ANATOMIC RELATIONSHIP OF THE RIGHT CAROTID ARTERY AND INTERNAL JUGULAR VEIN IN PEDIATRIC PATIENTS WITH CONGENITAL HEART DISEASE

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Introduction: Central venous cannulation via the right internal jugular vein (IJ) fails more often in pediatric than in adult patients (1) and risks injury to the common carotid artery (CC). Since the CC pulse may be the anesthesiologist's only guide to the location of the IJ, knowledge of the two vessels' anatomic relationship is essential for successful cannulation without CC puncture. In pediatric patients, the IJ catheter typically is used to monitor right atrial pressures and to administer vasoactive drugs centrally prior to surgery for congenital heart defects. Accordingly, we selected this patient population to document CC and IJ anatomic relationships via ultrasound imaging. We also studied changes in the ratio of the cross-sectional diameters of the CC and IJ as a function of patient weight.

Methods: Approval was obtained from the UCSF human research committee and informed consent from patients' parents or guardians. Patients were placed in ten degrees of Trendelenburg, then pillows were removed and the head turned completely to the left. A 5.5-MHz Hewlett Packard Sonos 1500 or Acuson 128XP/5 imaging probe was placed on the right side of the neck centered at the level of the cricoid cartilage and aimed directly posteriorly. Care was taken to avoid excessive pressure while simultaneously achieving sufficient contact for imaging. Images of the IJ and CC were recorded for one minute onto videotape.

IJ and CC relationships were divided into three categories (fig. 1). Each study tape was analyzed collaboratively by two experienced echocardiographers (MKC and IAM) who were blinded to the patient's age and weight. CC/IJ ratios were computed for each patient by printing an end-diastolic image (determined by timing of CC pulsations) and measuring the diameter of each vessel at its widest point.

Results: 35 patients were studied. The average age was 3.6 ± 3.7 years (mean ± SD) and range of ages was 3 days to 10.0 years. Average weight was 13.9 ± 10.6 kg and range of weights was 2.0 to 46.4 kg. For one patient, the CC position and CC/IJ ratio were excluded from analysis because the CC bifurcated below the clavicle and two arteries were present at the cricoid level (posterior and postero-medial). In the remaining 34 patients, CC positions were 59% posterior, 23% medial, and 18% postero-medial. The average CC/IJ ratio was 0.65 ± 0.21 and did not correlate with increasing weight (R=.098).

Discussion: The 59% incidence of posteriorly positioned CC's in this pediatric population contrasts sharply with the 2% incidence reported in an adult population of 200 (2). This higher incidence suggests a likelihood of posteriorly positioned CC's in children with congenital heart disease relative to adults. This potential likelihood presents practitioners attempting IJ cannulation in this pediatric population with two unique hazards: 1) A needle placed lateral to the CC in an effort to avoid CC injury may repeatedly miss the IJ; and, 2) The CC may be at increased risk of injury by the inadvertent passage of a needle entirely through the IJ.

This anatomic relationship in children with congenital heart disease poses a special risk rarely seen in adults, and we suggest the use of ultrasound guidance to visualize the patient's IJ and CC anatomy prior to cannulation.

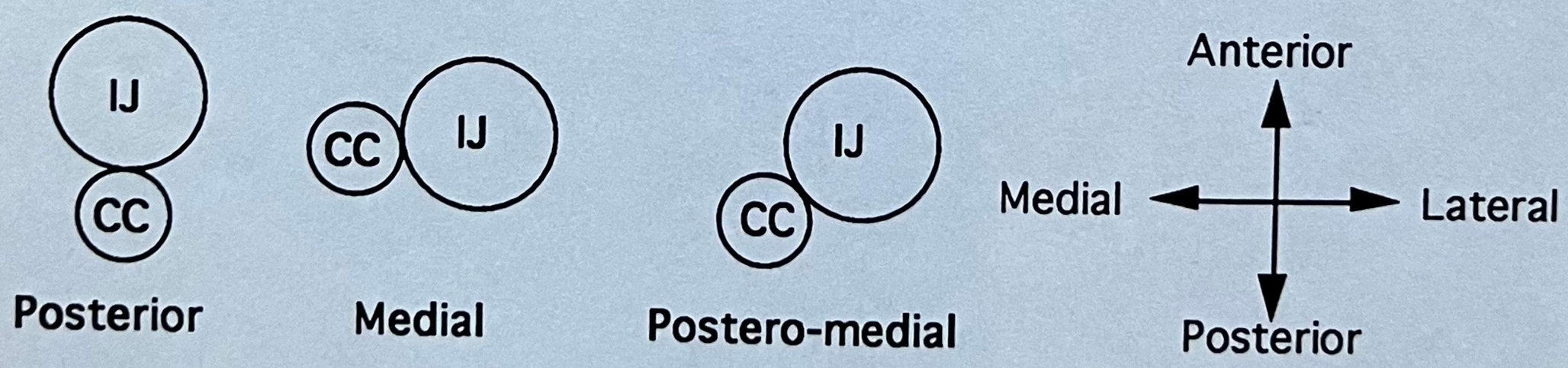

Fig. 1. Relationships between the right CC (common carotid artery) and IJ (internal jugular vein) in the neck. The CC was considered posterior if greater than 50% of the CC volume lay lateral to the far medial edge of the IJ, medial if none of the CC lay lateral to the IJ, and postero-medial if the CC lay between these two positions.

References:

1. Prince SR, Sullivan RL, Hackel A. Anesthesiology 44:170-4, 1976
2. Denys BG, Uretsky BF. Critical Care Medicine 19:1516-9, 1991