PEDIATRIC SURGERY *Update**
Vol. 56 No. 01 JANUARY 2021

Central Venous Catheter Tip Placement

Central venous catheters (CVC) are essential for providing long-term chemotherapy for cancer, total parenteral nutrition, central venous pressure monitoring, secure regular blood sampling, and prolonged intravenous management in children. Using ultrasound and Seldinger technique, the internal jugular, external jugular, cephalic or subclavian vein are usually cannulated as entrance points. The anatomic position of the tip of the CVC is of upmost importance to avoid dysrhythmias, thrombosis, valvular insufficiency, inaccurate venous pressure monitoring, tricuspid valve damage, and perforation of the right atrium (RA), right ventricle or superior vena cava (SVC) resulting in cardiac tamponade. Tips located outside the heart are associated with thrombosis of the cava or its tributaries, inadvertent infusion into nontarget vessels, catheter dysfunction, erosion of the catheter into the lung or bronchus and risk of perforation with hemothorax. Catheter angulation, curvature or looping is a major risk for perforation. The recommended position of the tip of the CVC is just above the superior vena cava-right atrial junction parallel to the SVC to prevent serious complications. Radiographic and fluoroscopy methods are the standard for defining tip position follow very closely by ultrasound and EKG. Several radiographic landmarks have been used to determine the exact position of the tip of the catheter in the SVC-RA junction. These include the right tracheobronchial angle and the carina. The right tracheobronchial angle has less clinical applicability as radiologist find difficult to identify in some chest films. The carina has several advantages as radiologic landmark of the catheter tip: it does not move with pathologic changes in the lung, it is positioned in the center of the body and it can be identified easily even in poor quality chest films. In adolescent and young adults, a point approximately two vertebral body units below the carina was found as the landmark of the cavoatrial junction. In order to place the catheter tip at the level of the carina several external landmarks must be used to cut the proper length of catheter during insertion. The CVC tip can be reliably placed near the carina level using the external landmarks of the sternal head of the right clavicle and a perpendicular line connecting both nipples. The catheter distance should be measured from the insertion point to midpoint the distance between these two landmarks substrated by 0.5 cm and cut. The insertion depth is determined placing the CVC over the sterilized skin from the insertion point to the midpoint of the perpendicular line joining the sternal head of the right clavicle and the line connecting both nipples. Alternatively, the depth of insertion of the catheter can be determined by the distance from the skin puncture to the second intercostal space (sternal angle of Lewis). The length of the CVC using either the carina or SVC-RA junction as measured by thoracic CT-Scan correlates with the patient age and body surface area and formulas for each catheter length have been devised previously. The carina is still an easily sighted and clear

radiological landmark in children to confirm that the CVC tip is outside the pericardial reflection. In neonates the carina is not always located above the pericardium, therefore, the carina could not be an appropriate landmark for CVC placement. In all cases, a chest film is mandatory after CVC placement to determine tip position and associated complications of punctured.

References:

1- Andropoulos DB, Bent ST, Skjonsby B, Stayer SA: The Optima Length of Insertion of Central Venous Catheters for Pediatric Patients. Anesth Analg. 93: 883-886, 2001
2- Yoon SZ, Shin JH, Hahn S, et al: Usefulness of the carina as a radiographic landmark for central venous catheter placement in paediatric patients. Br J Anaesth. 95(4): 514-517, 2005
3- Baskin KM, Jimenez RM, Cahill AM, Jawad AF, Towbin RB: Cavoatrial Junction and Central Venous Anatomy: Implications for Central Venous Access Tip Position. J vasc Interv Radiol 19: 359-365, 2008
4- Na HS, Kim JT, Kim HS, et al: Practical anatomic landmarks for determining the insertion depth of central venous catheter in paediatric patients. Br J Anaesth. 102(6): 820-823, 2009
5-Witthayapraphakorn L, Khositseth A, Jiraviwatana T, et al: Appropriate Length and Position of the Central Venous Catheter Insertion via Right Internal Jugular Vein in Children. Indian Pediatr. 50:749-752, 2013
6- Perin G, Scarpa MG: Defining central venous line position in children: tips for the tip. J Vasc Access. 16(2): 77-86, 2015
7- Hoffmann S, Goedeke J, Konig TT, et al: Multivariate analysis on complications of central venous access devices in children with cancer and severe disease influenced by catheter tip position and vessel insertion site (A STROBE-compliant study). Surgical Oncology. 34: 17-23, 2020
8- Maddali MM, Al-Shamsi F, Arora NR, Panchatcharam SM: The Optimal Length of Insertion for Central Venous Catheters Via the Right Internal Jugular Vein in Pediatric Cardiac Surgical Patients. J Cardiothoracic and Vasc Anesth. 34: 2386-2391, 2020

Bilateral Papillary Thyroid Carcinoma

Of all thyroid cancers occurring in the USA, around 10% occurs during the pediatric age. Almost 20% of all solid thyroid nodules in children harbor a malignancy. The most common histological type of thyroid malignancy found in children is papillary carcinoma, which together with the less common follicular variety (< 5%) comprise most cases of differentiated thyroid cancer in children. Differentiated thyroid carcinoma arises from the thyroid follicular cells. Papillary thyroid carcinoma (PTC) in children is characterized by a high incidence of regional lymph node metastasis at the time of diagnosis (60%), along with a higher incidence of bilateral and multifocal disease (30% and 65% respectively. In spite of this, children are less likely to die from disease, with disease-specific mortality less than 3%. The three most common risk factors identified in children with PTC include exposure to ionizing radiation in the head and neck area, a family history of thyroid cancer and a preoperative diagnosis of Hashimoto thyroiditis. A variety of genetic disorders may predispose to PTC including familial adenomatoid-polyposis, Carney complex, Werner syndrome, DICER1 syndrome and hamartoma tumor syndrome. The presence of lateral neck lymph node metastasis noted in preoperative ultrasound studies is associated with an increased risk of detectable bilateral PTC. FNA should be performed on any suspicious lymph nodes in the lateral neck as confirmation of metastatic involvement prior to lateral neck dissection. Of children diagnosed preoperatively with unilateral disease, if the dominant tumor measured greater than 2 cm a postoperative diagnosis of bilateral disease is more likely. Children with occult bilateral disease are more likely to have positive central

compartment lymph node involvement, extranodal extension of disease, extrathyroidal extension, lymphovascular invasion and multifocal disease. Diffuse-sclerosing variant tumors is associated with an increase of bilateral disease. Total thyroidectomy maximizes disease-free survival, overall survival and quality-adjusted life expectancy in children with PTC compared with lobectomy. Almost one-fourth of children have occult contralateral disease with a high risk for persistent disease if a total thyroidectomy is not performed at the time of diagnosis. Lesser thyroid resection than total thyroidectomy is associated with as high as 10-fold greater recurrences rates. Inadequate lymph node dissections in patients with clinically positive nodes increase the need for subsequent intervention 3-fold. Addition of central lymph node dissection to total thyroidectomy in PTC decrease recurrence rate to less than 5% at ten years.

References:

1- Baumgarten H, Jenks CM, Isaza A, et al: Bilateral papillary thyroid cancer in children: Risk factors and frequency of postoperative diagnosis. J Pediatr Surg. 55(6):1117-1122, 2020

2- Christison-Lagay ER, Beartschiger RM, Dinauer C, et al: Pediatric differentiated thyroid carcinoma: An update from the APSA Cancer Committee. J Pediatr Surg.http://doi.org/10.1016/j.pedsurg2020.05.003, 2020

3- Hay ID, Johnson TR, Kaggal S, et al: Papillary Thyroid Carcinoma (PTC) in Children and Adults: Comparison of Initial Presentation and Long-Term Postoperative Outcome in 4432 Patients Consecutively Treated at the Mayo Clinic During Eight Decades (1936-2015). World J Surg. 42(2):329-342, 2018

4- Qu N, Zhang L, Wu WL, et al: Bilaterality weighs more than unilateral multifocality in predicting prognosis in papillary thyroid cancer. Tumour Biol. 37(7):8783-9, 2016

5- Lee YS, Lim YS, Lee JC, et al: Clinical implications of bilateral lateral cervical lymph node metastasis in papillary thyroid cancer: a risk factor for lung metastasis. Ann Surg Oncol. 18(12):3486-92, 2011

6- Scholz S, Smith JR, Chaignaud B, Shamberger RC, Huang SA: Thyroid surgery at Children's Hospital Boston: a 35-year single-institution experience. J Pediatr Surg. 46(3):437-42, 2011

Zenker Diverticulum

Zenker diverticulum is considered the most common diverticulum of the esophagus. It is usually seen in the 6th to 8th decade of life with only a few cases described in the pediatric age. Zenker diverticulum is a protrusion of pharyngo-esophageal mucosa through a weak zone in the posterior wall of the pharynx known as Killian's triangle. It is an acquired hernia of the posterior pharyngeal mucosa membrane at the pharyngo-esophageal junction occurring between fibers of the lower pharyngeal constrictor and crico-pharyngeal muscles. Dysfunction of the cricopharyngeal muscle plays a major role in the pathogenesis of the diverticulum. It is a pulsion pseudodiverticulum since is associated with high intraluminal pressure and does not contain all the layers of the esophagus. Being a pseudodiverticulum there is involvement of only the mucosal layer. They are more common in males and present more frequently on the left side. Zenker diverticulum causes dysphagia, a sensation of food sticking in the throat, noisy deglutition, regurgitation of undigested food, cough, aspiration, chronic foreign body impaction and halitosis. Over time patients may present weight loss due to chronic dysphagia. Esophagogram (barium swallow is the gold standard), US or CT-Scan with oral contrast of the neck and proximal thorax are diagnostic, revealing a diverticular pouch filled with air, debris and food particles compressing the trachea. Zenker diverticulum is classified by their longitudinal size into small (diameter less than 2 cm), medium (diameter 2-4 cm), and large (diameter > 4 cm). Zenker diverticulum is

associated with Marfan's syndrome due to the abnormal pharyngeal weak wall related to the connective tissue disorder. The differential diagnosis includes a congenital crico-pharyngeal diverticulum, duplication of the esophagus, traction diverticulum, a false diverticulum above a congenital stenosis, traumatic pseudodiverticulum of the pharynx in newborns (perforation by nasogastric tube), and a postoperative diverticulum after repair of tracheo-esophageal fistula. Management of a Zenker diverticulum depends on the location, symptoms and size of the diverticulum. Endoscopy stapling or laser resection, diverticulectomy, cricopharyngeal myotomy or diverticulopexy are several procedures performed for Zenker diverticulum. Myotomy is the mainstay of treatment with favorable outcomes in more than 80% of patients with a reduced recurrence rate. Endoscopic management is not recommended in large diverticula because of incomplete emptying of pouch remnants.

References:

1- Gorkem SB, Yikilmaz A, Coskun A, Kucukaydin M: A pediatric case of Zenker diverticulum: imaging findings. Diagn Interv Radiol 15: 207-209, 2009

2- Patron V, Godey B, Aubry K, Jegoux F: Case report. Endoscopic treatment of pharyngo-esophageal diverticulum in child. Internat J Pediatr Otorhinolaryng. 74: 694-697, 2010

3- Abu-Omar A, Miller C, McDermott AL: Acquired pharyngoesophageal diverticulum in childhood. J Laryng & Otology. 124: 1298-1299, 2010

4- Lindholm EB, Hansbourgh F, Upp Jr JR, Cilloniz R, Lopoo J: Congenital esophageal diverticulum - A case report and review of literature. J Pediatr Surg. 48: 665-668, 2013

5- Bergeron JL, Chheri DK: Indications and Outcomes of Endoscopic CO2 Laser cricopharyngeal Myotomy. Larynsgoscope 124(4): 950-954, 2014

6- Crawley B, Dehom S, Tamares S, et al: Adverse Events after Rigid and Flexible Endoscopic Repair of Zenker's Diverticula: A Systematic Review and Meta-analysis. Otolaryngol Head Neck Surg. 161(3):388-400, 2019

***Edited by: Humberto Lugo-Vicente, MD, FACS, FAAP**

Professor of Pediatric Surgery, UPR - School of Medicine, UCC School of Medicine & Ponce School of Medicine.

Director - Pediatric Surgery, San Jorge Children's & Woman Hospital.

Postal Address: P.O. Box 10426, San Juan, Puerto Rico USA 00922-0426.

Tel (787) 340-1868 E-mail: *pediatricsurgerypr@gmail.net*

Internet: pedsurgeryupdate.com

**** PSU 1993-2021***

ISSN 1089-7739