Editorial

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Supraglottic airway devices: Placement and pharyngeal seal matters!

Supraglottic airway devices (SADs) are now an indispensable instrument in the operating room as well as in non-operative room anaesthesia practice. They have evolved greatly from Archie Brain's laryngeal mask airway (LMA).[1] Use of SADs has expanded over the time from short surgical procedures initially, to all types of surgeries including laparoscopic/robotic and obstetrics. SADs have also been used in oral, cervical tracheal, prone position surgeries[2,3] and during cardiopulmonary resuscitation.[4] From the first-generation LMA classic to the most advanced third-generation Baska mask®, there is much progress in the field of SADs. Despite their improved utility, SADs do have disadvantages like not providing 100% protection from pulmonary aspiration of gastric material like a cuffed tracheal tube (TT).[5]

Although the SAD is considered a minimally invasive device, complications and problems have been associated with its use. The 4th National Audit Project (NAP4) of the United Kingdom reported that the incidence of death/brain damage is 9.1, 6.5 and 5.0 per million with TT, face mask and SAD, respectively. NAP4 has found that aspiration is the most frequent cause of death accounting for 50% (8/16) of deaths and two cases resulted in brain damage during airway management.[6]

Factors that may prevent these complications include selecting patients appropriately, choosing an SAD with better sealing pressure, the correct size of SADs, and using a recommended or improved insertion technique. There are various types of SADs available and among all these, perilaryngeal sealers (e.g., ProSeal LMA, Supreme LMA, I-gel™, LMA Protector™ and Baska mask®) are most commonly used. Perilaryngeal sealers form a seal around the larynx by fitting into the shape of the hypopharynx and tongue. Head movement and a change in the position of the patient can compromise this seal and lead to air leakage and tidal volume loss during controlled ventilation. A perfect and appropriate seating of the SAD is very important to prevent displacement. A tug-test can be performed after placement of the SAD. Tug-test assures that the cuff of the SAD is beyond the base of the tongue and does not slip out into the mouth. Tug-test helps in placing the tip of the SAD above the upper oesophageal sphincter and also helps in correcting accidental epiglottis down folding.[2]

For adequate tidal volume delivery and ventilation, a proper oro-pharyngeal seal is required; this is determined by the oro-pharyngeal leak pressure (OPLP). Oro-pharyngeal leak pressure is measured by closing the expiratory valve of the anaesthetic circle system at a fixed gas flow rate (usually 3 L/min) and noting the equilibrium airway pressure. Second generation and third generation SADs are known to give better OPLP than first-generation SADs. Oro-pharyngeal leak pressure is the gold standard in SADs but a proper oro-pharyngeal seal cannot be attained without proper placement of SAD over the laryngeal inlet. Proper placement of LMA was studied by Brimacomb and Berry[7] and they proposed a grading system. A fibreoptic scope is passed through the ventilation tube of the LMA up to a position just proximal to the aperture bar of the LMA and the view is graded as follows: Grade 4 – only vocal cords seen; grade 3: vocal cords plus posterior epiglottis seen; Grade 2 – vocal cords plus anterior epiglottis seen; Grade 1 – vocal cords not seen, but LMA function adequate; Grade 0 – failure to function and vocal cords not seen. They mentioned that LMA function is not relevant for Grades 4, 3 and 2 because the vocal cords are clearly visible and functional failure is not due to improper positioning and warrant ruling out other causes. Ultrasonography can be used for confirmation of misplacement/malrotation of SAD and the cuff of the LMA can be visualised with USG if inflated with saline. Nevertheless, further research is needed in the use of USG for confirmation of LMA placement.[8,9]

Supraglottic airway devices are available in various sizes right from neonates to adults and large adults. Manufacturers recommend the size of SADs based on actual body weight of the patient.[10]

In practice, actual body weight (ABW) criteria do not work well always in SADs. In overweight and obese patients, SADs chosen based on ideal body weight (IBW) had better fibreoptic grading for perfect positioning, lower peak inspiratory pressure and greater ease at insertion as compared to SADs based on ABW because obesity increases the fat tissue around the upper airway and decreases the pharyngeal cross-sectional area. Furthermore, pharyngeal area reduces with increase in body mass index (BMI).[10]

There are mainly five reasons which cause malfunctioning of an SAD: 1) Tip of the distal cuff of SAD folding over/backward, 2) Tip of the distal cuff of SAD between vocal cords, 3) Epiglottis in bowl of SAD without downfolding, 4) Epiglottis in bowl of SAD with downfolding, and 5) Epiglottis folding double.[11] Distal cuff in laryngopharynx and supraglottic and glottis compression are the other reasons for malfunctioning. Insertion can be blind, through an introducer or laryngoscopy guided. Second generation SAD with an oesophageal drain tubing, can be inserted by bougie-guided insertion technique or using Stylet tool. These techniques proved to be better in placement by ease of insertion, reducing downfolding and trauma.[12,13]

Kim *et al*.[14] studied the effect of blind insertion and laryngoscopy guided insertion of LMA on OPLP and fibreoptic grading and found that laryngoscopy guided LMAs have significantly higher OPLP ($P = 0.031$) but similar fibreoptic grading ($P = 0.053$) than blind insertion. They mentioned that the reason for higher OPLP in laryngoscopy-guided insertion is that direct visual laryngoscopy facilitates insertion of the LMA cuff and plugs it more firmly into the periglottic area.

A meta-analysis of 10 randomised controlled trials showed that ProSeal™ LMAs have better OPLP as compared to I-gel™ in adult patients with comparable device insertion characteristics.[15]

The recent, LMA Protector™ is a second generation, fixed curved SAD with a pharyngeal chamber, inflatable airway cuff and dual gastric access ports. This is made of flexible and less traumatic medical-grade silicone. This is also available with a pilot balloon or the integrated Cuff Pilot™ for easier adjustment of the intracuff pressure. In a randomised study, LMA Protector™ was compared with I-gel™ and found to provide better OPLP than the I-gel™. However, it resulted in worse fibreoptic views, longer insertion time, and more trauma compared to the I-gel™.[16]

A proper position of SADs is needed to be maintained throughout the surgery for adequate ventilation, at various positions of operating tables and changing head and neck positions. In this issue of the Indian Journal of Anaesthesia (IJA) there is a randomised study by Sidhu *et al*.,[17] on the influence of head and neck positions (neutral, maximum flexion and maximum extension) on OPLP with Baska mask® and I-gel™. They included 70 patients and showed that there was a statistically higher OPLP with Baska mask® ($P < 0.000$) as compared to I-gel™ in all head and neck positions. They have mentioned that the higher OPLP with Baska mask® is because of the difference in the type of material of these devices. Baska mask® is made of silicone, whereas I-gel™ is made of styrene-ethylene butadiene styrene. Although, more patients in the I-gel™ group had favourable fibreoptic grading (grade 4 and 3) than the Baska mask® group, this was not analysed statistically. Baska mask® is considered a third-generation SAD as the OPLP is better because with each positive pressure breath the seal improves as the cuff is connected to the airway tube.

Oro-pharyngeal leak pressure and fibreoptic grading do not always correlate well with each other and there are studies which show a low OPLP but better fibreoptic grading. In one such study in adult male patients, the classic LMA was used based on tongue-width size and a lower OPLP but statistically better fibreoptic scores were found.[18] When the LMA is used during spontaneous breathing, OPLP is not very crucial and some leak can be allowed.

SADs are being used increasingly for obtaining a view of the glottis either during intubation in obese patients or during extubation (Bailey's manoeuvre) to see the status of vocal cord after thyroid surgeries.[19] Although a good OPLP is not required in these indications of SADs, a perfect placement is required to have a better view of the glottis and the vocal cords.

In a study published in this issue of the IJA, Lim *et al*.[20] conducted a pilot feasibility study and evaluated glottic views during SAD guided fibreoptic intubation in obese patients (median BMI 35.4 kg/m^2) using either the sniffing air position or the ramped position. In this study, they scored the fibreoptic glottic view based on Cormack-Lehane (CL) laryngeal view and found that glottic views were similar in both-the sniffing air and the ramped positions. In another study published in this issue, Chilkoti *et al*.,[21] compared glottic views by fibreoptic bronchoscopy with LMA-CTrach™ after thyroid surgery, and found that glottic view through LMA-CTrach™ is comparable to fibreoptic bronchoscopy and less time-consuming.

Supraglottic airway devices are also used in shoulder surgeries in the beach chair position. Tan *et al*.[22] published a report of three cases of shoulder surgeries with airway management by LMA Protector™ and found adequate OPLP and fibreoptic CL glottis views. Tantry *et al*.[23] in a meta-analysis published in this issue, examined adverse heart rate responses, bradycardia or bradycardia-hypotension episodes in the beach chair position and correlated these with various anaesthetic agents, opioids and vasoactive drugs used. This meta-analysis did not examine airway management and use of airway equipment which could also have had an effect on the heart rate and the hypotension-bradycardia complex.

In paediatric patients, use of SADs is on a rising trend and very small children are also receiving airway management with SADs. Insertion of SAD in children may be blind, bougie guided, suction catheter guided or laryngoscopy guided.[24]

Apart from standard weight-based criteria, SADs in children are also used based on the height and size of the pinna. In a study in overweight and underweight children, the OPLP was higher in underweight children when ProSeal™ LMA was selected based on IBW, but in overweight children, OPLP was higher when ProSeal™ LMA was selected based on ABW.[25] Second generation SADs are preferred in children as no third generation mask (Baska mask®) is yet available for a weight less than 30 kg. Guidelines also suggest the use of second-generation SADs during unanticipated difficult airway in children.[26] Fitting and seal of SADs is confirmed and as important as in adult patients. In a study on children aged 1 month to 12 years of age, it was found that the I-gel™ had a significantly higher OPLP compared to the ProSeal™ LMA in the supine and lateral positions. OPLP significantly decreased when the position was changed to lateral from supine in both I-gel™ and ProSeal™ LMA groups and resulted in tidal volume loss. Percentage reduction in OPLP from supine to lateral was comparable in both I-gel™ and ProSeal™ LMA.[27] Another study compared ProSeal™ LMA and Ambu AuraGain™ in children and found that OPLP was significantly higher with Ambu AuraGain™ but the fibreoptic grading was similar.[28]

In conclusion, a wide variety of SADs are available for all age groups but it is important to choose the correct device for the correct patient. While using SADs, correct placement and an adequate seal are necessary to deliver the required tidal volume during controlled ventilation. Second and third-generation devices with higher sealing pressures should be used and fibreoptic confirmation should be a norm wherever available.

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