Research Paper

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Utility of Two Bag Test to Detect The Consequence of A 'Missing' Reservoir Bag

Medical Science

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ABSTRACT

Incident reporting in anaesthesia practice plays a very important role as it helps in not only identifying new problems but it will also educate the practitioners about the potential events and possible solutions. Here we report a case of misconnection between the breathing system and scavenger port of ventilator assembly and how it was detected and subsequent adverse event was averted. Also we have discussed about how any untoward incidents occurring secondary to this type of misconnection can be avoided in future.

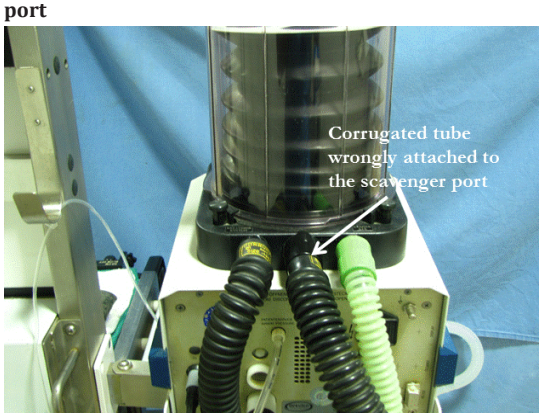
It is a well known fact that obstruction to the expired gas flow in a breathing system will cause building up of pressure within the circuit and result in physiological disruptions including barotrauma and unstable hemodynamics. To prevent this and other complications, the recommendations laid by the Association of Anaesthetists of Great Britain and Ireland (AAGBI) in 2012(Hartle et al., 2012) has been routinely practiced as a standard of care for pre procedural check of anaesthesia workstation. Here we report how such an incident was averted by "the two bag test" suggested by AAGBI for checking of anaesthesia machine.

A 40 year old male with bilateral gynecomastia was scheduled for excision of the same. After the initial check of the anaesthesia workstation (Elite 615 & EV 700 - AV ULCO Health care, Avasarala Technologies, Puducherry, India), we planned to perform two bag test to check the integrity as well as for any leak at circle absorber as well as anaesthesia machine including breathing system.

Two bag test suggested by AAGBGI is done by attaching two reservoir bags, one at the patient end of breathing system (Hartle et al., 2012). The regular reservoir bag acts as the second bag. A fresh gas flow of 5 litres/minute is set and reservoir bag is ventilated. At this time any leak in the system or malfunctioning of the unidirectional valves can be detected either by loss of volume or building up of excessive pressure within the system. Squeezing both the bags will give information about adjustable pressure limiting valve.

After connecting a test lung to breathing system through an angle piece we were unable to locate the reservoir bag of circle absorber immediately. On close inspection, we found the black corrugated tubing of circle absorber meant for connecting reservoir bag was fitted into the exhalation port (scavenger port) of the bellow assembly of the ventilator

Fig 1: Corrugated tubing wrongly attached to scavenger port



This was corrected (Fig.2) and we proceeded further with the remaining check list.

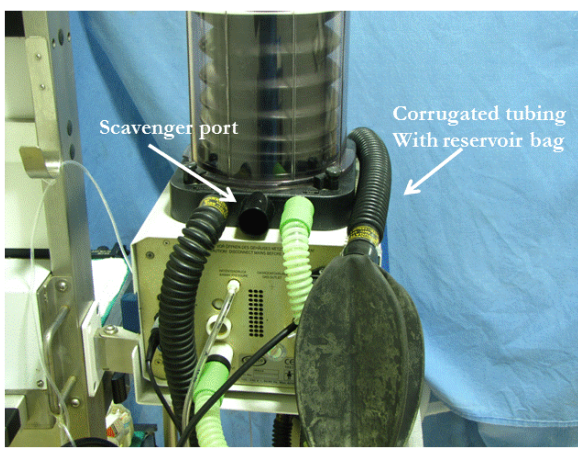


Fig 2. Corrected attachment of tubings

If it were not for this two bag test, this misconnection may have been missed and would have resulted in increased airway pressure during mechanical ventilation due to occlusion of scavenger(exhalation) port . This might have put the patient at risk of developing serious adverse events related to high intra thoracic pressure like barotraumas and unstable hemodynamics.

Discussion:

Critical incidents involving anaesthesia breathing system car arise secondary to either equipment misuse or equipment failure. Though obstructions in expiratory limb of the breathing system and the scavenging ports have been reported earlier (Elakkumanan et al., 2012; Flowerdew, 1981), this type of misconnection between scavenging port of ventilator and hose of the reservoir bag has never been reported so far to the best of our knowledge.

American Society of Anesthesiologists closed claim analysis, refers misuse as incidents caused by human error involving the preparation, maintenance, or deployment of a medical device. Equipment failure refers to malfunctioning of a device unexpectedly, despite regular maintenance and previous uneventful use. Even though the disconnection of the breathing system assembly has been found to be the most frequent cause of breathing system malfunction, obstruction will be rapidly injurious (Satya-Krishna, 2006). This rapidity of event may be attributed to the development of high intra thoracic pressure and thus producing positive end expiratory pressure (PEEP) like effect causing reduction in venous return and leading on to right ventricular filling volume and finally cardiac output(Cairo & Pilbeam, 2006).

So to avoid such misconnections related complications, international standards specify connector dimensions. International Standard Organization guidelines recommend 15 and 22 mm connectors for general use in breathing systems and 30 mm for connecting a breathing system to an anaesthetic gas scavenging system (AGSS) ("ISO standards.ISO 5356-1:2004 Anaesthetic and respiratory equipment -- Conical connectors -- Part 1: Cones and socket," 2004). The scavenger port of the ventilator in our case was conical in shape with an external diameter (ED) of 26 mm at orifice. This would fit into a 30 mm female connector of the AGSS hose assembly. However its internal diameter(ID) is about 24 mm. Since the 22 mm (ID) corrugated tubing which connects to the reservoir bag was made of rubber and it had an ED of 26 mm, it could snugly fit into the scavenger port of the ventilator though it was 24 mm in ID(fig 3)

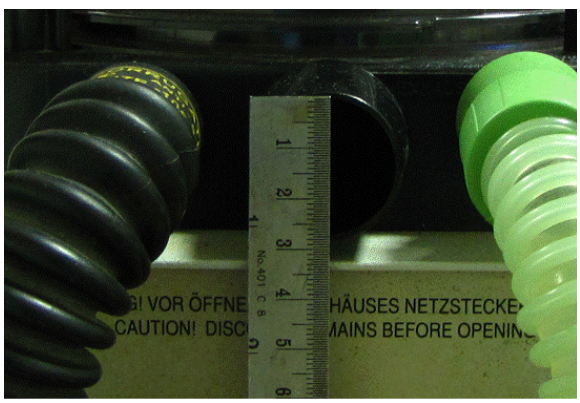


Fig 3 Scavenger port's internal diameter about 26mm

This misconnection could have been avoided if the ID of the scavenging port of the ventilator was kept such that they would not receive a 22mm connector which is ubiquitous in anesthesia systems. This shows the importance of standardizing both ID and ED of the male and female connectors. This incident has been brought to the attention of the anaesthesia machine manufacturer also.

Another safe guard will be to implement the recommendations of Flowerdew (Flowerdew, 1981) for changing the shape of scavenger port or to use some standard colour coding for inspiratory, expiratory, and reservoir bag tubings.

Though there is no substitute for systematic checking of anaesthesia delivery systems, these modifications will provide additional margin of safety.

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