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Balloon Catheter Should Increase Recovery of Embolized Air

To the Editor:—I read with interest the article by Bunegin *et al.*¹ concerned with positioning the right atrial catheter. Based on their data the addition of a small inflatable balloon to the CVP catheter would make it float into the air-blood vortex at inclinations $< 90^\circ$. This would improve the efficiency of the catheter in removing air.

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Balloon Catheter Increases Air Capture

To the Editor:—We greatly appreciate the letter from Dr. Diaz. Our research group has had many discussions on how to optimize aspiration of air from the heart chamber; our biomedical engineer, Professor Hung, also had suggested the balloon flotation method of doing this.

Using the right atrial model under the experimental conditions described in our recent publication,¹ we tested the efficacy of withdrawal via a number 7-French single-orifice flow directed catheter. We did not test a balloon-tipped multiorifice catheter since such a device is not presently available. The measurements were made with the catheter tip positioned 3.0 cm above the SA node which appears to be the optimal position for optimal air capture with the single-orifice catheter.

The data shown below represent the mean and standard deviation of 10 observations made at the 90° , 80° , and 60° inclination with the balloon inflated (0.75 ml) and deflated. A Student's *t* test was used for statistical analysis.

Balloon	Up	Down	Up	Down	Up	Down
Inclination	90°	90°	80°	80°	60°	60°
Per cent recovery	40 ± 3	43 ± 1	91 ± 7	27 ± 7	71 ± 2	7 ± 1
	NS*		$P < 0.001$		$P < 0.001$	

* NS not significant.

In the 90° inclination (fully upright) we observed the

catheter to be positioned axially within the vena cava regardless of balloon (up or down) and as expected, no significant increase in catheter efficiency was noted. In both the 80° and 60° atrial inclinations, however, a dramatic improvement in catheter efficiency resulted following balloon inflation. At these inclinations one can observe that the location of the air-saline vortex was near the uppermost wall of the vena cava. With the balloon deflated, the catheter remained axially positioned at the 80° inclination and sunk to the lowermost wall of the vena cava in the 60° inclination. Following balloon inflation with 0.75 ml of air, it could be observed that the catheter tip floated into the center of the vortex at 80° and into the lower portion of the vortex at 60° with recovery of 91 ± 7 per cent and 71 ± 2 per cent, respectively.

Our data indicate the possibility of increasing the maximal air aspiration yield to greater than 90 per cent using the single-orifice catheter with balloon inflation at the 80° atrial inclination. We are in the process of arranging for fabrication of a multiple orificed catheter with inflatable balloon which we calculate should increase our air yield to greater than 95 per cent on inflation. Clinical application would assume the proper application of a sensitive Doppler ultrasonic air bubble detector; placement of the multiorificed catheter; balloon inflation and aspiration the moment Doppler activation occurs.

It now appears that the almost total removal of en-

trained air is a reality. We strongly believe that since the patient in the sitting position is at risk from venous air embolism, the Doppler and right atrial catheter should be routinely employed.

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A Procedure for Measuring the Length of the Catheter in the Epidural Space

Epidural anesthesia is used with increasing frequency in obstetric practice. Often an intermittent technique is used and local anesthetic drugs are injected through the catheter as required. With epidural anesthesia, pain relief is not always as complete or predictable as with spinal anesthesia¹ and it is probable that inaccurate placement of the catheter tip may account for some cases of failure. Unilateral or inadequate anesthesia may be caused by an excessive length of the catheter in the epidural space if the catheter doubles back on itself,² exists the epidural space via an intervertebral foramen,³ or lies in the anterior instead of posterior epidural space.³ Although the importance of placing the correct length of the catheter (2-4 cm) in the epidural space has been stressed in many books, a procedure to accomplish this with any commercially available needles and catheters is not well-described.

We are describing a method for precise cannulation of the epidural space which can be used with two currently available epidural trays (Pharmaseal and Trav-enol Epidural Anesthesia Trays).

PROCEDURE

After the routine preparation of the patient, the following steps are performed (fig. 1). 1) The epidural needle is advanced into the epidural space. 2) The length of the needle including the hub remaining outside the skin is measured. This can be done easily using the 3-ml plastic syringe from the set. The syringe is held adjacent to the epidural needle. Step 2: The piston is withdrawn until its front black ring is in line with the end of the needle. Do not displace this syringe mark. 3) Insert the epidural catheter. When the first mark on the shaft of the catheter coincides with the hub of the needle, the tip of the catheter is in the epidural space. 4) When the third mark on the catheter coincides with the hub of the

needle, a 2-cm length of the catheter is in the epidural space. 5) To avoid accidental withdrawal of the catheter, withdraw the needle while advancing the catheter for an additional 2-3 cm (total 4-5 cm). 6) After the needle is

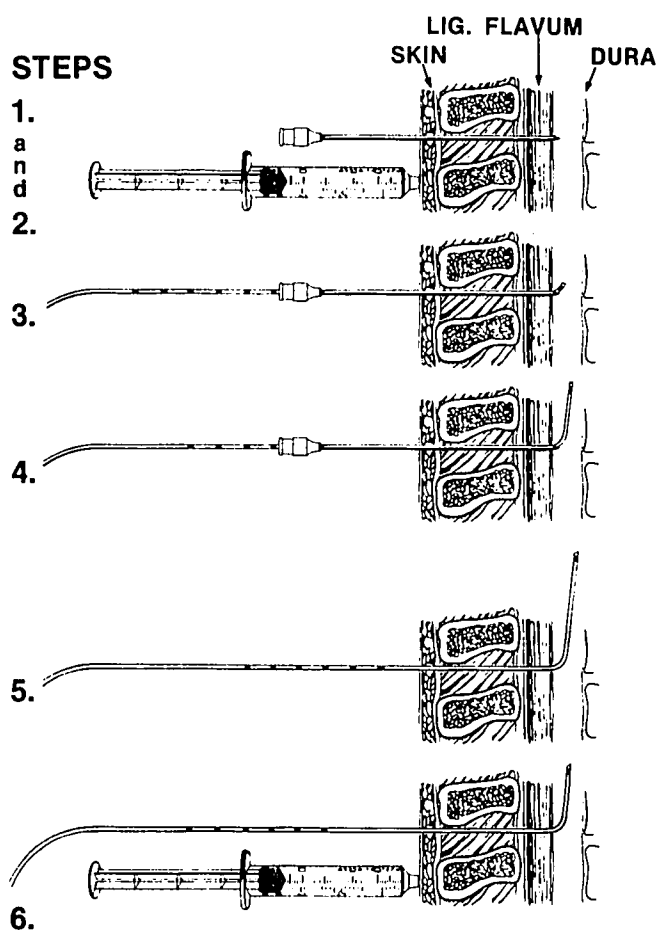


FIG. 1. Procedure for precise cannulation of the epidural space.