Intravenous infusions and one-way valves

To the Editor:

I would like to report a situation recently encountered during anaesthetic infusion. A 60-yr-old man presented for elective repair of a torn right rotator cuff. General anaesthesia was induced with propofol administered through an intravenous line inserted into a left forearm vein. Anaesthesia was maintained with an infusion of propofol, using a Bard Mini-infuser™ system, piggy-backed into an injection port of a Baxter Continuo-flo™ solution set. With each inflation of the automated blood pressure cuff, on the left upper arm, it was apparent that propofol was refluxing up past the check valve and into the drip chamber of the solution set. The check valve was examined, the disc appeared intact and no air bubbles were seen. Tapping the valve had no effect. The infusion rate was increased slightly and this was sufficient to keep retrograde flow below the level of the drip chamber during cuff inflation. After completion of the surgery the patient was awakened, taken to the recovery room and, before he was sent to the ward, the solution set was changed. The manufacturer (Baxter Corporation) was notified of the incident.

The one-way valve consists of a silicone rubber disc suspended on supports between the upper and lower halves of the valve. Pressure from above causes the outer edge of the disc to bend down and open the passages to downstream flow (Figure 1). Conversely, pressure from below will lift the disc against the upper portion of the valve and prevent flow back into the drip chamber (Figure 2). Because of the close tolerances throughout the assembly, it is possible that an outer edge of the valve could touch a wall of the valve housing and fail to lift. It is also possible for an air bubble to lodge in the fluid path and prevent the valve from lifting, making it essential to purge the assembly of air during the initial setup. Baxter Technical Services recommends that if back flow is observed, a quick knock on the valve housing will usually be enough to free the disc and restore proper valve function (personal communication).

It is likely that, had a clear solution been infused, the diagnosis of the valve failure would have been delayed or missed. This could have resulted in backward flow of the infusion agent into the bag of intravenous solution and, after the infusion pump was turned off, the infusion agent would continue to be delivered to the patient. The use of intravenous infusions is becoming increasingly common in anaesthesia and anaesthetists should be aware of these technical problems.

FIGURES 1 and 2.

Edward Crosby BSc MD FRCPC
Department of Anaesthesia
Ottawa General Hospital
501 Smyth
Ottawa, Ontario
K1H 8L6

REPLY

The Continuo-Flo® sets are designed with a check valve to prevent back flow of fluid from a secondary intravenous application into the primary container. Millions are sold annually in Canada and the USA. In order to ensure strict quality control, each set is inspected at every stage of the manufacturing process. The quality process ensures that Baxter's complaint frequency is very low, averaging one complaint for every 1.5 million sets sold in Canada.

Instructions for priming are printed on the packaging of every iv administration set that Baxter manufactures. Solution "Back Flow" or leakage of solution through the check valve's floating disk can occur as stated by Dr. Crosby. Our experience has found that if this occurs, tapping of the valve with a rigid instrument such as a haemostat or a pair of scissors, will dislodge any air bubbles or free the disk and stop the back flow. If back flow does occur, it will be evident the first time a back pressure is applied to the valve. This will not occur intermittently, it will be immediately visible to the anaesthetist. If back flow occurs there will be a rise in the fluid level and flooding of the primary set drip chamber and the anaesthetist can take appropriate action.

If there is any doubt about the integrity of any component of an iv administration set, the set should be replaced immediately. A refund or credit will be issued to the hospital by Baxter Corporation for a manufacturer's defect in the product.

If questions should arise regarding the use of Baxter iv administration sets with another manufacturer's product or for a special procedure, the local Baxter representative would be able to detail the proper protocol to ensure a safe and

incident-free procedure. Each representative has extensive training in iv therapy and procedures.

John Parks
Director, Regulatory Affairs and Quality Assurance
Baxter Corporation
Mississauga Ontario

Emergence phenomena after ketamine anaesthesia: the influence of music

To the Editor:

Emergence from ketamine anaesthesia in the postoperative period may be associated with visual, auditory, proprioceptive and confusional illusions which may progress to delirium.¹ Droperidol² and benzodiazepines¹ can reduce or mitigate these reactions but there is no uniform agreement concerning their effectiveness. In this letter we present the results of a study, conducted to ascertain the effect of music on the emergence phenomena after ketamine anaesthesia.

Eighty ASA-I patients aged 10–25 yr undergoing minor surgical procedures of less than 45 min under ketamine anaesthesia were randomly divided into two groups of 40. All the patients were given intravenous diazepam in the dose of $0.2 \text{ mg} \cdot \text{kg}^{-1}$. Headphones were applied to all the patients and music of the patient's choice was switched on in the study group five minutes before giving ketamine $2 \text{ mg} \cdot \text{kg}^{-1}$ iv, while the control group received no music. Supplemental doses of ketamine $1 \text{ mg} \cdot \text{kg}^{-1}$ were given every ten minutes whenever required. Headphones were removed two hours after the last dose of ketamine. Two days after surgery the patients answered a questionnaire based on that of Garfield *et al.*³

The incidence of dreams in the study group (23/40) was higher ($P < 0.05$) than that in the control group (12). However, none of the patients in the study group had unpleasant dreams with horror, while ten of the control group reported unpleasant experiences. More patients in the study group (32/40) opted to have a similar anaesthetic than in the control group (10/40) ($P < 0.01$) while ten patients in the control group and none in the study group refused to have a similar anaesthetic in future ($P < 0.01$).

Thus although the addition of music with ketamine anaesthesia increases the incidence of emergence phenomena the quality of wakening is pleasant and more acceptable to patients. The reasons for the differences are not known but may be attributed to the modulation of sensory experiences by music.

S.P. Ambesh MD
Ajay Kumar MD
Purnima Sarkar MBBS
Anil Bajaj MD
Department of Anaesthesiology
Postgraduate Institute of Medical
Education & Research, Chandigarh-160012 (India)

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Support for nalbuphine reversal of opioids: quantitative considerations

To the Editor:

The recent report by Blaise, Nugent, McMichan and Durant in your journal concluded against the use of nalbuphine after $50\text{--}75 \text{ } \mu\text{g} \cdot \text{kg}^{-1}$ fentanyl had been given during anaesthesia for abdominal aortic surgery.¹ My impression of this use of nalbuphine is that it is employed to reverse narcosis and respiratory depression in a dose of $0.05 \text{ mg} \cdot \text{kg}^{-1}$ to $0.3 \text{ mg} \cdot \text{kg}^{-1}$.

Latasch, Probst and Dudziak considered, in patients who had received $7 \text{ } \mu\text{g} \cdot \text{kg}^{-1}$ fentanyl for induction of anaesthesia and a further $200 \text{ } \mu\text{g}$ every 15 min, that the narcosis would be reversed with 20 mg nalbuphine.²

In that dose nalbuphine displaces fentanyl from mu opioid receptors to facilitate breathing and a concomitant lessening of mu antinociception. Kappa receptor mediated analgesia may be obtained with larger doses of nalbuphine (e.g., multiples of the 20 mg dose). Since nalbuphine is a potent anaesthetic,³ smaller doses, if sufficient, should be acceptable in the recovery room.

When opioids are used in large doses for major surgery, "large" doses of nalbuphine reversal seem to be warranted. By increasing the dose nalbuphine in proportion to the dose of opioid patients can be made comfortable, normotensive, eucapnic and normoxic and the catheter can be extubated after major surgery.