EFFECT OF APNEA AND HEAD POSITION ON THE LOCATION OF VENOUS CATHETERS INSERTED VIA BASILIC VEINS

G. MOLLASADEGHI ROKNABADI, M.D., A. HAYDARPOUR, M.D., R. FARASATKISH, M.D., AND N. AGHDAIE, M.D.

From the Department of Cardiac Anesthesia, Shahid Rajai Cardiovascular Medical Center, Tehran, Iran

ABSTRACT

Incorrectly placed central venous catheters for monitoring central venous pressure in patients undergoing various cardiac surgery procedures is a common problem faced by cardiac anesthetists. In an attempt to reduce the frequency of this problem, this study was performed to compare the results of 200 CVP catheter placements in two groups of patients, one group with the head turned ipsilaterally and the second group in addition to head position, patient apnea during insertion. Results showed a significant reduction in the percentage of incorrectly placed catheters in the second group (3% vs. 16%). We conclude that turning the patient's head ipsilaterally associated with apnea during insertion of central venous catheters can significantly reduce the rate of incorrect catheter position in patients in whom this type of monitoring is indicated.

Key words: Central venous cannulation, cardiovascular monitoring, apnea, head position, basilic vein

Correspondence:
G. Mollasadeghi, MD
Department of Cardiovascular Anesthesia
Shahid Rajai Cardiovascular Medical Center
Tehran, Iran

INTRODUCTION

One of the most important problems of catheters inserted through basilic arm veins for measurement of central venous pressure (CVP) is inaccurately or incorrectly placed catheter tips. 45 to 67 percent of catheters lie in internal jugular veins (IJV) rather than in a central intrathoracic vein.[1-3] If the patient's head is turned toward the arm of insertion, catheter placement into the internal jugular veins will be reduced to 20 percent. It has been suggested that catheters can be prevented from entering the internal jugular vein if the patient is apneic during catheter insertion. A 16 gauge, 61-cm long catheter was inserted into the basilic vein of the antecubital fossa of either arm in patients undergoing open-heart surgery after induction of anesthesia. In one group, patients' heads were turned toward the arm of insertion. In another group, in addition to head position, patients were apneic during insertion of the catheter.[2,4]

There is a report of the effect of head position on catheter location with venous catheters inserted via basilic veins,[5] but there has been no report of effects of apnea on catheter locations. Therefore, we analyzed the location of 200 central venous pressure catheters in two groups to determine the effect of position of the head (turned ipsilaterally) and that position associated with apnea during catheter insertion via basilic vein.

METHODS AND MATERIALS

We studied patients undergoing cardiac surgery and in whom central venous cannulation had indication. We chose two methods for insertion of central venous catheters via basilic veins and compared two conditions for peripheral central venous catheter insertion for two groups, each with 100 patients. All techniques and equipment were similar.

The head was turned toward the arm of insertion in 100 patients and head position and apnea induced during catheter insertion in another 100 patients. After skin preparation with an iodinated disinfectant solution, a 16-gauge, 61cm long catheter was inserted into the basilic vein of the antecubital fossa of either arm. During the threading of the catheter proximally, we grasped the catheter through the protective sleeve and gently advanced one inch at a time, until the desired indwelling depth was achieved. Then we removed the plug (and stylet) and connected it to the central venous coupling system.

The arm was adducted or the shoulder elevated as required to facilitate insertion of the catheter. A record was kept of whether the patients head was turned toward the arm of insertion with the chin touching the shoulder (ipsilateral)[5] or not turned toward either arm (mid-position)[15]. Postoperatively a roentgenogram of the chest was examined to determine the location of the catheter tip. After central venous catheter insertion and during the operation, the central venous pressure curve on the monitoring device was checked to show an optimal pressure curve.

The patients in the study were scheduled for open cardiac surgery and were selected randomly. They had valvular heart disease, coronary artery disease and congenital heart disease as seen in Table I. They were adults and from 17 to 75 years old.

Background Disease	Total	Male	Female
Valvular	43	19	26
Coronary	138	105	35
Congenital	22	13	6

Table I: Frequency of patients based on their background disease.

RESULTS

The results are summarized in Table II. Turning the head ipsilaterally significantly reduced the number of catheters entering the internal jugular veins. 14% of catheters entered an internal jugular vein with the head turned toward cannulation side, but only 2% of catheters were located in an internal jugular vein with the patient apneic and the head turned ipsilaterally during central venous catheter insertion. 2% of catheters entered long thoracic vein with the head turned ipsilaterally and 1% were located in an axillary vein when head position was associated with apnea. Right atrium and superior vena cava locations were more frequently achieved when the head was turned ipsilaterally plus apnea (97%) compared with placement when the head was turned ipsilaterally and the patients were ventilated (84%).

Location of Catheter tip	Head turned Ipsilaterally	Head turned Plus apnea
Right atrium	48	62
SVC	10	29
Subclavian v.	26	6
Int. jugular v.	14	2
Axillary vein	0	1
Long thoracic v.	2	0
Total Number	100	100

Table II: Effect of position and apnea on location of central venous catheter tips in two groups of patients.

With the head at mid-position (straight-forward position) catheter tips were successfully located within an intrathoracic vein less than in our study. Of the 200 catheters inserted, 53% were inserted via right arm and 47% via the left arm in the head-turned group, vs. 48% via right arm and 52% via left arm in patients with head position associated with apnea.

DISCUSSION

Cannulation of a large vein is the standard clinical method for monitoring central venous pressure[6]. In addition, central venous cannulation is performed to provide secure vascular access for administration of vasoactive drugs or initiation of rapid fluid resuscitation. Often the central venous location is the only site available for intravenous access of any kind. Patients at risk for venous air emboli may have central venous catheter placed for aspiration of entrapped air. Central venous access is required to initiate transvenous cardiac pacing, temporary hemodialysis, or pulmonary artery catheterization for more comprehensive cardiac monitoring and the most important of all is cardiovascular monitoring during open heart surgery and cardiopulmonary bypass.

The considerations for selecting the site of central venous cannulation include the experience of the operator, ease of access, anatomical anomalies and the ability of the patient to tolerate the position required for catheter insertion. The Trendelenburg position can be complicated by hypoxia in cardiac surgical patients breathing room air, and in this situation peripheral veins can be chosen for central venous cannulation.

The advantages of central venous monitoring via basilic veins are low likelihood of complication and the ease of access intraoperatively, if the arm is exposed. The major disadvantage is that it is often difficult to assure placement of the catheter in a central vein. Studies have

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indicated that blind advancement will result in central venous cannulation in 59 to 75 percent of attemps.[7,2] Chest radiographs are usually necessary to confirm that the tip of the catheter has been appropriately placed, and this involves some time delay.[8] Unsuccessful attempts result most frequently from failure to pass the catheter past the shoulder, or cannulation of the ipsilateral internal jugular vein. Turning the head to the ipsilateral side may help prevent internal jugular vein placement of the catheter.[9]

Artru et al. have reported high success rate (92%) for placement of multi-orifice catheter from antecubital veins using intravascular electrocardiography. The catheters are positioned at the SVC-RA junction and are used for aspiration of air emboli in neurosurgical patients.[10]

Peripherally-inserted central catheters (PICCs) have been associated with very low incidence of bloodstream infection but have mostly been used in outpatients until recently.[11,12] Lower infection rates with this approach than with subclavian or internal jugular catheters could be due to lower concentration of resident flora on the arm than the neck or chest.[13,14]

Failure to place a central venous pressure catheter tip in an ideal central location does not necessarily prevent accurate central venous pressure measurement. Pressures measured in the external jugular and internal jugular veins can accurately approximate central venous pressures, but only when the head is not turned to either side (compressing the veins), or when the chest is not open.[15] Failure to place the CVP catheter tip correctly can cause erroneous pressure readings when venous valves are interposed between the catheter tip and central veins or when the catheter tip is against the wall of a vein. In addition, placement of the catheter tip into the internal jugular veins may result in serious problems in patients who carry the risk of venous air embolism or in patients undergoing intravenous hyperalimentation.

A catheter inserted via an extremity vein cannot be relied on to thread into a central vein. The cephalic vein is rarely used due to its high failure rate, and was not used at all in our study.[2] Altering the position of the head changes the angle of entry of the internal jugular vein into the subclavian vein. Apnea prevents increasing intrathoracic pressure and blood flow continues from internal jugular vein to superior vena cava and catheter enters SVC from subclavian vein.

In patients whose arm veins are not available, or when rapid accurate placement of central venous catheter is needed, or the catheter is expected to be needed for a long period, we frequently use internal jugular catheter insertion to ensure correct placement. Subclavian punctures in the immediate preoperative and intra-operative period are usually avoided.

In conclusion, turning the head of the patient toward the arm of insertion and placing the chin onto the ipsilateral shoulder associated with apnea during the threading of the central venous catheter via basilic veins significantly reduces the number of catheter tips that erroneously enter the internal jugular vein, and significantly increases the success rate for correct intrathoracic placement.

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