MASSIVE INTRA OPERATIVE AIR EMBOLISM DUE TO THE USE OF PRESSURE INFUSER DEVICE ON A PARTIALLY FILLED INTRAVENOUS BOTTLE

Abstract

Here we report a case of massive air embolism following the use of a pressure infuser device to administer intravenous fluids in a semi-rigid plastic bottle. A young woman undergoing periperal sterilisation under spinal anaesthesia developed sudden cardiac arrest intraoperatively. The patient was revived and echo cardiology showed right ventricular strain pattern suggesting air embolism. This was caused by the use of pressure infuser device on a semi-rigid, partially filled plastic intravenous fluid bottle which was expanded manually to fill air before inserting it into the device. This case report shows the importance of avoiding this practice. We describe a simple set up to simulate this situation demonstrating the catastrophic nature of this event.

INTRODUCTION

Case Report

A 22 year old woman was scheduled for peurperal sterilisation. On pre operative assessment she was found to be ASA PS 1. She recived 500 ml of crystalloids as preloading in the waiting area. Spinal anesthesia was administered with 1.8 cc of bupivacaine 0.5% heavy. Sensory level was found to be T5 and the surgery was started. BP was 110/60 and HR had come down from 70 to 57 beats / min. Before shifting her to the operation table, a second 500 ml crystalloid bottle was attached to the intravenous infusion set. The anesthetist in the operation theater had not noticed that it is the second intravenous fluid bottle and assumed her to be under loaded. So the bottle was inserted into a pressure infuser bag and pressurised for faster administration.

After a few minutes, suddenly the patient became restless, non-responsive and started to gasp. It was noticed that the intravenous fluid bottle was empty and the intravenous fluid tubing was full of air. There was no bradycardia or hypotension immediately prior to this episode. As the patient was moving her arms restless, the monitor leads were displaced. Cardiac arrest was suspected and cardiopulmonary resuscitation was started immediately. The patient was intubated and ventilated with 100 % oxygen. End tidal carbon dioxide was low. Multiple doses of adrenalin were given and intravenous fluid was rushed. After about 7-8 minutes of chest compression, the carotid pulse returned. HR was 150 b/ min and ETCO2 was around 30 mmHg. Empircally 50 meq of sodium bicarbonate was given intravenously. Blood pressure became recordable (150/100 mmHg) and she had spontaneous respiratory efforts which improved over the next half hour. Blood sugar was 180 mg/dl. However she remained unconscious and the pupils were B/L dilated and not reacting to light. ECG was unremarkable except for sinus tachycardia. The pupil size subsequently reduced and she was responding to call. She was shifted to ICU for observation and further management.

Trans thoracic echocardiography revealed dilated right atrium, right ventricle and pulmonary artery. This prompted us to consider the possibility of air embolism. She was extubated after about 7hrs and went on to make an uneventful recovery. The consent from the patient for reporting this incident has been taken.

DISCUSSION

Air embolism due to pressure infuser bag has been reported in several case reports (Gray & Glover, 1999; Suwanpratheep & Siriusawakul, 2011). Semi rigid plastic bags have some amount of air in them when they are sealed. There is a danger of this air going into the patient when the fluid gets over, if a pressure infuser device is used. Usage of collapsible infusion bags have largely reduced this event though it has been reported even with this (Pant, Narani, & Sood, 2010).

As mentioned above, the semi rigid plastic bags when used with a pressure bag, there is a danger that air can go in after the fluid gets over. Usually this does not happen as the amount of air inside the bottle is small. We simulated this situation by a simple set up that can be easily reproduced. An intravenous fluid bottle was attached to a standard intravenous infusion set with an 18 G venous cannula connected to it. The bottle was pressurized to 200 mmHg with a pressure bag and was allowed to drain after dipping the venous cannula under a water seal. It was found that when the fluid in the bottle gets over, no air escapes out of the IV tubing (no bubbling of air is seen in the bottle). On the average our 0.5 L bottles are packed with 70-90 ml of air in them. This is just enough to fill the portion of the bottle where it is pierced and the I.V tubing. The

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portion of the bottle that is spiked is relatively rigid and is usually not compressed in a pressure bag. It accommodates most of the air in the bottle once the fluid is over.

However on reviewing the events of our case, it was found that the anesthetist had expanded the partially collapsed, half empty bottle, filling it with air before attaching it to the pressure bag. Semirigid plastic bottles have the tendency to collapse as the fluid gets drained. This reduces the flow and to prevent this some measures are used to allow air to fill into the bottle. Some i.v tubing has an airway system which allows the air to entrain into the bottle as the bottle drains. Piercing the top of the intravenous bottle with a needle and leaving it there is a crude method of creating an airway. The other common method is to remove the iv tubing from a partially collapsed, half filled bottle, expand the bottle filling it with air and reinserting the i.v tubing. Expanding the bottle and filling it with air in this way does not cause air to go into any the patient provided no pressure bag is used. However if it is attached to a pressure bag, the situation is totally different.

We used a set up similar to the one described above to determine if air can be pushed in. Instead of a full bottle, a half empty bottle, expanded with air was used. This contained 200 ml of fluid and 370 ml of air in it. When the fluid got over, about 300 ml of air escaped through the venous cannula in about 3 seconds. This was seen as furious bubbling in the water seal. The amount of air that passed through the water seal can easily be determined by measuring the volume of air remaining in the i.v bottle at the end of the experiment by fluid displacement method. This will be equal to the amount of fluid needed to fill the bottle at this state.

It is reasonable to conclude that something similar to this would have happened to our patient. The recommended treatment of venous air embolism include immediate initiation of cardiac compression to disrupt the air in the heart into smaller bubbles, steep Trendelenberg’s position, cannulation of internal jugular vein to aspirate the air from right side of heart. Immediate initiation of the cardiac compressions on our patient would have helped in dispersing the air inside her heart. She also had swollen veins over the neck and chest suggesting a strain on right ventricular outflow which was later confirmed by echo showing RA and RV dilated. However, the typical pattern of ECG ,i.e Q5 T 3 S1 was not present in the ECG monitor or 12 lead ECG that was obtained about 20 minutes after the incident. Though it is typical, these finding is not seen in all cases. She had normal chest X ray and this ruled out aspiration of any gastric contents.

We considered other causes for sudden cardiac arrest under anesthesia. High spinal causing bradycardia and arrest usually are preceded by progressively decreasing HR and BP. However we did not observe any decrease in BP or HR in this case prior to the cardiac arrest. A close differential diagnosis for such a dramatic presentation in this set up can be paradoxical Bezold Jarisch reflex(Kinsella & Tuckey, 2001). This is common in young athletic individuals with high vagal tone where extreme vagal stimulation originates from mechano receptors on the posterior wall of the ventricles. The receptors are stimulated due to the contraction of the empty ventricles due to decreased venous return caused by spinal anesthesia. Usually these patients are easily revived by CPR and fluid replacement if detected early enough. However our patient required multiple doses of adrenaline and CPR for almost 9 minutes. Even then she continued to have low saturation after extubation and had to be reintubated.

Allergic reactions can also have such sudden presentation typically within minutes of administration of the drug. But usually this will have tachycardia, hypotension, wheeze and rashes. Our patient did not have these typical symptoms.

Sudden onset of restlessness and rigidity can be accounted for by the hypoxia due to air embolism. As a large volume of air reaches the heart suddenly, it causes air lock obstructing the blood flow into the pulmonary arteries. In 30 % of population, probe patency of foramen ovale is present . In such cases it is possible that paradoxical air embolism(Yeddula et al., 2012) to the left side including brain can occur causing immediate cerebral hypoxia.

A similar incident of air embolism was reported where a patient in shock was given colloid and a needle was inserted into the top of the bottle to increase the administration rate (Sviri, Woods, & van Heerden, 2004). As the rate of fluid flow was deemed to be inadequate, a pressure bag was placed on the bottle and the needle hole sealed with tape. Several minutes later, the patient became profoundly shocked and bradycardic. In this case the bottle could have been half empty, with air inside and when the bottle was pressurized, significant amount of air could have been pushed in after the fluid got over.

To prevent air embolism during i.v infusion, various guidelines have been proposed. One of them is to avoid removing and reattaching the i.v set once the bottle has been pierced. Certain paediatric drip sets have got a floating stopper which closes over the outlet of the bottle once the fluid gets over. Care is advised while using the pressure bag. It is important not to over pressurize the system. The fluid level in the bottle should be closely watched and the infusion stopped as soon as the fluid gets over. But from the experience we had, we would recommend that the most important point would be to not load a half filled bottle in a pressure bag. When the fluid is over, the air goes in so fast that even if someone is carefully watching it may be impossible to stop it on time.

References


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