医生都要到私立医院挣第二份高收入，那种工作效率截然不同。让人不免感叹：这种资本主义公费医疗制度下，让病人等待，效率低下，临时取消手术等情况最终都是普通患者承受其不良后果，有钱人永远都能享受到优质高效的医疗服务，可叹的是绝大部分患者习惯了这样的状态也

十分的平和。有了这样深刻的体验从而让我对祖国的伟大和人民至上的共产党精神有了进一步的认识。

由于疫情的影响和医疗队的规定，为了保障医疗队全体队员的健康，除了工作之外，我们几乎没有与当地同事和他人的相互宴请和对外交流，更不用说集体外出餐馆就餐，少了很多融入当地五光十色生活的体验和感受。援外的生活非常固定：工作日上班下班，晚饭后大家集体锻炼学习交流，周六轮班出门采购生活物资和分组为集体做饭（队里厨师这一天休息），周日各自清洗打扫整理。就在这单调的生活轴线上看着时间的流逝，心里不免为没有像前面几批医疗队队员深入体验异乡的文化习俗而颇觉遗憾。每每此时，我都会安慰自己：我们见识了几十年不遇的火山灰尘降和飓风，感受了大自然的威力和体验了岛国人民应对自然灾害的无奈和豁达心态；我们经历了巴巴多斯脱离英联邦成为共和国选举自己的总统的历史时刻，了解了即使是弹丸小国，也要追求独立自主美好生活的自尊和努力；我们体会了疫情与俄乌战争对世人的影响（我们花了 2 个多月的时间才买到了分批回国的机票），没有一个国家能独善其身，没有一个老百姓能绝世而独立。这些独特的经历让我对这辈子能做一个中国人更加自豪而感恩，对身在红旗下长在新时代的幸福生活更加珍惜而努力，对要为中国和平崛起屹立世界民族之林更有使命和担当。

巴巴多斯只有夏天，没有四季的变换，在短短 1 年 3 个月的海岛工作和生活，虽然有山水阻隔。与家人分离，却让我有时间看到日出日落的山水大美，有心情感受海风拂面的轻柔舒适，聆听大海波涛的自由与开阔，有条件了解不同肤色真心相交的珍贵与友谊。日子就这样飞逝，国内的家人与同事与我视频的时候都说我瘦了，也黑了，但是元气满满。就在这岁月流转之间，在这异乡小岛国，我们医疗队用自己踏实的工作和积极的状态展示了中国医生的技术，中国人的友好和中国的形象，而我也从这段经历中领悟到好好活着追寻生命的价值和人生的意义。

献之兴来拈起笔，笔如解飞自钩掣。
戏染松烟作牸牛，脱似偃角眠沙丘。 宋 · 白玉蟾

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