CURRENT COMMENT AND CASE REPORTS

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INTRAVENOUS INFUSION APPARATUS

Dr. Russell C. Smith of Daytona Beach, Florida, presents the ultimate in gear for the administration of various fluids intravenously. He finds a number of disadvantages to the usual systems available for this purpose. These include: the difficulty of administering more than one fluid at a time; the unsatisfactory nature of control devices for limiting flow; the necessity for using new sets on each patient, and the instability of syringe holders.

He believes that a device for the combined administration of two or more parenteral fluids should incorporate the following features: (1) a sturdy, positive and smooth flow control for each fluid; (2) a flow indicator for each fluid; (3) a manifold to combine these separate fluid streams into one; (4) terminal tubing replaceable for each patient; (5) manifold system volume kept at a minimum to reduce interaction, physical or chemical, between solutions and to reduce time lag between change in dosage rate and effect on patient; (6) a sturdy and convenient syringe mounting; (7) maintenance of sterility of fluids with a minimum of parts requiring sterilization; (8) all parts easily cleaned and maintained; (9) standard Luer fittings for use with various syringes and infusion equipment; (10) flexible physical arrangement for maximum versatility, and (11) the whole system easily portable within the operating suite.

He was first confronted with an important problem. The different fluids involved would be given at different and variable rates, and the fluids in the reservoirs would be at different levels. Under these conditions, would it be possible to control one flow rate without serious or annoying interference with others?

Using aqueous solution, he found, experimentally, that within the limits of flow rates and fluid levels usually encountered in practice, neither rate nor level differences were of great importance provided a needle of sufficient size, no. 18 or larger, was used. The relative flow rates were determined entirely by the flow controls. With a marked change in one rate, slight readjustment of the controls on the others might be necessary, but introduced no problem. When one fluid had a tendency to back up into another at a lower level, the trouble was invariably because of either inadequate or obstructed outflow into the vein or improper setting of the respective controls.

On the other hand, blood, plasma, and plasma substitutes, because of their higher specific gravity and higher viscosity, quickly backed up into the aqueous solutions. This, however, was not an important factor, since these replacements should be given through a separate needle so that pressure feed may be used if necessary.

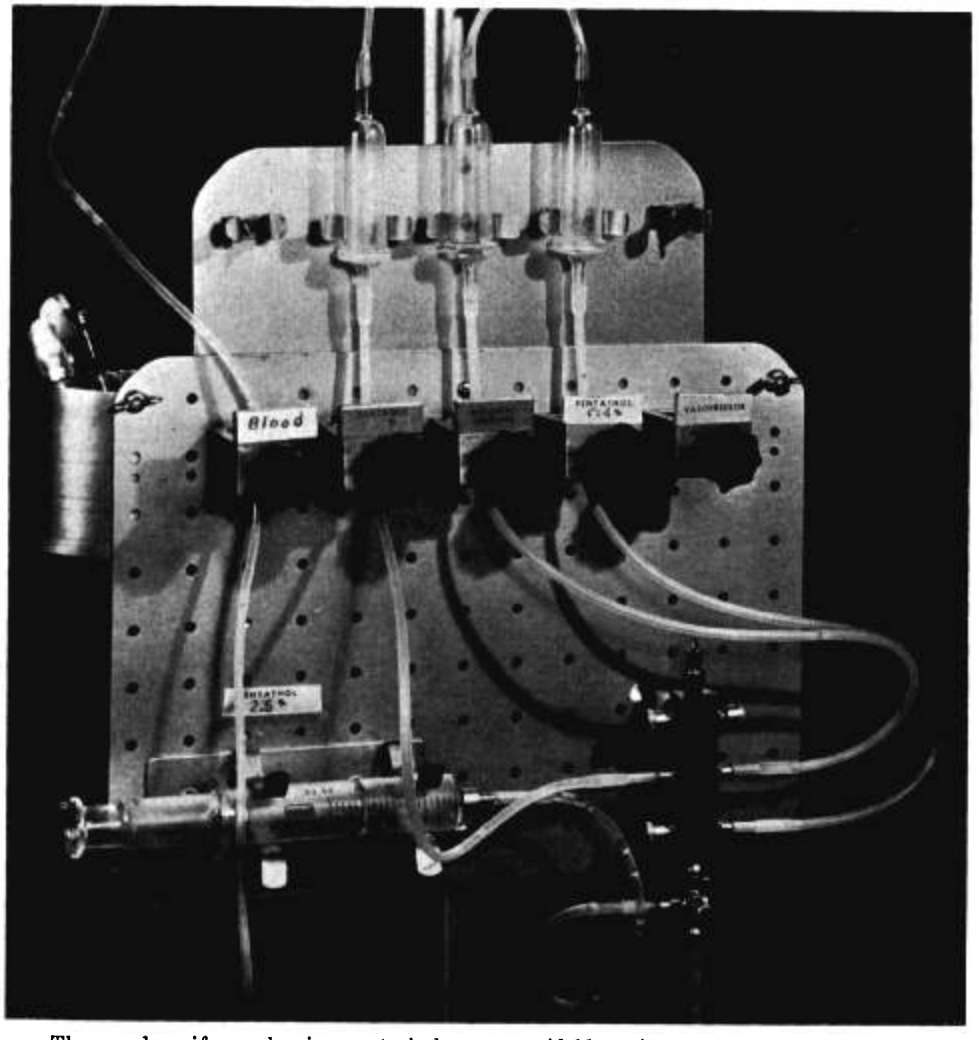
The basic elements of the panel venifusor have been used for over two years at the Abington and Halifax District Hospitals in more than 3,000 cases. They have acquired some permanence in individual design, but have been used in a variety of arrangements; a typical one is illustrated. Bottles of different solutions connected through their respective disposable infusion sets into the manifold at separate inlets are shown. Each flow rate is controlled by its individual control clamp and monitored by its own drip-sight flow indicator. A syringe of anesthetic solution is connected by a short tubing and stopcock into output from the manifold. The outlet of the stopcock is connected by a terminal tubing to a needle no. 18 or larger. All unused inlets and outlets are closed by male or female fittings.

The control clamps, manifold, and syringe holder are mounted by wing nuts on a vertical panel of an infusion stand on casters. The panel is perforated by rows of holes spaced one inch apart vertically and horizontally for flexibility or arrangement. It is

bolted to the stand about table height, approximately at the anesthetist's eye-level, and is convenient for easy observation and control.

The use of Luer fittings makes it possible to connect any standard infusion set into the manifold. These sets connected between the bottles and the manifold are seldom contaminated and are usually used all day for a series of patients without replacement.

Should it become necessary to give blood, plasma, or plasma substitutes through the same venipuncture, a 3-way stopcock can be inserted in the line between the manifold and



The panel venifusor showing control clamps, manifold, syringe holder and drip sights mounted on a vertical panel of an infusion stand.

the terminal tubing. Although this cuts off one channel, it does permit the use of blood without contaminating the manifold while still keeping the other solutions available. Should the manifold become soiled with blood, it is easily replaced, disassembled, cleaned, and resterilized before using again.

The venifusor as shown is set up for use at the left side of the anesthetist. By using a terminal tubing thirty or more inches long, it could be used on the right side as well, or it might be more convenient to reverse the positions of the manifold and syringe.

The panel venifusor stand showing bottles of different solutions connected through their respective disposable infusion sets into the manifold at separate inlets.

Dr. Smith found that the usual drip sight immediately below the bottle was somewhat inconvenient to watch. The correlation with its corresponding control was confusing at times. The set with the drip sight in the lower portion of the tubing was designed. The indicator is mounted in a small clip immediately above its respective control clamp, putting the control and indicator together at eye-level and making a convenient easily visible arrangement.

It is better to use only an infusion set with plastic tubing in the control clamp, as

latex tubing remains stuck together after a long period of compression and interferes with the response to the flow control adjustment.

Variations of the venifusor immediately occur to each user. Dr. Smith used the upper manifold outlet, as illustrated, instead of the lower outlet for a patient who was elevated quite high from the floor during operation. He has used two manifolds on the panel with two or more solutions on each with two venipunctures. The panel may be used in a darkened room for cystoscopic manipulations and transurethral resection by mounting an extra syringe holder on the panel in a vertical position to hold a low intensity flashlight shining upward on the drip sights or downward on the syringe of anesthetic solution. A setup he particularly likes is to connect the syringe of Pentothal into a stopcock below the manifold outlet, thus allowing injection from the syringe without the disadvantage of the solution backing up into the manifold.

CARDIAC ARREST DURING CHLOROFORM MONITORED BY EEG AND EKG

Dr. Curtis Pearcy of Augusta, Georgia, during his residency at the State University of Iowa, observed an incident of cardiac arrest during a chloroform anesthetic monitored by the electroencephalogram and electrocardiogram. He believes that the electroencephalographic activity seen before, during, and after the period of cardiac arrest was interesting enough to warrant report.

The patient was a 60-year-old white male in apparent good general health anesthetized for repair of an inguinal hernia. He was given 0.3 mg. scopolamine as premedication one hour prior to anesthesia. Fronto-occipital electrodes were used in obtaining the electroencephalogram, and lead I of the electrocardiogram was recorded simultaneously on a Grass model III D electroencephalograph. Induction with chloroform was accomplished on a semiclosed carbon dioxide absorption system utilizing a 5 liter per minute flow of oxygen. A moderate excitement phase lasted about three minutes. Skeletal muscle artefact masked the recordings during, and for about two minutes after, the excitement stage. As the recordings became interpretable, the electroencephalogram presented a predominant 2–3 per second activity of about 50 μv., with beginning intervals of isopotential (suppression) lasting about one second. The muscle artefact persisted as low voltage spikes. The pulse rate was 45 per minute, and the electrocardiographic complexes were essentially unchanged from the preoperative electrocardiogram (see illustration—postexcitement). An arterial blood sample drawn at this time was subsequently analyzed by the method of Morris, Frederickson, and Orth (J. Pharmacol. & Exper. Therap. **101**: 56, 1951) and found to contain 14 mg. per cent chloroform.

The upper airway then became partially obstructed, and the cardiac status deteriorated. The pulse rate was quite slow, and a 2:1 heart block was seen on the electrocardiogram. High voltage slow activity characterized the electroencephalogram, and no periods of isopotential were apparent (see illustration—prearrest).

Complete heart block with ventricular asystole was diagnosed by means of the electrocardiogram, the chest was opened, and artificial circulation by manual compression of the heart was begun. While the chest was being opened an orotracheal tube was inserted and the patient was artificially ventilated with oxygen. During the first 30 seconds of asystole the electroencephalogram deteriorated from activity at 1–2 cycles per second to flat (see illustration—early and late arrest). Eighty seconds after arrest spontaneous cardiac activity returned, and the electroencephalogram frequency was 3 per second (see illustration—postarrest). The electroencephalogram and electrocardiogram improved rapidly, the patient responded, and cyclopropane was administered for chest closure. Recovery was satisfactory, and the herniorrhaphy was performed two weeks later.

Insufficient information is available to discuss fully the cause of the cardiac arrest. The myocardial toxicity of chloroform and the hypoventilation from respiratory obstruction probably were the major factors.

The regular, slow electroencephalographic activity of the prearrest interval may represent the effects of inadequate cerebral circulation; indeed, it is similar to the activity