Use of Charcoal to Rapidly Decrease Depth of Anesthesia While Maintaining a Closed Circuit

To the Editor:—The use of a charcoal filter in the inspiratory limb of the breathing circuit immediately drops the inspiratory concentration of volatile anesthetic agents to undetectable levels, and rapidly lowers the alveolar concentration. The patient’s depth of anesthesia decreases at a maximal rate, independent of fresh gas inflow.

The adsorptive capacity of charcoal for volatile anesthetic agents is enormous.1-4 The resistance to gas flow through charcoal is negligible.2 Charcoal is inert and has been safely used in gas masks for decades. It poorly adsorbs high concentrations of nitrous oxide. Capon has shown that charcoal can be regenerated by autoclaving.5 Heretofore, the recommended use of charcoal in anesthetic systems has been limited to the scavenging of waste gases. A recent article by Hawes et al.6 does illustrate, without comment, an activated charcoal shunt located on the inspiratory limb of their experimental circuit.

We use 50 grams of charcoal* placed in a 8.75 × 5 cm plastic cylinder. A two-way valve directs the inspiratory gas flow and initiates, or terminates, the “charcoal shunt” at any desired time. A 12-inch piece of disposable plastic tubing returns the filtered gas to the inspiratory limb.

This simple, inexpensive, and safe addition to a closed circuit provides close control of circuit anesthesia concentration. Up to now circuit concentrations could be increased rapidly, but could not be rapidly decreased without opening the circuit and employing high flows. With the use of the charcoal filter, all the advantages of closed circuit anesthesia can be realized throughout the entire anesthetic, including emergence.

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Anesthesia Machine Explosion

To the Editor:—We would like to report a deflagration occurring in the flow-guard regulator of an anesthetic machine. The machine, manufactured by Dupaco, was equipped to operate from either E-sized cylinders attached to the machine or from the hospital's gas pipeline system and was in regular use in the Veterinary Medical Teaching Hospital (VMTH) of the University of Florida until it developed an audible gas leak at or near the oxygen pressure regulator, and was withdrawn from service to be repaired.

A representative of the manufacturer was asked to repair the leaking machine when he per chance visited the hospital. The oxygen pressure regulator was replaced with a new part recently shipped from the company’s main office. The repair process apparently required the use of a vice. A vice from the VMTH’s building maintenance workshop was used. The machine was checked and, because it functioned normally, it was returned to normal service.

At the time of the machine repair, extensions were being completed to the VMTH’s compressed gas pipeline system and the new lines flushed with nitrogen. On the afternoon of its repair, the anesthetic machine was used in checking the identity of gases delivered by the new
nitrous oxide and oxygen outlets. This entailed connecting the machine to each gas outlet individually and allowing the gas to flow at 4–6 l/min for at least five minutes before measuring its oxygen content by polarography to determine if the delivered gas was either 100% oxygen or 0% oxygen (and presumably, therefore, nitrous oxide). Three pairs of outlets were tested in all, and all proved to have been properly connected to the system. The anesthetic machine was disconnected from the gas pipeline system and, to assure the validity of the method used, the procedure was repeated using the E tanks on the machine.

At the completion of this, the machine was allowed to stand with both cylinders open under normal maximum pressure. After standing for approximately one half-hour there was a loud bang from the machine and a pressurized shower of sparks could be seen coming from the region of reducing valves and yolk systems under the machine work top. This pyrotechnic display was accompanied by a loud roaring sound. Both E tanks were closed immediately and the shower of sparks and sound ceased. The underside of the machine was inspected and some external charring marks could be seen on the oxygen flow guard regulator which was extremely hot to the touch.

Upon dismantling the oxygen line system, the inside “O” ring of the flow-guard regulator was found to have partially melted and the insides of the chamber were blackened and charred. The flow guard regulator is part of the oxygen failure safety system of the Dupaco anesthetic machine in that it reduces the pressure of nitrous oxide going to the flow meter as the oxygen pressure falls, thereby preventing an anoxic fresh gas mixture from reaching the patient’s breathing circuit. The machine was taken away to be repaired and cleaned and has functioned normally since.

Vickers1 lists three components that are required for fires and explosions to occur: an oxidizing gas to support combustion; a flammable material; and a source of ignition. Oxygen or nitrous oxide meet the first criterion. In this instance, three sources of flammable material can be postulated: contamination of the pipeline system during alterations, with dust or oil; contamination of the anesthetic machine’s gas system during repairs in a non-standard workshop; or finally, dust or other combustible material being blown in from the new “E” cylinders, valve. Steps had been taken to prevent all of these occurring, e.g., flushing of the pipelines upon completion of the plumber’s work, strict attention to avoid contamination of equipment during repairs, and lastly, the new cylinders “cracked” before being placed on the machine.

The last component, ignition source, is the hardest to determine. Spontaneous ignition has been recorded in pressure-reducing valves because of adiabatic compression when compressed gas cylinders were turned on, but why in this instance it took 30 min before ignition occurred seems excessive. Macintosh et al.3 do cite time delays after initial heating of milliseconds to hours, but do not give the long duration much practical significance. The other source of ignition could be a static electric spark. Attempts to simulate the above event have not reproduced the deflagration; however, we believe that the ignition most likely came from a static electric spark from the isolated diaphragm of the flow-guard regulator. Efforts to pinpoint the source of combustible material have not been successful.

To prevent similar occurrences in the future, it is essential that standard precautions be exercised to prevent the causes of these kinds of accidents. It is necessary to eliminate at least one of the three requirements for combustion. In most cases it is impossible to eliminate the oxidizer since it is usually oxygen or nitrous oxide that is being used in the system. The fuel can be eliminated with constant attention to cleanliness during servicing of the equipment and/or the supply system, filtration of the supply gases, and ensuring the connections are clean when attaching a high pressure bottle.

The means of ignition must be eliminated. It can result from either adiabatic compression or static electric discharge. This heating by sudden compression is eliminated by just “cracking” the high pressure cylinder valve and allowing the system pressure to come up slowly. This allows heat to dissipate through the metal components of the system. Another precaution that should be routine is to only open the high pressure bottle valve enough to supply the needed gas. It is rarely necessary to open this valve fully. The static discharge problem can be corrected with proper grounding wires, or a periodic maintenance program that includes cleaning and testing the conductive wheels normally provided with this type of equipment.

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Treatment of Hiccups by Continuous Positive Airway Pressure (CPAP) in Anesthetized Subjects

To the Editor—Hiccups during anesthesia can be a very difficult problem to manage.1,2 In our experience, hiccups occur more commonly during light anesthesia with thiopental and low-dose fentanyl for short procedures such as uterine curettage and other minor OB-GYN operations. In these cases, it is difficult to treat hiccups by pharmacologic means, and we have been forced at times to use succinylcholine to end the jerky diaphragmatic contractions. Looking for a more effective and easier way to cope with this complication, we recalled our grandmother’s advice: “Hold your breath and close your nose and mouth!” Accordingly, we tightly held a standard anesthesia face mask to our patients while maintaining an O2 flow of about 8 l/min with the pop-off valve of the circuit partially closed and without actively assisting ventilation. In this way, we created a continuous positive airway pressure (CPAP) of between 25 and 35 cm H2O3 with the patient breathing spontaneously. We have employed this technique in 16 patients. Within 5 to 15 s of initiating CPAP, hiccups stopped in all of our patients who then started breathing regularly after a short apneic period. In none of them have we observed stomach distension, vomiting, or other adverse effects. We conclude that CPAP is an effective treatment of hiccups in anesthetized subjects.

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Cannulation of the Internal Jugular Vein: Another Cautionary Note

To the Editor—The recent report by Goldfarb and Lebrec of percutaneous cannulation of the internal jugular vein in 1,000 patients with coagulopathies reported a 99.3% success rate with minimal complications, and concluded that the internal jugular vein “can reasonably be proposed as a usual route of catheter placement in such patients.”1 Although their success and minimal complications in a large series of patients is most impressive, and the unique requirement of their relatively inflexible biopsy needle dictated the use of the internal jugular vein, we suggest that their conclusion is much too strong for routine application of their approach on three counts: 1) Complications which occur during internal jugular cannulation in patients with defects in hemostasis may be catastrophic and other routes are available.2-3 2) A large gauge needle should not be used...