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Challenges and Advances in Difficult Airway Management: Past Present and Future.

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Difficult airway is the most dreaded problem encountered in the practice of anesthesia. The unanticipated difficult airway was considered as the most critical event in the life of an anaesthesiologist during the conduct of cases under general anesthesia; the scenario was either successful intubation or inability to intubate "can't intubate can't ventilate' (CICV)", and the serious airway catastrophes or even cardiac arrest due to hypoxia. Even the close claim analysis reported in 1990 in Anaesthesiology, the difficult airway management was one of the leading causes of anaesthetic deaths and malpractice claims in the USA.[1] In the past, there was no term like "difficult airway management algorithm" and no alternative plan or plan B.

In the last three decades, remarkable advances have been done in the field of airway management. The new concept of airway management, the LMA, which was introduced by Dr. Archie Brain in 1881, opens the new avenues.[2] Practice guidelines for management of difficult airway,[3] "a protocol based Algorithm that consider the various interventions to facilitate intubation for the Management of the Difficult Airway" was developed by the ASA Task Force in 2002 published in 2003 provided the common platform for approaching the difficult airway scenarios.[4] In this regard the 4th National Audit Project of the Royal College of Anaesthetists and Difficult Airway Society (NAP4) provided detailed information about the factors contributing to poor outcomes associated with airway management and highlighted deficiencies relating to judgement, communication, planning, equipment, and training.[5] Then a pre-planned, pre-induction strategy was designed that included the- awake intubation, video-assisted laryngoscopy, intubating / lighted stylets or bougies, SGA for ventilation & intubation, rigid laryngoscopic blades of varying design and size, fiberoptic-guided intubation[6], and the presence of difficult airway cart in anticipated difficult intubation.

Now the knowledge in this area has expanded greatly, as evidenced by the 2015 guidelines for management of unanticipated difficult intubation in adults. Here, the planning for failed intubation was considered as a part of the pre-induction briefing, particularly for urgent surgery. Emphasis was given to the airway assessment and preparation, positioning and pre-oxygenation of patient, maintenance of oxygenation, and thrust on minimizing trauma from airway interventions with limited number of airway interventions. The blind techniques utilizing bougie or supraglottic airway devices were superseded by video- or fibre-optically guided intubation techniques. The updated guidelines provided a sequential series of plans for failed tracheal intubation. The plan A comprised of face mask ventilation and tracheal intubation through laryngoscope either normal /optical/videolaryngoscope. In the condition of failed intubation, the oxygenation and ventilation should be maintained through face mask. In plan B the thrust was given to maintaining oxygenation through supraglottic airway devices (SAD) insertion (preferably second generation intubating SAD) by which oxygenation, ventilation and intubation can be performed successfully. On failure to maintain ventilation through SAD then plan C was planned, final attempt should be taken to oxygenate by face mask. If face-mask ventilation is impossible, then paralyse and if it is possible; then maintain oxygenation and wake the patient up or declare CICO and start Plan D with continue attempts to oxygenate by face mask, SAD, and nasal cannulae. Emergency front of neck access (plan D) was designed in the situation of 'can't intubate can't oxygenate (CICO). For this a didactic scalpel technique has been selected to promote standardized training. Here a wide-bore cuffed tube has to be placed through the cricothyroid membrane, which facilitates normal minute ventilation with a standard breathing system. For plan D wide publicity was given to train the airway healthcare provider. A multidisciplinary bed side training programme for tracheostomy became popular as "Johns Hopkins percutaneous tracheostomy Program" was established to improve patient safety. All anaesthetists should be trained to perform a surgical airway and the training should be repeated at regular intervals to ensure skill retention.

In this regard the NAP4 had provided commentary on a cohort of emergency surgical airways and cannula cricothyroidotomies performed when other methods of securing the airway during general anaesthesia had failed.[8] In the field of airway management ultrasound is also considered as a valuable skill tool for airway evaluation by anaesthetists, and training is recommended for its use.

Recently a complementary training module, the Vortex Approach[9] is designed to facilitate implementation of the principles advocated in guideline algorithm, so they perform under pressure. It is based on the hypothesis the three upper airway 'lifelines' (non-surgical techniques) by which alveolar oxygen delivery can be established and confirmed: face mask, supraglottic airway and endotracheal tube. If with a 'best effort' at each of these three lifelines is unsuccessful, a can't intubate, can't oxygenate situation (CICO) situation exists then 'CICO Rescue' (emergency front-of-neck access) must be initiated. The Vortex tool is depicted in circular graphic intended to represent looking down into a funnel on the three dimensional image.

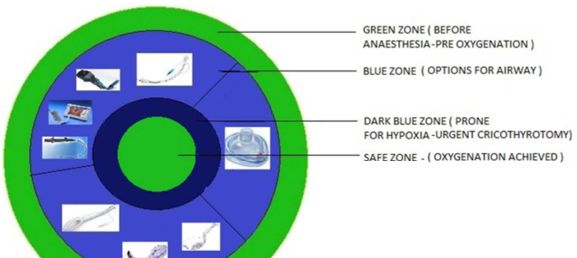

Figure-showing options for lifeline & definitive airway

The narrowing of the funnel represents the decreased time and options available, while the slope emphasises the instability of situation. The darker blue at the centre of the funnel evokes the potential for worsening hypoxaemia if alveolar oxygen delivery is not restored. The Green Zone reminded that the alveolar oxygen delivery is achieved. The Vortex model advises five categories of optimisation that may be applied to improve success and timely entry into the Green Zone via any of the lifelines. The optimisation manoeuvres are- manipulations (head & neck, larynx and device), adjuncts, size/type, and suction /O2 flow and muscle tone.

In recent times three-dimensional printed Intubating model are prepared, for the difficult cases of repeated airway surgery for airway malignancy. Based on the computed tomographic images of the pharynx, larynx, and the trachea, which were imported in the post-processing software Mimics (Materialise, Leuven, Belgium), a virtual 3D-reconstruction of the patient's airway was performed using an established technique. The airway lumen was printed in clear and rigid resin (Somos Watershed XC; DSM Somos, Elgin, IL, USA) using an SLA Viper machine (3D Systems; Rock Hill, SC, USA). The models can evaluate complex and unusual anatomical structures that are not easily understood in two dimensions.[10]

With the surge of promising new intubating devices such as Airtraq, Pentax, Mcgrath, C-MAC and D-blade and LMA C-trach etc, the selection of particular device become a dilemma for health care provider (Figure-showing options for lifeline & definitive airway). Therefore, it is high time for software developments which will advice the anaesthesiologist about most suited device to be used for the patient, based on the 3 D-CT or MRI done during pre-anaesthetic evaluation.

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