cording to the instructions of the manufacturer and the Portex Coil was placed in a stirred thermostat-controlled water bath. The room temperature was +24 C and the operating temperature of both warmers +36.8 C.

We found that the flow resistance of the DW 1220 was 1.8 times that of the Portex Coil at both flow rates used (table 1). Warming of blood with the DW 1220 did not cause any increase in plasma hemoglobin or potassium (table 2), indicating that no erythrocytic damage occurred. Finally, the Portex Coil tolerated a considerably higher flow of cold water than did the DW 1220. The mean infusion temperature decreased to +32 C at flow rates of 228 (Portex Coil) and 157 ml/min (DW 1220). The highest infusion temperature with the DW 1220 (+34 C) was obtained at a flow rate of about 85 ml/min. At lower flow rates the infusion temperature decreased because of cooling of the water in the line distal to the warmer (fig. 1).

We believe that the higher flow resistance of the DW 1220 can be explained by the long narrow inlet and outlet tubings of the warmer. Since cold blood warms about as rapidly as cold water,[4] we conclude that the warming efficiency of the DW 1220 is considerably less than that of the Portex Coil, probably because the cylinder of the DW 1220 warms the cuff only from one side. Furthermore, the long, narrow uninsulated outlet tubing allows the warmed blood to cool down, especially at low flow rates.

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An Unusual Malfunction of an Anesthetic Machine

To the Editor:—The following case is presented to illustrate an unusual anesthetic machine failure involving the outlet check valve. This particular machine failure developed despite a careful and thorough preanesthetic machine check.

REPORT OF A CASE

A 10-year-old healthy Caucasian boy (ASA classification 1; weight 36 kg) was brought to the operating room after receiving premedication consisting of 75 mg pentobarbital and 0.2 mg glycopyrrolate administered intramuscularly. The patient was scheduled for revision of a previous radical mastoid procedure. After careful check of the anesthetic machine (an Ohio Unitrol Model Heidbrink® Gas Machine) an inhalational induction was initiated, using halothane, nitrous oxide, and oxygen administered via a Bain system. Anesthesia was induced with nitrous oxide, 8 l/min, oxygen, 3 l/min, and 0.5 per cent increments of halothane to a maximum concentration of 4 per cent. After the patient had received 4 per cent halothane for a few minutes, the flowmeter readings suddenly dropped to 2 l/min nitrous oxide and 1 l/min oxygen. An attempt was made to increase the flows, but the flowmeter readings remained at the same levels. Despite a total flowmeter reading of 3 l/min, the reservoir bag would not remain filled. Attempts to fill the reservoir bag by oxygen flush were unsuccessful. The anesthetic induction was prolonged and the patient experienced an extended excitement stage. The patient vomited and was immediately turned on his side, and suctioning of the oropharynx was performed. Another Ohio Anesthetic Machine was brought into the room and quickly checked. Immediately following oropharyngeal evacuation, an intravenous line was started and the patient was given an intravenous bolus of 200 mg thiamylal followed by 50 mg succinylcholine, and orotracheal intubation was performed atraumatically. Anesthetic maintenance was carried out with halothane, nitrous oxide, and oxygen using the second anesthetic machine. The remainder of the operation and recovery were uneventful.

A subsequent check of the anesthetic machine in question revealed that the mushroom valve from the outlet check valve had become dislodged and eventually had become trapped within the pipeline system (see fig. 1). An inspection of the mushroom valve revealed it to be intact but of a softer consistency than a new mushroom valve. The rubber mushroom valve involved in this case may have dislodged due to either incorrect seating within the outlet check valve during maintenance or a defect of the mushroom valve.*

The outlet check valve is located downstream from the vaporizers. It is a one-way valve that contains a

* The local Ohio Medical service agency was contacted about this incident and a report was filed.

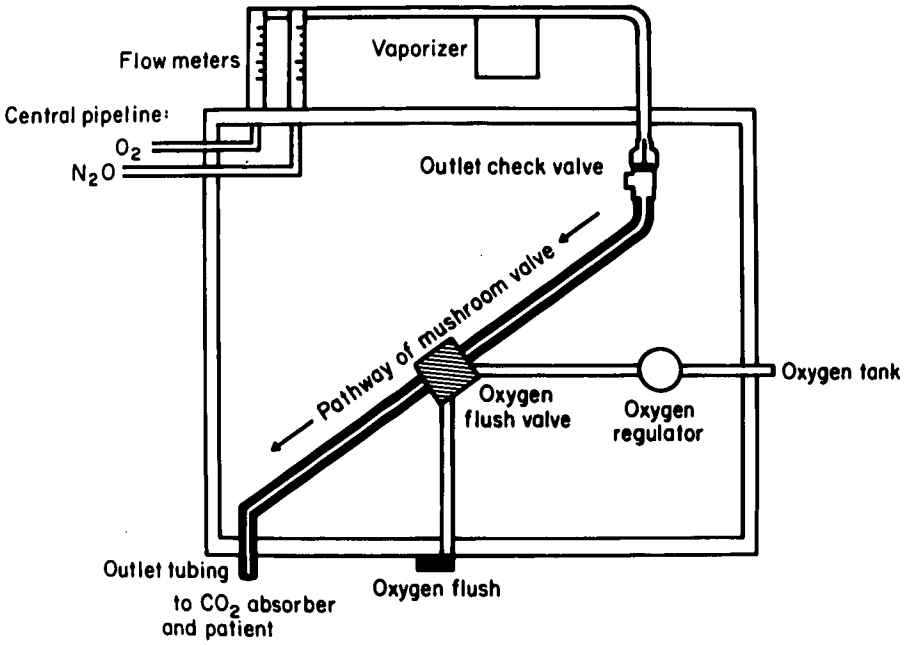

FIG. 1. Simplified diagram of an Ohio anesthetic machine.

rubber mushroom valve and is designed so as to prevent retrograde flow in the vaporizers and flowmeters.

Dislodgement of the mushroom valve from the outlet check valve resulted in the occlusion of the pipeline system and prevented gas flow to the patient. The flowmeters read 2 l/min nitrous oxide and 1 l/min oxygen, which should have been sufficient for ventilation of this patient had those been the actual amounts being delivered and had a tight mask fit been obtained. In actuality the reservoir bag could hardly be distended even though a tight mask fit had been obtained and the pop-off valve was entirely closed. The probable explanation for these findings is that very little gas flow was able to pass the occlusion caused by the mushroom valve. The level of the flowmeter column floats was lowered by retrograde pressure resulting from the obstruction of flow by the displaced valve. This phenomenon is apparent in variable-orifice flowmeters[1] such as those present in the Ohio Unitrol Model Heidbrink Gas Machine used in this case.[2]

The mushroom valve in the machine in question has since been replaced with a new mushroom valve and has been in continuous use for more than four months with no subsequent problem.

The purpose of reporting this case is to stress the possibility of failure of anesthetic machines in spite of regular inspection and the necessity of having accessory ventilatory equipment such as Ambu bags and an extra anesthetic machine readily accessible.

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Successful Central Venous Catheter Placement from Peripheral Subcutaneous Veins in Children

To the Editor:—Central venous catheter placement can be accomplished reliably by percutaneous cannulation of the large veins of the chest via the subclavian and internal jugular veins. There are, however, risks associated with these approaches in patients with coagulopathies and in small children. In