

## Evaluation of the Catheter Tip Position Among Children with Totally Implantable Port During 2015 in Dr. Sheikh Children's Hospital

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How to cite this article:

Shojaeian R, Khazravi MM. Evaluation of the catheter tip position among children with totally implantable port during 2015 in Dr. Sheikh Children's hospital. Iranian Journal of Pediatric Surgery 2018; 4 (2):88 -92 .

DOI: <https://doi.org/10.22037/irjps.v4i2.21466>

### Abstract

**Introduction:** Totally implantable port insertion is a common procedure in pediatrics surgery and the main concern is the position of catheter tip, which is directly related to its complications, failure and durability. The best position is in superior vena cava (SVC)/ right atrium (RA) junction which is compatible with carina or T5-T6 vertebral level in chest x-ray.

In our center we routinely use surface anatomy to estimate the adequate length for the tip to reach SVC/RA junction. In this study we compared the precision and accuracy of this method by post-operative chest x-ray study.

**Materials and Methods:** as a retrospective study we evaluated the accuracy of surface anatomical land marks to estimate the catheter tip position, considering the carina or vertebra in chest x-ray which represents the SVC/RA junction. Forty eight patients were included and their records were reviewed in Dr. Sheikh Children's hospital in Mashhad.

**Results:** Considering the carina as the best radiographic land mark, we had accurate tip position only in 29.2%, over insertion in 45.8% and under inserted catheter tip in 10.4%. Considering the vertebral bodies as radiographic land mark, 50% were over inserted, 35.4% accurate and 14.6% under inserted.

**Conclusion:** Regarding our high rate of catheter tip mal-position arising from considering surface anatomy alone, we suggest not only to rely on surface anatomy but use imaging modalities such as portable X-ray, fluoroscopy or ultra-sonography within the operation room while inserting implantable port devices.

### Keywords

- pediatrics
- implantable catheter
- superior vena cava
- access port
- chest x ray

received: 19 May 2018

accepted: 14 July 2018

ISSN 2423-5067

## Introduction

Totally implantable port insertion is a common procedure especially for children with cancer or coagulopathy or among those who need prolonged medical therapy or frequent sampling or total parental nutrition mostly in the ICU.<sup>1</sup>

Catheter tip position is a cardinal matter of concern in this surgical procedure. Optimal tip position has been discussed in several studies. Proper tip position will improve catheter function and decrease related potentially fatal complications such as cardiac perforation, tamponade and arrhythmia.<sup>2,3</sup>

Although the best catheter tip position is a matter of controversy but the superior vena cava to right atrium junction is widely suggested as the optimal catheter tip position.<sup>4</sup>

Several methods are used to evaluate catheter tip proper location such as surface anatomy landmarks,<sup>5</sup> calculation of catheter length,<sup>1</sup> radiologic landmarks,<sup>4</sup> Ultrasonographic studies,<sup>6</sup> computed tomography assessment<sup>2</sup> and etc.

Traditionally catheter length and surface anatomy have been used for proper central catheter insertion in our department combined with post-operative x-ray confirmation.

In this article we have studied the accuracy of our routine approach.

## Materials and Methods

This is a retrospective study of children who underwent implantable port insertion surgery from March 2015 to March 2016 in DR. Sheikh Children's Hospital in Mashhad.

We used the national operation code for implantable port insertion to identify our cases during this time period and used the record number to check the post-operative x-ray study in radiology e-data base of our hospital.

We reviewed all medical records of these cases during a one year time period and assessed the post-

operative chest x-rays to evaluate the catheter tip position. In our policy, a chest x ray was obtained from all cases to approve the correct position of central catheter and in case of malposition, patients were prepared for reoperation to correct the catheter tip position. Correction of tip over insertion was performed under sedation and by re-exploration of neck incision at the site of venotomy and simply pulling out the catheter to the measured distance on CXR and replacing the excessive length in a subcutaneous pocket.

We considered the carina as the best radiologic land mark for anatomical judgment. In case of unidentified carina we considered T5-T6 vertebral bodies as a substitute radiologic land mark then divided our patients to 3 groups of under, over and proper inserted catheters **Figure 1**.

Then we compared the findings using SPSS 11.5 for statistical analysis.

## Results

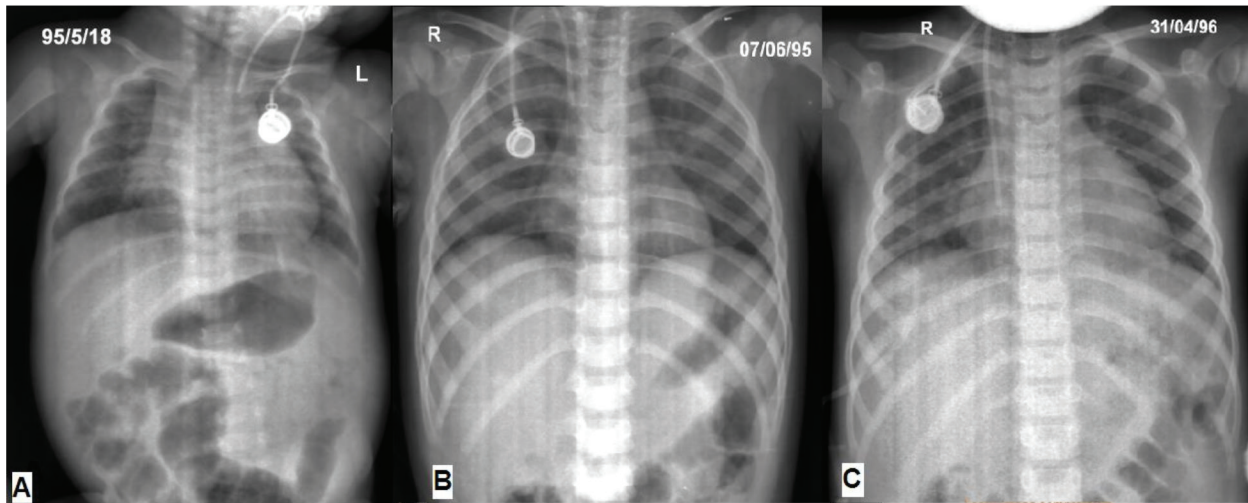
A total of 70 patients who had undergone the total implantable port insertion surgery were identified between 2015 -2016. According to the imaging data base 22 patients were excluded from the study as we didn't have access to their imaging records. This limitation was due to outpatient x-ray studies that were not accessible by our radiology department e-data base.

All 48 patients' x-rays were investigated for the position of port tip according to radiologic land marks (carina and or vertebra).

Totally 60.4 %( 29) patients were female and 39.6 % (19 patients) were male.

Considering the carina we identified 14 cases (29.2%) with a correct catheter position, 5 cases (10.4 %) under insertion and 22 cases (45.8 %) over inserted. The carina level was not clearly observable in 7 cases (14.6 %).

Considering vertebral bodies 17 cases (35.4 %) were accurately positioned, 7 cases (14.6 %) were



**Figure 1:** X-Ray study of patients with total implantable port a) Under insertion. b) Correct position. c) Over insertion

under inserted and 24 cases (50 %) were over inserted **Table1**.

The surgical approach was left sided in 3 patients (6.3 %) and right sided in 45 patients (93.7 %).

Comparing the tip position according to the side of intervention all three left side ones had a sort of mal position. In the right sided ones 17 cases were correct in position (37.8 %). Six cases were under inserted (13.3%) and 22 were over positioned (48.9 %).

**Table 1:** Comparing the catheter tip position regarding carina vs. vertebral bodies.

Reassessment with vertebral body position	Catheter tip position according to Carina			
	Correct	Under	Over	Unidentified
Correct	12(85.7%)	0(0%)	0(0%)	5(71.4%)
Under	1(7.1%)	5(100%)	0(0%)	1(14.3%)
Over	1(7.1%)	0(0%)	22(100%)	1(14.3%)
Total	14(100%)	5(100%)	22(100%)	7(100%)

## Discussion

Importance of proper tip position in central venous catheter insertion is discussed in some studies and serious complications are observed due to catheter tip mal positions.<sup>3, 7, 8</sup>

Traditionally in our department we use surface anatomical land marks for measurement of catheter depth from the accessed Jugular vein: we measure the distance of venotomy site to superior sternal notch plus the distance from superior sternal notch to Manubrial-Sternal junction as a guide for the

length of catheter, then all the patients undergo an x-ray before discharge from the hospital to make sure the position of the tip is correct. In case of malposition, patients had a reoperation to correct the catheter tip position.

Radiologic studies surprisingly showed a high rate of catheter mal position which were mostly over insertion.

Surface land marks or anthropometric data were used for determining the length of catheter insertion by Witthayapraphakorn et al, with acceptable results confirmed by thoracic CT.<sup>1</sup>

Some other studies like Yoon et al., suggested carina level in CXR as a useful landmark.<sup>2</sup>

Similar to what we did in practice Na.et.al. suggested pure surface anatomical distances to evaluate the insertion depth of central venous catheter.<sup>9</sup> Dulce et al, conducted topographic analysis to evaluate anatomical land marks to compare with x-ray and CT findings and suggested 9 mm above the carina compatible with extra pericardial SVC as the best catheter position with the lowest rates of complications.<sup>5</sup> According to this study, our over insertion rate is even higher than what we reported.

Those who suggest carina as a useful land mark state that the carina is a fix and reliable land mark as it doesn't move cephalad or caudal even in different lung pathologies, although we observed 7 cases with unidentified carina in our study.

On the other hand Tan et al conducted an evidence-

based study to evaluate surface anatomical land marks representing SVC-Atrial junction and reported unreliability of surface land marks such as rib level.<sup>2</sup>

We found an unexpectedly high rate of catheter tip mal-position especially over insertion among our patients, so in many cases we had to re-operate in order to adjust the tip position, therefore we suggest an intra operative imaging study to confirm the accuracy of the procedure. Portable x-ray is the most accessible modality but its time consuming and sometimes unreliable. Recent studies propose ultra-sonography or fluoroscopy as a more accurate and feasible tool to confirm the catheter tip level.<sup>5,6</sup>

### Conclusion


Regarding our high rate of catheter tip mal-position based on surface anatomical land marks we suggest intra-operative radiologic confirmation to decrease the rate of reoperation and complications among the patients who undergo surgery for total implantable port insertion.

### Conflict of Interest

There is no conflict of interest.

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