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Research Article

GENERAL ANAESTHESIA FOR BILATERAL ARTHROPLASTY OF THE TEMPOROMANDIBULAR JOINT IN A PATIENT WITH A DIFFICULT AIRWAY

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ABSTRACT

UR, a 20-year-old female student was referred on account of micrognatia and bilateral fibrous ankylosis of the temporomandibular joint (TMJ) secondary to trauma. A preoperative evaluation showed severe limitation of mouth opening and her bedside airway assessment was Mallampati class 4.The patient presented twice in the theatre for bilateral arthroplasty of the TMJ. In her first visit to the theatre, surgery was rescheduled because of failed intubation. Two weeks later, bilateral arthroplasty of the TMJ was done following a nasotracheal intubation achieved through a blind nasal technique and confirmed by fibreoptic laryngoscope under general anaesthesia with muscle relaxation.

Postoperatively, the patient was noticed with airway obstruction and bleeding. Postoperative recovery was uneventful and she was discharged home on the 12th postoperative day. Management of an anticipated difficult airway and the anaesthetic considerations in bilateral arthrosplasty are discussed.

INTRODUCTION

Temporomandibular joint (TMJ) ankylosis is the stiffening or fixation of the joint leading to chronic, painless limitation in the movements of the joints which makes mouth opening, chewing, swallowing and speech difficult. Bilateral ankylosis of the TMJ leads to micrognathia, an indication for arthroplasty.[1,2] Tracheal intubation during anaesthesia for arthroplasty provides a better operativecondition for the surgeon than face mask.[2]Studies report an incidence of one difficult intubation in every 65 patients.[3,4] Poormanagement of difficult intubation is a significant cause of anaesthetic morbidity and mortality.[5,6]A careful pre-anaesthetic assessment of the patient's airway is therefore obligatory.

Case History

UR, a 20-year-old female undergraduate was referred to the Otorhinolaringology unit of University of Port Harcourt teaching Hospital, Rivesr State, Nigeria on account of limitation in mouth opening of 10 years duration. The patient's condition had been progressive. At presentation she could hardly open her mouth. There was associated pain while chewing but no dysphagia or odynophagia. She had a history of trauma due to a fall from height about 6 years before the onset of the problem.

Physical examination revealed a young lady, who was not pale, anicteric and afebrile. Her pulse rate was 86 beats per minute, blood pressure was 120/60 mmHg. Heart sounds were normal. Musculoskeletal examination revealed micrognathia, ankylosis of both temporomandibular joints and severe trismus. Oral hygiene was fair with moderate accumulation of plaques and calculi.

A diagnosis of bilateral fibrous ankylosis of the temporomandibular joint was made. The patient was scheduled for bilateral arthroplasty. Investigations revealed full blood count (FBC), serum electrolytes, creatinine and urea and, urinalysis values that were within normal range. Computerized tomography (CT) scan showed- facial asymmetry, engorged nasal turbinates, widening and irregularity of both mandibular condyles. The articulating temporal fossae also showed shallow and irregular articular surfaces. There was marked narrowing of both TMJ spaces with a demonstrable bony ankylosis. Features seen in the CT scan were suggestive of fibrous ankylosis of the TMJ.X-ray of the TMJ showed significant limitation in the degree of mouth opening with no significant difference in both temporomandibular joints (TMJs) in the

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open and closed mouth views. And, there was slight increased sclerosis of the articular surfaces worse on the right which was suggestive of chronic ankylosis of both TMJs.

At the pre-anaesthetic visit, the history, physical examination and investigation results were asdocumented above. On examination, she was not pale, icteric nor febrile but appeared depressed. Her pulse rate was 80 beats/minute, regular and of full volume. She had a blood pressure of 110/70 mmHg and her heart sounds were normal, there was no cardiac murmur. Her respiratory rate was 16 breaths per minute and air entry was equal in both lungs.

She had facial asymmetry and mouth opening was highly restricted (about one finger breadth or approximately 2 cm). In assessment of the airway, she could not protrude her tongue because of severe limitation in mouth opening, her airway was categorised as Mallampatclass 4. Thyromental and sternomental distances were 6cm and 12.5 cm respectively. The distance from her mandible to her hyoid bone was 1.5cm. The patient was unable to protrude the lower teeth beyond the upper incisors. There was no limitation of flexion and extension of the neck at the atlanto-axial joint. The physical status according to the American Society of Anesthesiologist (ASA) was class 3. Airway management options including emergency tracheostomy were discussed with the patient and informed consent for anaesthesia was obtained. Oral diazepam (10 mg) at night before surgery was prescribed as premedication.

On the morning of the surgery, prior to the arrival of the patient in the theatre, routine pre-anaesthetic check of the anaesthetic machine, monitors and suction machine were performed. Equipment for difficult intubation including a tracheostomy set was assembled. Functionality of the fibreoptic laryngoscope was also confirmed. Anaesthetic drugs were drawn up in syringes and properly labelled. All intravenous fluids were warmed.

On patient's arrival to the theatrethe base line vital signs were; pulse rate- 78 beats per minute, oxygen saturation (on room air)- 100%,blood pressure- 110/70 mmHg, temperature (axillary)- 37^0C and the electrocardiogram showed normal sinus rhythm. Capnograph was calibrated and employed to monitor the end tidal carbon dioxide after endotracheal intubation. Intravenous access was secured on the left arm with a 14-gauge cannula through which warm normal saline was administered to the patient. Intravenous glycopyrrolate (0. 4 mg) was administered as premedication. The patient was preoxygenated for 5 minutes with 100% oxygen. Anaesthesia was induced with intravenous sodium thiopentone (STP) 250mgafter lung inflation by bag and mask was confirmed. Muscle relaxation was achieved with 100 mg of suxamethonium. Blind nasotracheal intubation was unsuccessful. Fibreoptic intubation was attempted but the patient suddenly developed both laryngeal spasm and bronchospasms. There was noisy respiration, rhonchi and reduced air entry in all the lung fields. This was relieved by administration of intravenous aminophylline 500 mg, hydrocotisone 300 mg, subcutaneous adrenalin 1:1000 with ventilation maintained with 100% oxygen via face mask. Surgery was postponed. Patient suffered delayed recovery. She was then commenced on 20% mannitol 250mls statim and was transferred to the Intensive Care Unit (ICU) where her recovery was satisfactory. The patient was re-scheduled for surgery after two weeks.

Preoperative review two weeks later revealed the same findings as before. Patient had counselling for pre-operative anxiety and oral diazepam (10 mg) the night before surgery was prescribed as premedication. All the other preparations were as per her last visit to the theatre except that the presence of more experienced anaesthetist, otorhinolaryngologist, maxillofacial surgeon, scrub nurse and anaesthetic technician was ensured before anaesthesia. Intravenous glycopyrrolate (0. 4 mg) was administered as premedication. The patient was preoxygenated with 100% oxygen using a transparent size 3 face mask at a flow rate of 6 litres/minute for 5 minutes. The otorhinolaryngologist, maxillofacial surgeon, and experienced scrub nurse were scrubbed and gowned before induction of anaesthesia was achieved with 250 mg of iv Sodium thiopentone (STP). Possibility oflung inflation by bag and mask was confirmed. Muscle relaxation was achieved with 100 mg of suxamethonium. The patient was placed in a sniffing position and the first three attempts at blind nasotracheal intubation were unsuccessful. Each repeat attempt was preceded by administration of 100% oxygen by face mask, 0.6 mg atropine, 100 mg thiopentone and 50 mg suxamethonium. Blind nasotracheal intubation was finally achieved at the 4^{th} attempt with a well lubricated size 7.0 mm internal diameter cuffed nasotracheal tube and confirmed with the aid of the fibreoptic laryngoscope.

Intermittent positive pressure ventilation was applied at 16 breaths per minute via a circle breathing system with 100% oxygen (6 litres per minute) and 0.5% to 1% halothane. Muscle relaxation was maintained with 6mg of intravenous pancuronium bromide and 3 additional boluses of 2 mg on each occasion. Analgesia was achieved with intravenous morphine 10mg and in the later part of the surgery; intravenous fentanyl 25 mcg was also administered to supplement analgesia. Intravenous ciprofloxacin 500 mg and metronidazole 500 mg were administered as perioperative antibiotics. The patient was carefully positioned on the padded operation table with 15 degree head up tilt and the arms were made to rest on padded arm rests. Surgery lasted 6 hours. Intraoperative blood pressure ranged from 90 to 145 mmHg systolic, 60 to 90 mmHg diastolic. The pulse rate ranged from 68 to 124 beats/minute. Arterial oxygen saturation was 97% to 100% throughout the surgery. End tidal carbondioxide was between 19 and 35 mmHg. The core temperature measured with rectal probe was between 36.8 and 37^0C. Peripheral temperature ranged between 34 and 37.2^0C.Estimated blood loss was 1500mls and 2 units of warm fully cross-matched whole blood was transfused. Also 1.5 litre of 0.9% saline was infused and, urine output was 500mls.

In her surgery, preauricular incision was made. Incision was deepened to expose the joint space. A repair and repositioning of the articular disc were carried out on the right TMJ. Removal of the disc and replacement with a prosthetic implant were performed on the left TMJ. Scar tissue or bony growths were also removed on both sides. Haemostasis was secured and wound closed.

At the end of surgery, halothane was turned off. And residual muscle relaxation was reversed with intravenous atropine 1.2

mg and 2.5 mg of neostigmine. The hypopharynx and oral cavity were cleared of secretions and blood. She was extubated fully conscious. Postoperative vital signs were; pulse rate- 102 beats/minute, blood pressure- 132/76 mmHg, arterial oxygen saturation(in room air)- 100%, and respiratory rate- 16 breaths per minute. The patient was transferred to the recovery room for further observation.

She was observed for 1 hour in the recovery room for respiratory difficulty before her transfer to the ward. She was nursed on either left or right lateral position for 24 hours. Intravenous fluids management consisted of 5% dextrose in 0.9% saline 1litre to alternate with 500mls of 0.9% saline 8 hourly for 24 hours. Total fluid intake was 4.5 litres in first 24 hours and urine output was 1.6 litres. Suctioning of the oral cavity was done regularly. Postoperative analgesia was achieved with intramuscular pentazocine 30 mg and paracetamol 1gram 6-hourly for 48 hours, respectively. Antimicrobials consisted of Intravenous ciprofloxacin 500 mg 12 hourly and metronidazole 500 mg 8 hourly for 48 hours. Thereafter she was continued on oral ciprofloxacin 500 mg 2 times daily and metronidazole 400 mg 3 times daily and oral multivitamins for 5 days. Oral sips were commenced on the first postoperative day and were well tolerated. Early ambulation was also encouraged on the second day. Facial palsy secondary to facial nerve paresis of the left zygomaticotemporal branch was noticed on the 2nd postoperative day and oral neurobion one tablet daily was administered for 2 weeks with good result. Jaw exercise was started 48 hours after surgery. The patient was discharged on the 12th postoperative day.

DISCUSSION

Bilateral fibrous ankylosis of the temporomandibular joint is commoner within the age range of 20-40 years.[2] It has a male to female ratio of 1:9. About 17% of the population suffer from various forms of temporomandibular joint dysfunction (TMJD). The cause of TMJD may be traumatic as seen in this patient or idiopathic.[2]Key elements of this disease include jaw joint pain and limited mouth opening. Patients with maxillofacial abnormalities such as the reported case often present with difficulty in tracheal intubation and maintenance of the airway. Difficult intubation may be defined as failure to intubate the trachea by a trained anaesthetist after three best attempts lasting about 10 minutes[7]. When there is associated inability to ventilate, it is referred to as difficult airway.[7]Similarly, the American Society of Anesthesiologists (ASA) definesa difficult airway as the clinical situation where a trained anesthesiologist in the operating room experiences difficulty with mask ventilation, difficulty with tracheal intubation, or both.[7] It is a life-threatening condition and mortality often occurs as from hypoxia and aspiration of gastric content.[5]

Successful management of a difficult airway begins with the recognition of the potential problem such as the severe limitation in the mouth opening. To determine the ease of airway control, a detailed pre-anaesthetic assessment based on a complete history and examination with special attention to the upper airway should be performed. Specific examination of this patients airway revealed a highly limited ability at mouth opening. The visualization of the oral cavity structures was not possible in this patient because of this limitation in mouth opening. The sternomental and thyromental distances were also measured. Difficult airway may be predicted in patients presenting for elective or emergency surgery based on pre-anaesthetic airway assessment. Information from past anaesthetic records, physical examination and radiological investigations might also be predictive of difficult intubation. And, presence of congenitallyabnormal bony and soft tissue structures of the face, upper airway anomalies, airway tumours, retropharyngeal abscess, cervical spondylosis, airway trauma and maxillo-facial tumours are associated with difficult intubation.

A number of specific clinical assessments have been developed for preoperative assessment of the airway. However, preoperative assessment of the airway using a test described by Mallamapat and modified by Samson and Young[8] is commonly used in surgical patients with no facial or neck pathology. This test is based on the visualization of pharyngeal structures when the patient sits upright and directly opposite the examiner with her mouth wide open and the tongue extruded.[8]Modified Mallampati airway categories according to Samson and Young[8] include; Class 1: Faucial pillars, soft palate, uvula visible; Class 2: Faucial pillars and soft palate but uvula masked by the base of the tongue; Class 3: Only the soft palate visible; Class 4: Soft palate not visible. The results from this test are influenced by the ability to open the mouth, the size and mobility of the tongue and other intra oral structures and movement at the cranio-cervical junction. This test is particularly important in predicting difficult airway in those patients who appear normal.

In 1984 Cormack and Lehane correlated Mallampati's classification with what was visible at direct laryngoscopic view of the larynx. The 4 categories are; Grade 1: Full glottic exposure; Grade 2: Only the posterior commisure of the glottis seen; Grade 3: No exposure of the glottis but the epiglottis seen; Grade 4: Not even the epiglottis seen. Clinically, grades 3 and 4 of both classifications suggest a significant chance that the patient will prove difficult to intubate. Mouth opening is largely a function of the temporomandibular joint and is of prime importance.[1] A problem with mouth opening can make visualization of laryngeal structure impossible. A distance of less than 2 large finger breadths between the upper and lower incisors points to a possibility of difficult intubation.[9] Examination of the oral cavity in this patient was not possible because of severe restriction of the mouth opening due to the facial deformity caused by the bilateral contracture at the TMJ. Laryngoscopy could not be done because of the same reason and this predicted serious difficult intubation.

In order to improve on the reliability of Mallampat's criteria, Wilson et al.[10] devised a risk sum score comprising 5 risk factors namely; weight, head/neck, jaw movements, mandibular recession and presence or absence of buck teeth. Each factor has three possible scores: (0,1and 2). Based on set criteria, a score greater than 3 predicts more than 75% chance of difficult intubation, however, this was noticed with a significant number of false positives. A simple bed side assessment of the airway was described by Patil, Stehling and Zaudar who uses the thyromental distance (distance from the

thyroid notch to the mental prominence when the neck is fully extended) as predictor of difficult intubation.[11] A thyromental distance of less than 6cm or 60mm or (breadth of) 3 large finger breaths is suggestive of impossible laryngoscopy while a distance of 6.5 cm or more is associated with no difficulty at laryngoscopy and intubation.[11] If the distance is 6-6.5 cm, without other anatomical problems, laryngoscopy and intubation are predicted to be difficult but possible. The thyromental distance of 6cm with facial pathology such as seen here predicts difficult intubation. This method of assessing the airway is associated with false positives and lacks specificity, but its sensitivity increases when used in patients who are Mallampati classes 3 and 4.[12]

The distance from the mandible to the hyoid bone should be at least 2 large finger breaths or 4cm or 40mm in adults as against the 1.5 cm measurement observed in this patient.[13] This area is important because the laryngoscope displaces the tongue into the space and exposure of the glottis may be inadequate if the space is narrowed. A receding or hypoplastic mandible as seen here results in a situation often referred to as "anterior or high larynx" which is a pointer to difficult intubation.

The sterno-mental distance measured from the sternum to the tip of the mandible with the head extended; is influenced by a number of factors including neck extension, presence of deformity or restriction of neck movement. A distance of 12.5 cm or less predicts difficult intubation. If the patient is able to protrude the lower teeth beyond the upper incisors, intubation is usually easy but protrusion of the mandible was not possible in this patient. It was an indication of immobility of the mandible which suggested that intubation would be difficult.
Radiological investigations may be of use in predicting difficult intubation. Radiographic prediction of difficult intubation by Hortol et al[14] demonstrated that lateral radiographs of normal volunteers undergoing laryngoscopy revealed a mean $C_1 - C_2$ extension of 25 degrees and there was a progressive increase in extension from C_4 to C_1, with the atlanto-axial extension apparently near the upper limits of normal. Limitation of this extension causes difficulties during laryngoscopy[14]. This patient was not able to perform this investigation because of financial constraints.

Difficult intubation was suggested in this patient by restricted mouth opening, unfavourable Mallampati and modified Mallampati scores, narrow thyromental, sternomental and hyomental distances. A contingency plan should always be formulated for the management of anticipated difficult intubation. One of these plans is extensive discussion with the surgical team on the planned procedure to ensure safe induction of anaesthesia and airway protection with the full co-operation of the entire surgical team. The main problems associated with anaesthesia revolve around the provision and securing of the airway, shared airway and difficulties associated with prolonged procedures. General anaesthesia with endotracheal intubation for maxillofacial surgery may be provided using a variety of techniques.

In view of the anticipated difficulties and experience with the patient during her previous visit to the theatre, anaesthesia was induced in the presence of the full surgical team including the otorhinolaryngologist and consultant anaesthetist to ensure safe airway control. According to the earlier mentioned A.S.A definition, difficulty with mask ventilation is present when the operator is unable to maintain the patient's arterial oxygen saturation at greater than 90% using positive pressure mask ventilation with 100% oxygen. The method of induction here was not ideal as, anticipated difficult intubation is contraindicates use of intravenous anaesthetic agent. During intravenous induction airway may be lost with consequent morbidity as seen in her first visit to the theatre. Muscle relaxant should not be used until the ability to ventilate the lungs and view the vocal cords is confirmed[3]. The ideal method of induction in this patient should have been inhalational induction in which the depth of anaesthesia is increased carefully by spontaneous ventilation of increasing concentrations of a volatile agent in 100% oxygen until laryngoscopy can be performed safely. The presence of a consultant anaesthetist, otorhinolaryngologist and ability to achieve 100% oxygen saturation with spontaneous respiration on oxygen enriched air in this patient gave the confidence in proceeding with nasotracheal intubation under general anaesthesia with muscle relaxation.

The main techniques for anticipated difficult intubation consist of those used for awake or sedated patients and under general anaesthesia. The options available for securing the airway are blind nasotracheal intubation, fibreoptic assisted intubation or tracheostomy under local anaesthesia. Blind nasal and fibreoptic assisted intubation could be done when the patient is awake or sedated or under general anaesthesia. Blind nasal intubation confirmed by fibreoptic laryngoscope was chosen here because of availability of specialist personnel and equipment. Orotracheal intubation in a patient with limitation of mouth opening is difficult if not impossible.

The anaesthetist should be familiar with the equipment and techniques that may be necessary to secure the airway or pass a tracheal tube under difficult circumstances. These include endotracheal tube guides, lighted stylets, rigid laryngoscopes, indirect rigid fibreoptic laryngoscope; supraglottic ventilatory devices like laryngeal mask airway and oesophageal combitube. Cricothyrotomy is a life-saving procedure which is a final "cannot- ventilate, cannot intubate" option in all emergency airway algorithms.

The Brain's laryngeal mask airway (LMA) has been used in both adults and children when intubation has failed and represents an important advance in airway management.[15,16] Although LMA is well recognized in the management of difficult intubation, it was not considered because insertion requires some degree of mouth opening and may be limited in patients with temporomandibular ankylosis. The combi-tube if available is a better alternative to the classic LMA in patients at risk of aspiration but it also requires good mouth opening for its placement. A gum elastic bougie can be passed into the trachea and an endotracheal tube rail - roaded over it into the trachea. Successful insertion of gum elastic bougie is confirmed by its movement over the tracheal rings. A retrograde catheterization of the trachea as described by Waters can also be done.[17] A catheter is inserted through the cricothyroid membrane and advanced until it emerges either in the mouth or nose, and a tracheal tube is rail - roaded over the catheter into the trachea.[17]But there is still a risk of the endotracheal tube getting impacted on the epiglottis or vocal cords.

Regional anaesthetic techniques may be used in situations where they are suitable. Tracheostomy under local anaesthesia is a final option. Tracheostomy establishes transcutaneous access to the trachea below the level of the cricoid cartilage.[18] The indications are governed by the patient and other options available.[19] This was not considered as the first option even though consent was obtained from the patient for it because skilled personnel for both blind nasal intubation and fibreoptic laryngoscopy were available.

The commonest technique for maintenance of anaesthesia comprises ventilation with a volatile agent supplemented with muscle relaxant and opioids. In order to achieve a hypotensive anaesthesia and to minimize intra-operative blood loss, balanced anaesthesia with halothane and opioid was used. The selection of muscle relaxant depend on the individual preference of the anaesthetist where there are no contraindications. Hence intravenous pancuronium was employed because it is long acting and reduced the frequency of administration sincea prolonged surgery was anticipated. Mechanical ventilation should be employed throughout the procedure and adjusted to maintain optimal haemoglobin saturation with oxygen and normocapnia. Prolonged surgery may lead to fatigue of intercostal muscles therefore controlled ventilation is indicated.

Maxillofacial surgeries can be prolonged and complex, resulting in heat and fluid losses, damage to pressure areas and deep vein thrombosis.[20] Evaporative losses of heat from surgical sites and the respiratory tract combined with radiant and convective losses to the ambient air to cool the patient results in hypothermia and postoperative shivering. To reduce heat loss, operating theatre's ambient temperature and humidity should be kept as high as comfortably possible.[21] In view of the enormous risk of hypothermia in this patient, precautions which were taken from the onset to minimize intraoperative heat loss included adequate draping and warming of all infused fluids.

The use of a well–padded operation table with arm rest protects the patient's bony protuberances from pressure and nerve injuries. Injuries may also be minimized by careful positioning to prevent unnecessary traction on nerve trunks or superficial nerves.[22] Elastic stockings or calf pump compressors should be used to minimize the risk of deep vein thrombosis if they are available. Low molecular weight heparin (clexane) when given subcutaneously reduces the incidence of venous thrombosis. In absence of its antidote (protamine) sulphate, it should be used with caution because of risk of bleeding.

Fluid balance must be very carefully monitored and maintenance fluids in the form of crystalloids such as compound sodium lactate should be given early. Temporo-mandibular arthroplasty is associated with significant blood loss. Grouping and cross-matching is therefore indicated. Blood loss should be closely monitord and red cell replacement should be considered after the loss of 10% of calculated total blood volume. Plasma expanders in the form of gelatin, starch or albumin, where available could be used to replace volume in addition to packed red blood cells. The haematocrit should be monitored throughout the procedure and maintained above 30% to improve oxygen delivery.[23]

Majority of complex maxillofacial procedures require intra-arterial blood pressure monitoring in addition to the electrocardiogram, pulse oximetry and measurement of inspired and expired gas partial pressures. Continuous monitoring of physiological variables allows tighter control of and fluid balance during procedures. Air embolism can be a occur and, these could be assessed using precordial Doppler detector. End tidal carbon dioxide monitoring can detect major incidents. In the absence of facilities for monitoring arterial blood gases, end tidal carbon dioxide monitoring may be used as a guide to adequate ventilation. Patients may experience respiratory difficulties after bilateral arthroplasty of the TMJ. Extubation when the patient is fully awake is highly indicated. Postoperative monitoring of respiration is also mandatory.

Postoperative analgesia should be provided by intravenous infusions of opioid or patient controlled analgesia. Intermittent injections of pentazocine used here is however associated with fluctuations in the concentration, with break-through pains. Non-steroidal anti-inflammatory agents may be given with care after blood loss and coagulation abnormalities have been corrected as these drugs inhibit platelets.[24]

CONCLUSION

Management of a patient with a potentially difficult airway for oral surgery is a challenging endeavour. However, detailed pre-operative assessment and a definite plan of management with suitable equipment are required to ensure a favourable outcome. Team-work, sound clinical judgement and expeditious response to clinical challenges are key elements to successful anaesthesia. When non-surgical manoeuvres fail, surgical intervention must be instituted immediately to ensure patient safety.

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