

Substance abuse and anaesthesia - Part 2

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Tobacco and alcohol remain the most abused substances in South Africa and elsewhere in the western world. Tobacco is commonly smoked, but in South Africa it is also “sniffed” as snuff, and if inhaled causes as much damage as inhaled tobacco smoke. There is also a high incidence of related cancer.¹ Likewise people exposed passively to tobacco smoke may acquire smoking-related conditions such as coronary artery disease and asthma.²

Key words:

Alcohol withdrawal syndrome (AWS); Alcohol abuse; Tobacco abuse; Smoking

ALCOHOL ABUSE

Alcohol abuse is rife in all sectors of society in South Africa. There is an unusually high incidence amongst the farm workers in the deciduous fruit industry³, as well as amongst the large population of mine workers.⁴ Chronic alcoholism has been found to be prevalent in tuberculosis patients⁴, as well as in many patients admitted to hospital with severe (e.g. Klebsiella) pneumonia.⁵ In some centres at least half of the patients presenting for elective and emergency surgery suffer from chronic alcoholism.

Chronic alcohol abuse is often difficult to diagnose preoperatively, as there is often an element of denial. It is, however imperative that one diagnoses it preoperatively, for two reasons; firstly so that postoperative alcohol withdrawal syndrome (AWS)⁶ can be avoided, and secondly so that the anaesthesia technique can be modified to accommodate any end organ damage.⁷

ALCOHOL WITHDRAWAL SYNDROME

The most feared postoperative complication of AWS is unanticipated delirium tremens. This is a life-threatening condition, with a mortality of 10%. AWS consists of a range of signs and symptoms that develop in alcohol-dependent people 6-24 hours after their last drink.

Autonomic hyperactivity appears within hours, and peaks at 24-48hours. It is characterised by:-

- Tremulousness
- Sweating
- Nausea and vomiting
- Anxiety and agitation

Neuronal excitation, which may include grand mal seizures, occurs within 12-48 hours of abstinence.

Delirium tremens then follows. It is characterised by:

- Auditory and visual hallucinations
- Confusion and disorientation
- Clouding of consciousness
- Pronounced autonomic neuropathy

If untreated, respiratory and cardiovascular collapse can result in death.⁶

The pathophysiology of AWS is thought to be the following: During chronic alcohol intake an up-regulation of the cyclic adenosine 3'5'-monophosphate (cAMP) occurs in certain regions of the brain. On withdrawal of the alcohol, the upregulated cAMP pathway “overshoots”, contributing to features of withdrawal. Upregulation of the cAMP pathway interferes with glutamatergic, GABAergic, dopaminergic, serotonergic and opioidergic actions of the neurons. As so many neurotransmitter systems are affected, the signs and symptoms of AWS are extremely varied (Figure1).⁶ This in turn makes diagnosis very difficult.

The incidence and severity of AWS varies from centre to centre and from elective to emergency surgery patients. In an Australian study a 16% incidence of AWS was found in general surgical patients, whereas in trauma patients the incidence was 31%.⁶ It is well known that many trauma patients treated in South African hospitals are chronic alcoholics, so

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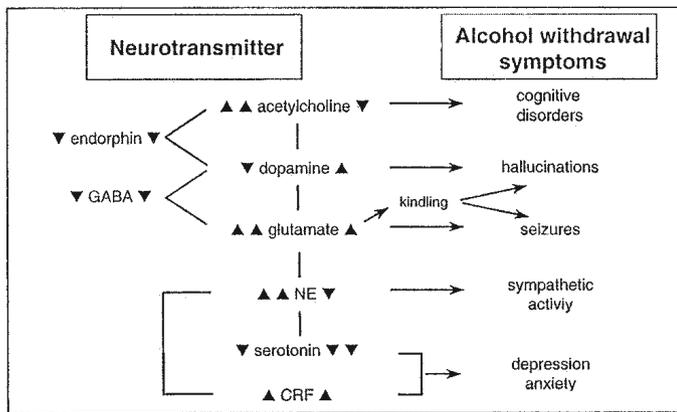


Figure 1. Neurotransmitter imbalance and alcohol withdrawal-related symptoms. NE = norepinephrine, CRF = corticotropin-releasing factor. ▲ = increase, ▼ = decrease.

one can only guess that the incidence of AWS in the postoperative trauma patient in South Africa is high. Peden et al found in their study in Cape Town in 2000³ that 25% of trauma patients could be classified on CAGE criteria as chronic alcoholics, and more than 60% of trauma admissions have positive alcohol levels.

Thorough preoperative assessment is vital, as it has been shown that AWS can be prevented and/or the severity of symptoms reduced by treatment with a benzodiazepine.

The preoperative assessment includes the following:⁻⁶

1. Recognition

- History and physical examination
- Alcoholism-related questionnaire : CAGE
 - * Have you ever felt you should cut down on your drinking?
 - * Have other people annoyed you by criticising your drinking?
 - * Have you ever felt guilty about drinking?
 - * Have you ever taken a drink in the morning to steady your nerves or cure a hangover?
- Laboratory markers: carbohydrate-deficient transferrin (CDT); ?glutamyl transferase (GGT) and mean corpuscular volume (MCV).

CDT appears to have the greatest specificity and sensitivity. A chronic daily intake of >50-80 grams of alcohol for longer than a week significantly increases CDT levels.

2. Strategy

- If CAGE = 3 or CAGE = 2 and at least one laboratory marker is positive then preoperative/immediate postoperative prophylaxis is imperative.
- If CAGE < 2 but two laboratory markers are positive, maintain a high index of suspicion, re-evaluate patient; consider prophylaxis.

Prophylaxis in ward patients consists of the following:⁻⁶

- Benzodiazepines orally 6 hourly; diazepam 2,5-10 mg;

lorazepam 0,5-2mg; chlordiazepoxide 5-25mg OR

- Chlormethiazole 0,25-1g enterally 6 hourly OR
- Ethanol 0,5-1g/kg/day enterally or 0,5g/kg/day intravenously.

Prophylaxis in intensive care patients includes the following:-

- Flunitrazepam 1,0mg intravenously; 6µg/kg/hour infusion OR
- Chlormethiazole 150mg intravenously; 2,5mg/kg/hour OR
- Haloperidol 10mg intravenously; 29mg/kg/hour OR
- Clonidine 0,15 mg intravenously; 0,83mg/kg/hour OR
- Ethanol 3g intravenously; 48mg/kg/hour intravenously

As different surgical units have varying results with different regimens, there is no strong recommendation for any one drug or combination of drugs.

If prophylaxis has not worked, or the patient has been mis-assessed and AWS occurs, the following therapy is recommended:⁻⁶

- Establish diagnosis and severity of AWS, ensuring that the diagnosis is in fact AWS. The CIWA-Ar Scoring system (Clinical institute withdrawal assessment for alcohol scale) is recommended.
- Monitor vital signs.
- Obtain laboratory results: sodium, potassium, magnesium, blood sugar, arterial blood gas, full blood count.
- Depending on the severity the patient may need to be transferred to an intensive care unit – Do not underestimate the severity of AWS!!
- Treat with benzodiazepine: midazolam 0,2-0,4 mg/kg/hour¹³ or diazepam 10-40 mg or lorazepam 1-8 mg or chlordiazepoxide 50-100 mg (the longer acting drugs seem to reduce the incidence of seizures more effectively than the short acting ones).
- Re-assess the patient after one hour and start 6 hourly benzodiazepines as follows: diazepam 5-20mg or lorazepam 1-4 mg or chlordiazepoxide 25-100 mg.
- If severe hallucinations occur give haloperidol or risperidone.
- If severe autonomic symptoms occur use clonidine or betablockers.
- To prevent Wernicke's encephalopathy, administer thiamine.
- Monitor the patient intensively.
- For refractory delirium tremens, propofol works very well.

END ORGAN DAMAGE

The following should be taken into account when anaesthetising a patient who is a chronic alcoholic:⁻⁷

- Neurologic syndromes; these may be central or peripheral
 - * Central nervous system syndromes include Wernicke's disease and Korsakoff's psychosis, often in combi-

nation, as they are both associated with malnutrition in alcoholics. Wernicke's disease is characterised by nystagmus, bilateral paralysis of the external recti muscles, ataxia and impaired mentation. Other signs include apathy, disorientation and occasionally hallucinations. A polyneuropathy may also be present. Korsakoff's psychosis is characterised by a disordered memory function that precludes the performance of a complex task or the learning of new ones. Thiamine treatment can produce dramatic improvement, but not a cure.

- * Peripheral nerves are affected by alcohol more often than any other neural tissues. Clinical signs include parasthesias; change in temperature sensation; tenderness to pressure (especially hands, feet and fingers); motor weakness and wasting. Improvement may occur with vitamin B therapy. (pyridoxine, nicotinic acid and pantothenic acid).
- * Autonomic involvement is indicated by excessive perspiration.
- Liver damage occurs in various forms
 - * Alcoholic fatty liver presents with hepatomegaly, pain, tenderness, mildly raised transaminases and bilirubin, mildly prolonged prothrombin time and normal serum albumin.
 - * Alcoholic hepatitis (very similar to viral hepatitis) with lower levels of transaminases. Patients are usually very ill and may benefit from steroids.
 - * Laennec's/Portal Cirrhosis occurs with prolonged intake of large amounts of alcohol (60g/day in men and 20g/day in women). This equates to 750ml and 250ml of wine respectively. Patients present with weight loss, anorexia, nausea, vomiting and diarrhoea; weakness and fatigability. They are often jaundiced and febrile, and may also have peptic ulceration, gastro-oesophageal reflux and oesophageal varices. They have neurological signs and symptoms, anaemia and impaired clotting. Hypoalbuminaemia is present, and is often associated with ascites. Hypoxia may be present. Gynecomastia and impotence occurs in men and amenorrhoea in women. During advanced stages secondary hyperaldosteronism and diabetes may occur.
- Cardiac dysfunction is very common in patients subjected to chronic alcohol ingestion. It may take 2 forms
 - * Alcoholic cardiomyopathy presents as a dilated cardiomyopathy, with severe left ventricular dysfunction
 - * Beriberi heart takes 2 forms: the classic form is high output cardiac failure, which responds well to treatment with thiamine. Shoshin beriberi is a more severe form, presenting with acute shock. It also responds well to treatment with thiamine, but may require more intensive therapy initially.
- Skeletal muscle is also affected; skeletal myopathy pre-

sents with swelling and tenderness of affected muscles, occasionally with myoglobinuria. Later the muscles become atrophic and weak.

- Haematological effects are common; these include anaemia, leukopenia and thrombocytopenia.
- Pancreatitis often occurs in patients and may be associated with hypoglycaemia.
- Endocrine effects include a central inhibition of ADH and hence a diuresis, and an increase in cortisol production. Immunity is also suppressed.
- The Foetal Alcohol Syndrome is common in South Africa in babies born to mothers with chronic alcoholism. The features include central nervous system dysfunction, impaired growth, facial, cardiac and musculoskeletal abnormalities.

ANAESTHETIC MANAGEMENT

The most important aspect of this is to have a high index of suspicion. Chronic alcoholism occurs at all levels of society and in all age groups. Once the diagnosis is made, a full and detailed preoperative assessment must be performed. This includes laboratory investigations.

The anaesthetic technique must take into account any end-organ damage, particularly the liver and heart.

Some general points are as follows:-

- It has been shown that the induction dose of propofol is increased⁸, but for thiopentone there is no alteration in anaesthetic requirement, pharmacokinetics or pharmacodynamics.⁹
- The MAC (minimum alveolar concentration) for volatiles may be increased.
- If the patient is acutely intoxicated at the time of induction, a rapid sequence induction should be considered, bearing in mind the potential problems with suxamethonium and skeletal muscle myopathy.
- Pharmacokinetics may be markedly altered by hypoalbuminaemia.
- The choice of a volatile agent is often determined by the degree of myocardial and liver dysfunction.
- Hypoglycaemia may be a problem if liver dysfunction is present or if the patient is acutely intoxicated.
- Sodium-containing fluids may be contra-indicated in the presence of ascites.
- Regional anaesthesia: a thorough assessment of the degree of peripheral neuropathy must be documented prior to using any form of neuraxial or other regional anaesthetic technique. The clotting profile must also be assessed.
- Anaesthesia should be avoided during the alcohol withdrawal syndrome (AWS).
- Postoperative management depends on the degree of end organ damage as well as the surgery performed, but in all cases a high index of suspicion for the occurrence of AWS is essential.

TOBACCO ABUSE

This takes the form of cigarette, pipe and cigar smoking, as well as “smokeless tobacco” (snuff) use.

Smokeless tobacco usage is very high in Sweden, and also amongst certain groups in South Africa. In a study conducted in 1999 it was shown that in certain population groups almost half of the tobacco use was in the form of snuff.¹ Most snuff users acknowledge the addictive effects of nicotine, but are not aware of the increased incidence of oral and nasal (and possibly breast) cancers.

Chronic smoking of tobacco often occurs together with chronic alcohol ingestion.

Smoking continues to be a cause of increased perioperative morbidity. Many components (4700) of cigarette, cigar and pipe smoke have been identified, and these may be carcinogenic, as well as have effects on many organ systems.

END ORGAN DAMAGE

Carbon monoxide (CO) and nicotine produce most of the damage and pathophysiological effects in all the affected organ systems¹¹. This is an important fact, bearing in mind that nicotine is absorbed during smokeless tobacco use as well as during the smoking of tobacco.

The following systems are the most affected:-

- Cardiovascular: Inhaled mainstream tobacco smoke contains 1-5% carbon monoxide, which when diluted in the oropharynx is inhaled in concentrations of approximately 400 ppm (parts per million). The affinity of haemoglobin for CO is 200 times greater than for oxygen, hence the formation of significant amounts of carboxyhaemoglobin (COHb). Most urban non-smokers have COHb levels of approximately 2,5%, whereas tobacco smokers have levels that range from 3-15%, depending on the brand smoked, the amount smoked and inhaled, the pattern of smoking and the degree of activity and/or pulmonary ventilation whilst smoking.

The two major effects of an increase in COHb levels are:-

- * A decrease in the amount of haemoglobin (Hb) available for combination with oxygen, producing an absolute decrease in oxygen content.
- * A shift of the oxygen dissociation curve to the left, resulting in an increased affinity of haemoglobin for oxygen.

These effects summate to decrease oxygen supply at tissue level. The body's response to this is to increase oxygen extraction. This is problematic at myocardial level where extraction is normally high, even under resting conditions. In patients with ischaemic heart disease this will cause angina.

Carbon monoxide may also cause arrhythmias, and it may exert a negative inotropic effect on the heart. The latter is thought to be due to increased amounts of carboxymyoglobin.¹¹

Chronic tissue hypoxia results in an increase in red cell mass, with a resultant increase in blood viscosity. This in turn has

adverse effects on cardiovascular performance and tissue perfusion.

Nicotine has profound dose-related effects on the cardiovascular system, causing a tachycardia, vasoconstriction and a rise in systolic and diastolic blood pressure. These effects are mediated via carotid body and aortic chemoreceptors, autonomic ganglia and by the release of catecholamines from the adrenal medulla. Cigarette abstinence is followed by a reduction in pulse rate and blood pressure, peripheral redistribution of body temperature and decreased catecholamine levels. The pressor response after smoking one cigarette abates after 20-30 minutes.

- Respiratory system: The respiratory effects of smoking are diverse. Morton, as far back as 1944 showed that patients who smoked more than 10 cigarettes per day had a six-fold increase in postoperative chest complications. Numerous more recent studies have shown similar results. The mechanisms by which smoking affects the respiratory system are:
 - * Mucous hypersecretion and clearance: smoking may interfere with either ciliary activity and/or respiratory tract mucous rheology, resulting in impaired clearance. This smoke-induced ciliostasis is reversible, often resulting in marked bronchorrhoea after the cessation of smoking.
 - * Small airways narrowing: this is often difficult to measure as FEV₁ and FVC remain unchanged. It is partially reversible 2 months after cessation of smoking. It is often associated with an increase in bronchial reactivity.
 - * There is also an increase in the permeability of the respiratory epithelium, but the clinical significance is uncertain.

The end result of these respiratory effects is ventilation-perfusion mismatching.

- Immune system: components of inhaled cigarette smoke impair numerous components of the immune response.
- Haemostasis: the incidence of thromboembolic phenomena correlates very strongly with cigarette smoking, in that decreased platelet survival time and increased platelet aggregability have been found. The same has not been found with venous thrombosis.
- Drug metabolism: some components of tobacco smoke cause hepatic enzyme induction, interfering with drug metabolism. Drugs affected include benzodiazepines, theophyllin, warfarin and others. In 2001 Mayo showed that theophyllin clearance was increased in asthmatic children subjected to passive smoke inhalation.¹²

PERI-OPERATIVE MANAGEMENT

The most important question is how long before anaesthesia should the patient stop smoking? (if at all)

Carbon monoxide (CO) is excreted unchanged via the lungs, according to Haldane's law.¹¹ The major factors favouring COHb dissociation and CO elimination are an increase in inspired oxy-

gen tension and an increase in alveolar ventilation. On average the elimination half-life of CO is 4 hours (during sleep it is as high as 10 hours) and if breathing 100% oxygen it is reduced to 40-80 minutes. The recommendations for a smoking-free period before anaesthesia should therefore be at least 3 half-lives; i.e. 12-18 hours. During this time the oxygen dissociation curve returns to the normal position. A maximum period of 48 hours would be expected to be sufficient time for the COHb of all smokers to fall to a non-smoker's level and to produce a rise in oxygen content and availability.

Nicotine is metabolised in the liver, lung and kidney. The half-life of nicotine after inhalation is 30-60 minutes. Hence 180 minutes (3 hours) is sufficient if one looks at only nicotine, and we know that the pressor response after smoking one cigarette abates after 20-30 minutes.

From the pulmonary point of view it takes at least 4-6 weeks for changes to reverse after the cessation of smoking, except for sputum volume, which decreases after 2 weeks. It takes approximately 4-6 weeks for the immune system and the hepatic enzyme induction to recover.

ANAESTHETIC CONSIDERATIONS

As can be seen from the preceding paragraph it is best if the patient stops smoking 6 weeks prior to anaesthesia. If this is not possible, then at least 24-48 hours before anaesthesia. This will at least ensure minimal effects from nicotine and CO, and hence less cardiovascular effects.

Psychologically it may be very difficult for a smoker to abstain for as long as 24-48 hours preoperatively. The patient may become very agitated. Under these circumstances a good preoperative visit followed by a good premedicant is advocated.

In view of the end organ damage associated with smoking, an anaesthetic technique that decreases oxygen demand on the heart and increases availability is ideal. Interestingly enough, an anticipated increase in perioperative myocardial infarction and unstable angina has not been shown in smokers¹⁴, despite the fact that smoking is a documented risk factor for coronary artery disease.

Smokers have lower arterial oxygen tensions preoperatively. There are studies suggesting they desaturate more readily than non-smokers after induction, sedation or during recovery from anaesthesia. Other studies have not confirmed these findings. It is important to know that pulse oximeters equate COHb with oxygenated haemoglobin; thus in the presence of an elevated COHb the pulse oximeter will over-read.

Airway and pulmonary complications are definitely increased in smokers. There is evidence that they are more prone to upper airway problems, including laryngospasm, during induction of and emergence from anaesthesia.¹⁴ Postoperatively smokers are 2-6 times more likely to develop atelectasis and pneumonia. Hence a regional anaesthetic technique is favoured.

The risk of aspiration is similar to that of non-smokers, but the incidence of postoperative nausea and vomiting is less.¹⁵

Cigarette smoking during pregnancy does not appear to adversely affect the outcome of the foetus.¹⁰ However, as is well known, many smokers drink alcohol as well, and this may well have an effect on foetal outcome.

In summary, tobacco abuse assaults one's cardiovascular system and causes long-term damage to the lungs. Alcohol abuse damages every organ system except the lungs, and sudden withdrawal may have catastrophic results. Both may result in morbidity and mortality to the abuser. Alcohol may also cause damage to the unborn foetus.

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