STUDENT CONTRIBUTION

Asphyxial Cardiac Arrest and the possible aetiological role of Antipsychotic Medications – A case study

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Introduction

Emergencies in the pre-hospital setting involving asphyxial cardiac arrest due to choking, whether by aspiration or foreign body are encountered rarely. Such an event is more likely to occur in paediatrics, especially six months to four years of age. [1,2] Adults at risk of asphyxia are typically persons who are unable to protect their airway for example, persons suffering from psychosis, neurological conditions and disability.

This paper presents a case of adult asphyxial cardiac arrest secondary to a foreign body. It will outline the details of the emergency call and the initial treatment by primary health care practitioners. A review of the aetiology and pathophysiology of asphyxia will be presented. A discussion will then ensue around the management of choking and the possible link between antipsychotics and upper airway obstruction in adults.

Case Presentation

An emergency call was received via 000 advising of a 40 year old male collapsed / unconscious - query drug overdose. An ambulance was dispatched with primary care practitioners and a student practitioner from Charles Sturt University on clinical placement, arriving on scene fourteen minutes following the call.

Initial Assessment

Airway	Airway cleared unknown material found.
Breathing	Apnoeic.
Circulation	Pulseless. Perfusion - cyanosed. Skin cool and clammy. ECG - Asystole. Neck veins - no distension evident.
Neurological	GCS [E=1, V=1, M=1] Total Score = 3 Pupils - fixed and dilated.
Other	Location - supine in dining room. No bystander CPR prior to arrival. Mother on scene.

Patient and Initial Treatment

Basic Life Support was immediately initiated. Upon clearing the patient's airway, a small amount of [what was believed to be] the patient's bitten tongue was identified. Suction with a Yankauer sucker was performed and an oropharyngeal airway was inserted. Further history from the patient's mother was obtained revealing that the patient was eating lunch prior to the arrest. Furthermore, the patient had a history of depression and was currently taking Risperdal [risperidone].

A monitor/defibrillator was attached to the patient revealing asystole. Intermittent Positive Pressure Ventilation [IPPV] via bag-mask ventilation and External Cardiac Compressions [ECC] were performed. During resuscitation, ventilation appeared ineffective. Cyanosis persisted and there was no chest movement with ventilation.

Intensive Care practitioners were requested. Further attempts at suctioning the oropharynx occurred to remove a possible foreign body. This was however unsuccessful and resuscitation continued. On arrival of Intensive Care practitioners, practitioner laryngoscopy was attempted and a foreign body was identified in the laryngopharynx. The foreign body was removed with Magill forceps.

The patient was subsequently intubated, IV access was established and pharmacotherapy [Adrenaline, Atropine and Sodium Bicarbonate] was administered. Perfusion improved and ROSC occurred approximately two minutes following advanced life support - post removal of the foreign body. The patient was transported to definitive care. One hour later after Emergency admission, the patient was transferred to the Intensive Care Unit.

Patient Assessment at Definitive Care

Airway	Airway - intubated.
Breathing	Assisted ventilation.
Circulation	Perfusion - pink. Skin - normal. ECG - Normal Sinus Rhythm. Pulse - palpable. Neck veins - no distension evident.
Neurological	GCS [E=1, V=1, M=1] Total Score = 3 Pupils - fixed and dilated.

Aetiology of Injury

The client is eating lunch and then accidentally swallows the partially masticated bolus. The body's initial response would be to produce a cough reflex mechanism. This mechanism would ideally try to assist in removing the foreign object. [3] The cough reflex is controlled by a centre in the medulla, the reflex allows a series of coordinated movements that cause the person to inspire air, and then close the glottis and vocal cords; [3] from here a forceful expiration occurs, the glottis then opens and the bolus is expelled superiorly out through the oral cavity. [3] If forceful expiration doesn't occur the foreign body will impact the laryngopharynx, in the larynx entrance or at the level of the cricoid cartilage. [3] "Once

complete obstruction progresses to unconsciousness, asphyxial cardiac arrest occurs rapidly”. [3]

Pathophysiology of Asphyxia

Asphyxia occurs when either airway or ventilation are compromised thus resulting in alveolar hypoxia and hypercapnia.[3] When oxygen supply and demand have been disrupted cellular hypoxia occurs.[3] Consequently respiratory and metabolic acidosis develops. [3]

Respiratory Acidosis

The retention of carbon dioxide is the cause of respiratory acidosis with an increase in P_{CO_2} . This occurs at the alveolar level where production and elimination of carbon dioxide is impaired from failure of ventilation, secondary to upper airway obstruction.[4] As P_{O_2} decreases and P_{CO_2} increases, the diffusion of oxygen at cellular level also decreases. The elevated P_{CO_2} is termed hypercapnia. [5] Failure of ventilation causes hypoxemia and eventually cardiac arrest. [4] Correction of hypoxemia can occur through relieving airway obstruction, increasing rate or depth of ventilation. [5]

Metabolic Acidosis

Lactic acidosis develops when numerous cells become insufficiently perfused thereby causing a shift from aerobic to anaerobic metabolism. [4] Metabolic acidosis ensues as a result of an accumulation of lactic acid and a loss of base, ultimately resulting in excessive hydrogen ions moving into extracellular fluid overwhelming the buffer systems including bicarbonate.[4] Under physiological conditions, the respiratory system would try to counteract the acidotic state [in part] by increasing respiratory rate, depth and ventilation mechanisms to reduce carbon dioxide levels. [4]

During metabolic acidosis tissue metabolites and hydrogen ion accumulate. Such an accumulation causes vasodilation of the precapillary sphincters. This causes a decrease in tissue perfusion. Postcapillary sphincters are briefly unaffected by the accumulation effects of metabolites and hydrogen ion, thus an increase in capillary hydrostatic pressure occurs. A loss of fluid from the vascular space to the interstitial space now develops. [4]

During these stages the cardiovascular system is also affected by the massive release of catecholamines [dopamine, adrenalin, and noradrenaline], adrenal corticosteroids and antidiuretic hormone. This response can induce dysrhythmias, and bring about hyperglycaemia and hypokalemia. [6]

Scarce energy from anaerobic metabolism effects the sodium and potassium differential across the cell membrane. Further damage to the cell is infiltrated by intracellular potassium moving out of the cell with sodium moving in through leakage and now cellular swelling is the last result in the series of events that have occurred. As these events cascade they ultimately cause cellular damage and death. [4]

Neurological Insult

The human brain represents 2% of body weight; however it significantly receives 20% of cardiac output. Blood flow to the brain is through mainly the carotid and vertebral arteries; the jugular veins return blood back to the heart from the brain [7, 8] Oxygen and glucose are

vital for many of the chemical reactions that take place through neurotransmitters for example noradrenalin, dopamine and serotonin. [9]

Asphyxia causes severe neurological insult if not corrected. The neurological system is susceptible to oxygen and glucose deficit more so than the rest of the body due to the brain's affinity for constant oxygen and glucose. [3] The brain relies on oxygen and glucose through adequate cerebral blood flow. [7, 8] Thus the prognosis of full neurological recovery after an asphyxial cardiac arrest remains poor due to such a deficit. [3] An overview of the pathophysiology of events leading to brain injury can be seen in Figure.1.

The brain is protected by two physiological mechanisms these being one, autoregulation and two, the cerebral metabolic requirement for oxygen. During normal circulation autoregulation maintains constant cerebral perfusion which allows for constant oxygen and glucose.[8] In normal conditions "autoregulation maintains cerebral blood flow of about 50mL/100g brain/min". [8]

Cerebral metabolic requirements for oxygen are conditioned through the brain's metabolic needs and flow moves into specified areas of the brain when needed.[9] Certain regions of the brain are particularly sensitive to anoxia these are the hippocampus, cerebral cortex, basal ganglia and spinal cord. [9] Such mechanisms during cardiac arrest are limited because circulation is anomalous.

Asphyxia causes [cerebral hypoxia], unconsciousness can occur within ten seconds when adequate cerebral oxygen is depleted. It further follows with the depletion of glucose this transpires within two to four minutes and leads to cerebral anoxia and then finally neuro-cellular necrosis. [8]

Figure.1. Pathophysiology of Brain Injury: the cascade of events

Adapted from Eaton [10]

Discussion

Management of Choking

In the event of complete foreign body obstruction of the airway the Australian Resuscitation Council recommends the practitioner attempt [initially] four back blows. [\[Click here to see Diagram\]](#) The rationale behind this form of treatment is firstly, that it may intensify any pressure in the obstructed airway thus resulting in partial or total dislodgement. Secondly, the back blow may cause movement that could initiate the person to cough and expel the foreign body. [11]

If the four initial attempts of back blows to remove the foreign body are refractory, four Lateral Chest Thrusts [LCT] should be performed. The LCT method consists of posturing the patient in the lateral position, then placing one hand against the lower fold of the patients armpit with the other hand located next to the first hand. Then four quick, downward thrusts are administered, keeping the hands on the chest throughout the procedure. This method may cause an increase in internal pressure that may expel the foreign body. [11]

Schou, Safar and Paradis state that digital scooping of the laryngopharynx should be performed as this technique may also assist in removing a foreign body. Caution should be noted here, further obstruction may occur if this is undertaken, especially when incomplete obstruction is present. [12, 3]

When reviewing the treatment given by practitioners in this case, it is reasonable to ask why the practitioners did not use the manoeuvres to relieve the upper airway obstruction that was suspected, and stipulated by practice guidelines. It is important to recognise that these manoeuvres may or may not have resulted in an improved outcome in light of the down time prior to arrival, however initial ventilatory assistance would have been performed more effectively if the foreign body was removed.

It is reasonable to suggest that this procedure should have been carried out as a secondary attempt at removing the questionable foreign body when ventilation was ineffective after initial attempts. It is worth noting that treating airway obstruction starts with thinking that it may exist in the first place. Thus theoretical foundations of practitioner's knowledge play a vital role informing treatment and diagnostic practices.

Airway management in out-of-hospital care

For advanced practitioners the laryngopharynx should be visualised through the use of the laryngoscope, and an attempt to remove the foreign body should occur with the use of the Magill forceps. [3]

This case demonstrates the need for basic practitioners to have the skills to be able to remove a foreign body compromising basic airway management rather than waiting for Intensive Care practitioners. Foreign body removal with forceps should not be limited to advanced practitioners, the rationale behind this recommendation is so not to increase neurological impairment and initiate respiratory assistance earlier delivering vital oxygen to the body.

Metropolitan Ambulance Service [MAS] and Rural Ambulance Victoria [RAV] are among leaders in the treatment of foreign body airway obstruction. Paramedic and MICA practitioners are taught the clinical skill of laryngoscopy and are able to remove an impacted foreign body from the upper airway with the use of Magill forceps. [13, 14] If the complete obstruction is refractory to current interventions, for example back blows/LCT and Magill

forceps removal, any decision to undertake cricothyrotomy may be extremely beneficial. [3] However, few pre-hospital practitioners are clinically versed in this procedure.

Neurological Impairment

It is vital that practitioners focus resuscitation efforts beyond the paradigm of CPR and incorporate the ideals of Cardiopulmonary Cerebral Resuscitation CPCPR. [8,15] Richmond recommends “approaching the patient from the perspective that death is not a distinct moment in time, but rather a protracted physiologic process during which the person dies cell by cell by cell”. [8]

The ultimate goal of prehospital resuscitation is the ROSC with an adequate outcome of neurological systems, although rarely possible. Neurological recovery in cardiac arrest continues to be the foremost limiting factor in resuscitation and it is certainly the position in

this case. [8] At the time of admission to definitive care, full neurological recovery without some sort of disability for this patient remained grim. This was evident by a GCS score of three on admission to hospital.

Risperdal [risperidone]

What becomes apparent after an examination of the information presented throughout the case study is the patient’s current medication. Risperdal [risperidone] is an antipsychotic selective monoaminergic antagonist with a high affinity for serotonergic 5-HT₂ and dopaminergic D₂ receptors sites.[16, 17, 18, 19] Risperdal is indicated for the treatment of schizophrenia, related psychosis, behavioral disturbances and disruptive disorders in children. [16]

The benefits of using Risperdal are due to a reduction of extrapyramidal effects at low doses compared with other older antipsychotics that are available.[17,19] Extrapyramidal side effects of Risperdal can occur when high dosages of medication and patient are not reviewed regularly, and or if the drug is misused. [16]

Movement disorders that result from the continued exposure of dopamine antagonists effect basal ganglia and brainstem nuclei these are termed Extrapyramidal Syndromes [EPS].[20,21] The clinical presentation of EPS can involve parkinsonism, dystonia, akathisia and dyskinesia. [21] A brief overview of these effects can be seen below.

EPS Overview of Effects

Parkinsonism: Drug related parkinsonism effects are characterized by rigidity, tremor and bradykinesia. These characteristics can be identified around several [days/weeks] on continued medication.

Dystonia: Dystonia is caused by involuntary contractions of agonist and antagonist at the muscular level. Involuntary contractions can occur in the head, neck, trunk and limbs. Effects include oculogyric crisis, trismus, laryngeal - pharyngeal constriction, retrocollis and toricollis; surreal body position and posture.

Akathisia: Akathisia is a state of restlessness. The person feels the need to move, pace, rock whilst in the sitting or standing positions. Other purposeless repetitive actions may also occur.

Tardive Dyskinesia: Tardive Dyskinesia [TD] includes “repetitive, involuntary, hyperkinetic movements”. These movements may consist of the person chewing their tongue, lip smacking as well as grimacing. The signs and symptoms can be seen [months/years] of continued medication.

Adapted from Schillevoort [21]

Author: Robinson, K.

There are no definitive theoretical foundations that explain the mechanisms that cause dyskinesias. One hypothesis currently takes the view that dyskinesia is caused by “supersensitive postsynaptic dopamine striatal receptors” [22] occurring as a result of the long-term use of dopamine antagonists. [20, 22] “Long-term blockade of postsynaptic dopamine receptors results in denervation supersensitivity with up-regulation” [22] causing an increase in postsynaptic dopamine receptors that can interact with endogenous dopamine. Blockade of these receptors decrease involuntary movements, and increase in these receptors intensifies dyskinesias. [22]

Ruschena *et al.* investigated the deaths of individuals from the age of fifteen and over in a study undertaken on behalf of the Department of Human Services Victoria. The study researched deaths from 1989 to 1995 that had been identified by a Forensic Pathologist as death due to asphyxia. In total the study identified 186 asphyxia related deaths. [1] Specifically, excluded from this study was death due to strangulation, postural asphyxia,

autoerotic asphyxiation asphyxiation by foreign substance except for food and death due to blood alcohol content. [1]

A total of 70 deaths related to choking [airway obstruction] had been identified. [1] Patients died from aspiration of gastric contents and 39 non-aspiration café coronary. The study also acknowledged that there was a risk 30 times that of the general population for those diagnosed with schizophrenia and 43 times that of the population that had an organic disorder of non-aspiration [asphyxia]. [1]

Ruschena *et al.* states throughout the study that choking is one of the mechanisms that have been identified in connection with antipsychotic medication and sudden death. Possible reasons for choking can be attributed to EPS. From the review of literature on the long-term use of antipsychotics it is postulated that the primary cause of airway obstruction in this case was possibly due to Risperdals EPS effects. This ultimately caused asphyxial cardiac arrest.

Conclusion

Despite resuscitation efforts and advanced skills employed by practitioners the likelihood of neurological survival for this patient remains grim. Resuscitation attempts were initially inhibited by a complete obstruction by a foreign body of the laryngopharynx. In the event of such an obstruction definitive steps should be taken to remove or dislodge the foreign body in order to facilitate ventilation and ultimately respiration. It is important to recognise that antipsychotics [e.g. Risperdal] may have an important relationship to choking in adults.

This case study has highlighted the importance of airway management and the principles surrounding the techniques that are used in relieving upper airway obstruction. Laryngoscopy should ideally be employed by all practitioners. The take home message from this case comes down to the simple theoretical foundations of Airway, Breathing and Circulation. When in doubt of a patient’s condition always re-examine the ABC and respond to problems found.

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