

Oxygen Embolism During Surgical Lavage of Chronic Osteomyelitis of Femur with Hydrogen Peroxide

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ABSTRACT

Hydrogen peroxide, an over the counter irrigation solution used in infected and dirty wounds, has been reported mainly in the anesthesia literature to have life threatening complications. We report a case of near fatal gas embolism during an orthopedic procedure of irrigating the wound of a 30 year old female with chronic osteomyelitis of the femur using hydrogen peroxide solution.

Keywords: hydrogen peroxide; oxygen embolism; osteomyelitis.

INTRODUCTION

Hydrogen peroxide is a commonly used antiseptic solution for cleansing and dressing infected, dirty and contaminated wounds and also abscesses. Hydrogen peroxide promptly breaks down into water and oxygen by the enzymatic action of catalase present in the tissues and blood.^{1,2} Despite this apparently host friendly mechanism of action, H₂O₂ has been implicated in several fatal and near-fatal complications.^{3,4} H₂O₂, especially when forcefully injected inside an enclosed wound space results in formation of first; the nascent oxygen and subsequently; molecular oxygen which cause either venous or arterial embolism.³ We report a case of venous oxygen embolism during an orthopedic surgical lavage of the wound of chronic osteomyelitis of femur.

CASE REPORT

A previously healthy 30 year old female had sustained fracture of shaft of right femur and had undergone Kuntscher nailing at some other center nine months back. She was admitted at our Hospital with the diagnosis of chronic osteomyelitis with discharging sinus over the greater trochanter and abscess on the lateral aspect of distal thigh. She had infective non-union of the femur and K-nail was in situ. Her initial laboratory findings showed the total white cell count to be 31200 with 92 % neutrophils and ESR to be 45 mm

per hour. She was initially managed with intravenous antibiotics and supportive care after draining of around 100 ml of pus with stab incision on the distal thigh. After 7 days of admission, she underwent an uneventful debridement with irrigation and exchange nailing. Post-operatively, she was doing well till the fifth day when pus re-collection was noted in the wound on the lateral aspect of the distal thigh. Also, purulent discharge re-appeared at the entry portal of the nail proximally. Daily dressings were done.

One month after the day of exchange nailing, after repeating her pre-operative routine laboratory tests (which were in normal range), she was taken for debridement and irrigation of the wound.

Intravenous preloading was done and under all aseptic and antiseptic precautions, sub-arachnoid block was performed by the anesthetist with 2.8 ml of 0.5% Bupivacaine (Heavy) using 25G Quinke's needle at the level between L3-L4 vertebra in sitting position. Unilateral block of the right lower limb was achieved and patient was re-positioned for surgical procedure.

Surgical irrigation with betadine and normal saline was begun. After around half an hour from the time of sub-arachnoid block, nearly 100 ml of 3 % hydrogen peroxide was added to the normal saline solution (nearly 50:50 dilution) and pushed into the wound with a 20ml syringe. On the third forceful irrigation of solution into the wound, there was increased bubbling

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sound of effervescence and the patient immediately began complaining of heaviness around the chest. The heart rate and blood pressure dropped. Injection Atropine 0.6 mg and adrenaline 1.8mg (1:10000) IV was given. By then, there was cardiopulmonary arrest and EKG monitor showed asystole. Immediate airway was maintained with endotracheal intubation and chest compression was started. Injection Adrenaline one ampoule IV repeated. Total 5 cycles of CPR were done. Heart beat reverted and BP was recordable. Injection hydrocortisone 200mg IV stat was given. BP was maintained with fluids and vasopressors. Senior anesthetist attempted opening CVP lines first on the right and then on the left side. Gas bubbles oozed from the CVP line on the right side but placement was not confirmed. So, central line was inserted on the left femoral vein. The patient was shifted to the ICU and put on a mechanical ventilation with CMV mode with $FiO_2=100$. The patient had multiple episodes of partial seizures and anticonvulsant was started with neuro-medicine consultation. ABG done in the ICU showed PH 7.346, PCO_2 24.4 mmHg, PaO_2 464.7 mmHg, HCO_3 13.5 mmol/L and cardiac enzymes ordered were negative. Chest radiograph and EKG showed no significant abnormality.

CMV mode was changed to SIMV mode on the second post-op day. Nutritional support with nasogastric tube was started on the third day. Intubation was converted to tracheostomy on the fourth post op day and SIMV was continued.

She had upper motor neuron lesion signs and had purposeless eye blinking. This neuro-vegetative state is harbinger of grave prognosis. She is on constant medical review with no significant improvement in neurology.

DISCUSSION

H_2O_2 is a colorless and clear solution. It is an unstable compound and decomposes on prolonged keeping. This decomposition is rapid when in direct contact with biological materials such as blood or tissues as they contain an enzyme, catalase which catalyzes the decomposition of H_2O_2 into water and oxygen.⁵

1 ml of a 3% H_2O_2 solution will yield 10 ml of oxygen gas in tissue when it decomposes.⁵ This gas when enters the circulation may cause severe gas embolism. However, the exact mechanism of embolism has been in controversy. One study concluded that oxygen molecules formed outside the vessels further diffuse into the vascular bed.¹⁴ But another study suggested

that oxygen formed inside the vessels cause the embolism as H_2O_2 has higher diffusing capacity than the molecular oxygen itself.¹⁵ In our case, the 60 ml of diluted (50:50) solution contained nearly 30 ml of 3% H_2O_2 which in effect produces 300ml of oxygen.

Several literatures report sudden cardiopulmonary collapse after H_2O_2 administration. Loeb reported severe oxygen embolism after wound irrigation with H_2O_2 of a large thigh trauma.³ Shukrimu reported venous gas embolism after use of hydrogen peroxide irrigation of a chronic osteomyelitis lesion of the humerus.⁶ Ouerghi et al reported two cases of gas embolism following use of H_2O_2 after cystectomy of hydatid cysts.⁷ Despond noted oxygen venous embolism with H_2O_2 use in post discectomy wound and discouraged the use of it.⁸ Vidil et al reported a severe oxygen embolism after wound irrigation under pressure with hydrogen peroxide into a closed or partially closed cavity.⁹ Beattie has reported cardiac arrest following H_2O_2 irrigation in breast wound and questioned the relative advantage of it for decontamination.¹⁰ In the present case, although a transoesophageal echocardiography or precordial Doppler was not used to exactly diagnose gas embolism, the air bubbles gushing out after inserting the central venous line needle on the right side and also the timing of the symptoms and clinical presentation, such as hypotension, bradycardia and finally arrest occurring abruptly after H_2O_2 forceful lavage in the semi enclosed wound on the thigh, strongly suggest the diagnosis of a gas embolism. This case clearly demonstrates that H_2O_2 application is not danger free.

The treatment of air embolism is challenging. Various supportive and preventive modalities like Trendelenburg positioning, hyperbaric oxygenation, military antishock trousers (MAST), positive end-expiratory ventilation, avoidance of nitrous oxide and use of steroids and mannitol have been put forward.^{11,12,13} The easiest method is to avoid the use of the potential culprit of air embolism; the hydrogen peroxide itself.⁸

CONCLUSION

The routine use of hydrogen peroxide should be avoided. The use of hydrogen peroxide should be restricted or abandoned especially when the risk outweighs the benefit.

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