Air Entrainment Through a Multiport Injection System

To the Editor—The FDA recommends that anesthesiologists avoid recapping of needles after their use to prevent needle stick injuries.* For anesthesiologists, who administer multiple drugs for complex cases, this poses a considerable difficulty. Consequently several devices have recently been introduced that allow the injection of multiple drugs via a manifold system of one-way valves interposed in the intravenous tubing. We have recently discovered that such a system may allow significant air entrainment.

Report of a case: A 64-yr-old male was scheduled for coronary artery bypass grafting. Prior to induction of anesthesia, a 14-gauge catheter was inserted in a vein in the left forearm, a 20-gauge catheter was inserted into the left radial artery, and a pulmonary artery catheter was inserted via the right internal jugular vein. A Multiport Anesthesia Injection Set with Check Valves (item 9113, Quest Medical Inc., Carrollton, Texas) was interposed in the side port of the sheath introducer. Anesthesia was induced with fentanyl (100 µg/kg) and maintained with fentanyl/oxygen. All drugs were administered via the Multiport Anesthesia Injection Set. Just prior to initiation of cardiopulmonary bypass, the anesthetist administered additional fentanyl and muscle relaxants and removed the syringes from their individual check valves. Upon initiation of bypass, the perfusionist immediately noted that large amounts of air were returning via the venous cannulae. The anesthetist noted that air bubbles were moving down the side port of the sheath introducer into the internal jugular vein. Since it appeared that the air bubbles were originating from the check valve areas of the Multiport Anesthesia Injection Set, the anesthetist capped each port with a solid plastic Luer-Lock cap. This immediately stopped the air from being entrained. The Multiport Anesthesia Injection Set was removed and the case continued uneventfully.

In order to rule out the possibility that the valves in this case were "stuck," in the open position, we measured the negative pressure necessary to open the one-way valves in this system and in two other check valve systems currently available in our department. A simple water manometer was attached to each system in turn. The pressure required to open the one-way valves to allow air entrainment and to overcome the valve to cause a leak was measured. Tested were the device described above, which consists of a hard plastic manifold with three side ports, the Quest™ model 9107 trirrificated extension set which has two side ports with check valves, and the Cutter Chezet™ anesthesia set which has one check valve on the main intravenous tubing and a spring-loaded check valve on a single side port. Each set is sold with plastic caps attached to the side ports.

Results for the two models manufactured by Quest were similar:


The air entrainment appears to occur due to a combination of factors. Firstly, the negative pressure generated by the administration of drugs through the check valves causes air to be entrained in the system. Secondly, the design of the check valves may not be sufficient to prevent air from entering the system. The use of solid plastic Luer-Lock caps on the side ports may prevent further air entrainment. However, the potential for air entrainment remains a concern, and anesthesiologists should be aware of this issue and take steps to minimize it.

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