

FIG. 3. Complete assembly as in use (small band of Cellophane tape securing mid-tube to blade is for demonstrative purposes only and is not used in practice).

Figure 3 shows the gag, blade, and tube assembled as in use.

The advantages of this over previously described blades<sup>1, 2, 3</sup> are:

(1) Modification of existing equipment by a good hospital maintenance department is possible. Expense is minimized and equipment already familiar to the surgeon is used. (In many hospitals are to be found blades previously discarded and replaced because the insufflation tube has broken off.)

(2) The "open pronged end" as "potentially a traumatic weapon"<sup>2</sup> is avoided.

(3) "The tube hanging up and being inadvertently removed"<sup>2</sup> has not been encountered.

(4) Removal of the insufflation sidearm actually gives a more unobstructed view of the working area than with unmodified blades.

(5) Use of anode tubes<sup>1, 2</sup> (which provide less wide assortment of sizes and are technically more difficult to insert) has not been necessary to provide an unobstructed airway.

#### REFERENCES

1. Rew, J. B., Wyly, A. J., and Grant, G. B.: *ANESTHESIOLOGY* 22: 494, 1961.
2. Barbee, W. H.: *ANESTHESIOLOGY* 24: 590, 1963.
3. Ring, W. H.: *ANESTHESIOLOGY* 24: 740, 1963.

## Blood Warmer

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Methods used to warm blood have been generally rather cumbersome. Warming the bottles of blood before transfusion is slow and also wasteful if they are not used. Howland and Boyan<sup>1</sup> have employed a 24-foot coil of plastic tubing in the transfusion circuit. This is placed in a 20-liter water bath maintained at 37° C. and is capable of raising the temperature of blood at 4.0–5.8° C. to 30–35° C. even at transfusion rates as high as 150 ml. per minute. Because of the large size and awkwardness of maintaining the temperature of such an apparatus, a local instrument firm was asked to design such an apparatus with similar capabilities but more compact (fig. 1). The device produced has been used by the

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Anesthesia and Surgical Departments of Los Angeles County General Hospital for the last year. Because of the large traumatic, vascular, cardiac, and neurological services at this hospital, there are numerous occasions for massive transfusions. This blood warmer has proven to be very efficient and simple to use in all cases.

It consists of a sealed metal case containing heating elements and thermostatic controls for maximum unit temperature of 40° C. It is portable, weighing 16 lbs. and has the overall dimensions of 5 inches wide by 8½ inches deep and 10 inches high. It contains a water reservoir in which a presterilized coil of vinyl tubing is placed. The latter has an internal diameter of 0.118 inch and is 25 feet in



FIG. 1. Blood warmer with coil of plastic tubing in place.

length and is equipped with male and female adapters at the ends (fig. 2). It is packaged in the form of a coil and is presterilized. To use the warmer the coil is placed in the reservoir and connected by its female adapter to the terminal end of a blood-pump transfusion set and an extension cord is joined to the male adapter. The tubing is filled with blood (approximately 55 ml. for the coil) and then joined to the needle in the patient's vein. Because of the reduction in blood viscosity with warming and the decreased venous constriction using fluid near body temperature, the flow through this system is as rapid as a direct system, and the blood may be pumped with ease in spite of the increased length of tubing.

Tests of temperature gradients using blood flows through the coil up to 100 ml. per minute were performed. Whole blood with a bottle temperature of 12.5° C. reached a minimal temperature of 34.6° C. at the outflow, even though 1,000 ml. were pumped through in 10 minutes. This is well above the critical

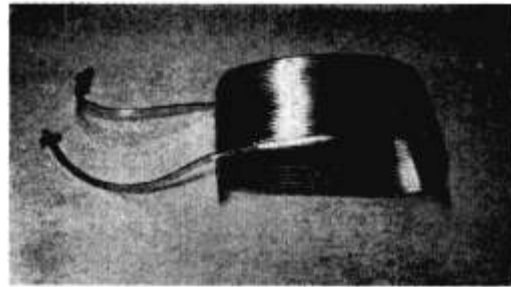


FIG. 2. Presterilized coil of vinyl plastic tubing showing capped male and female adapters.

temperature of increased cardiac irritability (28° C.). If the infusion were allowed to drip slowly, the temperature reached was 38° C.; but because of the small amount of blood entering the circulation per given time, there was no elevation of body temperature. A further test was run using ice water (0° C.) at a flow rate of 200 ml. per minute. In this case, the lowest temperature reached in the outflow was 30° C.—still within the safe range.

Two indicator lamps are provided to indicate when the power is on and also the cycling of the heating elements. A recess is provided for a thermometer if monitoring of the bath temperature is desired. The instrument has been tested extensively to demonstrate its safety in explosive or inflammable atmospheres.

Since the blood warmer has been in use at this institution, a number of advantages have been noticed clinically. The patient being transfused remains warm and pink instead of cold and blue—especially the limb into which the blood is being introduced. Peripheral pulses remain easily palpable unless the patient has extreme hypotension. Shivering and chills during or after infusions are reduced or absent. On two occasions the use of the warmer reversed cardiac arrhythmias which appeared during the rapid administration of cold blood. One of these irregularities (bigeminy) occurred after only three cold units had been given at high flow rates; 5,000 ml. more was given through the warmer without incident.

#### REFERENCE

1. Boyan, C. P., and Howland, W. S.: Cardiac arrest and temperature of bank blood, *J.A.M.A.* **183**: 1; 58, 1963.