

Long Term Follow up of Neonatal Internal Jugular Vein Catheterization: Patency and Thrombosis

Mahdi Parvizi Mashhadi¹, Leila Ameri², Reza Shojaeian^{1*}

¹ Endoscopic and Minimally Invasive Surgery Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.

² Parsian Medical Imaging Center, Mashhad, Iran.

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ABSTRACT

Introduction: Maintaining a vascular access is a common procedure in neonates specifically for those who need prolonged hospitalization or intensive care support. This situation may happen several times among those with complex congenital anomalies therefore patency of central vein is a major concern at the time of re-cannulation. We evaluate the patency of internal jugular vein after previous open catheterization in this study.

Material and Method: All term neonates with documented internal jugular vein catheterization during 2008-2018 were enrolled in our study. Patients were followed for more than a year after catheter removal and internal jugular vein (IJV) patency was assessed by Doppler ultrasound.

Results: 87 neonates were undergone central venous catheterization while just 18 were participated in our study protocol successfully. Mean age at the time of catheterization was 16.22 ± 8.14 days. Doppler ultrasound assessment was arranged meanly 29.2 ± 6.53 months after catheter removal. Doppler ultrasound studies revealed normal patency in 38.9%, stenotic in 27.8% and occluded in 33.3% of cases. Mean age of catheterization was significantly lower in occluded IJV group while no meaningful correlation was detected between venous thrombosis and patient gender or catheter maintenance time. IJV occlusion rate was not related to the indication of catheterization

Conclusion: It is necessary to keep in mind the probability of IJV thrombosis and occlusion among those patients with the history of early neonatal ICU admission and CV catheterization. Ultrasound evaluation could be helpful while re-cannulation will be the best option for those with patent IJV to save the contra lateral venous patency.

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Introduction

Central venous catheterization is a helpful technique in treatment of ill children and specially neonates. Maintaining a vascular

access is a common procedure in neonates specifically for those who needs prolonged hospitalization or intensive care support, administration of blood products, some medications and also total parenteral nutrition (1). Internal jugular vein is one of

*Corresponding author: Reza Shojaeian, Endoscopic and Minimally Invasive Surgery Research Center, Mashhad University of Medical Sciences, Mashhad, Iran. Address: Sarvar Children's hospital- Dr Sheikh St - Gharani Ave- Mashhad - IRAN. Tel: +989155150923, Fax: +985117249025, E mail: Drshojaeian@ymail.com

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the best options to provide a central venous line in neonates. This procedure could be done percutaneously with or without ultrasound guide or conventionally by open exploration of neck in right lateral region, catheter insertion via a small venotomy in internal jugular vein, and venorrhaphy under general anesthesia (2). Percutaneous catheter insertion could be done by ultrasound guide using Seldinger technique and even as a bedside procedure (2, 3).

The profound impact of the complications associated with central venous catheter usage is highly important while the efforts to minimize and prevent their occurrence should be a routine element of quality improvement programs (4). Several complications are reported either while insertion such as Pneumothorax, Mal-positioning of a catheter and Puncture of the carotid artery and bleeding or also during the time of maintaining the catheter such as infection and thrombosis and even while Extraction of the catheter like air embolism and breakage, separation from the hub, knotting of the catheter or guidewire and retained catheter fragments or tip thrombosis (1, 4).

Long term complications are also reported during follow up such as venous stenosis or thrombosis that may cause portal hypertension after umbilical vein catheterization or head edema in bilateral jugular catheterization (5).

Neonates in NICU with complex congenital disease are mostly required several admission while a central venous access is an integral part of care every time. It is very important to save the patency of limited accessible routes for further usage. Regarding this fact, most pediatric surgeons try to use minimally invasive methods or repair the central vein meticulously to maintain the venous function while the patency of internal jugular vein (IJV) is a major concern at the time of surgical consult to maintain a central venous catheter among patients with previous history of vascular intervention. We aim to evaluate the patency of internal jugular vein after previous open catheterization in this study.

Material and Method

This is a retrospective single surgeon study of children who underwent open surgical cut down of internal jugular vein in neonatal period during ten years in a referral academic children's hospital for surgical neonatal care [Sarvar children's hospital (Mashhad-Iran)]. Our data mining in electronic health recording of the hospital was performed using the national operation code for open surgical cut down of central vein to identify our intending cases during the time period.

We reviewed all medical records of these patients during 10 years (2008-2018). All term neonates (age less than 28 days and delivery between 37 to 41 weeks of gestation) with documented internal jugular vein cut down and catheterization following a same protocol as open venotomy and further venorrhaphy who discharged from hospital alive, were enrolled.

A 3F silicon catheter was inserted to the internal jugular vein during an open exploration and venotomy. The length of inserted catheter has been set using anatomic land marks (second intercostal space was assumed as a surface indicator for cavo-atrial junction). Surgical intervention was accomplished in operation room under general anesthesia and after a primary echocardiography for assessment of major congenital heart anomalies and central venous patency and anatomy among those patients with abnormal clinical findings or syndromic disorders.

Those with known thrombotic disorder or any hematologic disease, internal jugular ligation during operation, congenital heart anomalies or abnormal flow or location of IJV were excluded from study. Patients who encountered catheter related complications such as catheter malfunction or displacement or infection and sepsis were also excluded.

The procedure was done with the patient in supine position, with a roll under the shoulders for neck extension while tilting to the left, the head was secured to the table by adhesives. After making a small transverse incision on the lowest third of right sternocleidomastoid muscle (SCM), the exploration was continued deeply through

the SCM muscle by sharp dissection. The platysma was transected. The SCM was dissected bluntly along its fibers to reach the anterior surface of the internal jugular vein (IJV). Then the IJV was dissected from the Vagus nerve and carotid artery to achieve proximal and distal control.

IJV catheterization was accomplished via a small venous stab incision by a No 11 blade and further venorrhaphy by 6-0 non absorbable (Prolene) X stitch. We considered the superior vena cava to right atrium junction as the optimal catheter tip position (6). In this light, we used the surface anatomy landmarks including supra sternal notch and manubrio-sternal joint to estimate the indwelling catheter length. The catheter proper position was confirmed by chest x-ray.

Central vein catheter was removed at the time of leaving the hospital or later as a secondary procedure for those with totally implantable ports. Patients were followed for more than a year and IJV patency assessment was planned by a phone call follow up to arrange an appointment for a screening Doppler ultrasound study of central neck venous system and assessment of central venous patency.

Follow up imaging studies for assessment of neck vessel patency included venous Doppler ultrasounds with Samsung model WS80A by linear probe in 3-12 frequency.

IJV was considered to be patent if there was less than 70% luminal narrowing in compare to contralateral internal jugular vein by two dimensional imaging in any imaging plane (7). Asymmetrical decreased flow rate (A high velocity linear flow or turbulence) in the intervention side compare to intact side IJV was considered as stenosis.

Age, gender, reason of admission, purpose of catheter insertion, catheter type and the time period from catheter insertion to removal were also recorded. IJV patency was evaluated by a single radiologist using Doppler ultrasound.

This study was approved by Mashhad University of Medical Sciences Research ethics committee (IR.MUMS.MEDICAL.REC.1398.307).

Then we analyzed the findings using SPSS 11.5 for statistical analysis. P Value less than 0.05 was indicated a statistically meaningful difference.

Results

78 neonates were underwent central venous catheterization during the study time period. 35 patients were excluded regarding our exclusion criteria. 43 neonates we enrolled in the follow up program while just 18 were participated in our study protocol successfully (Figure 1).

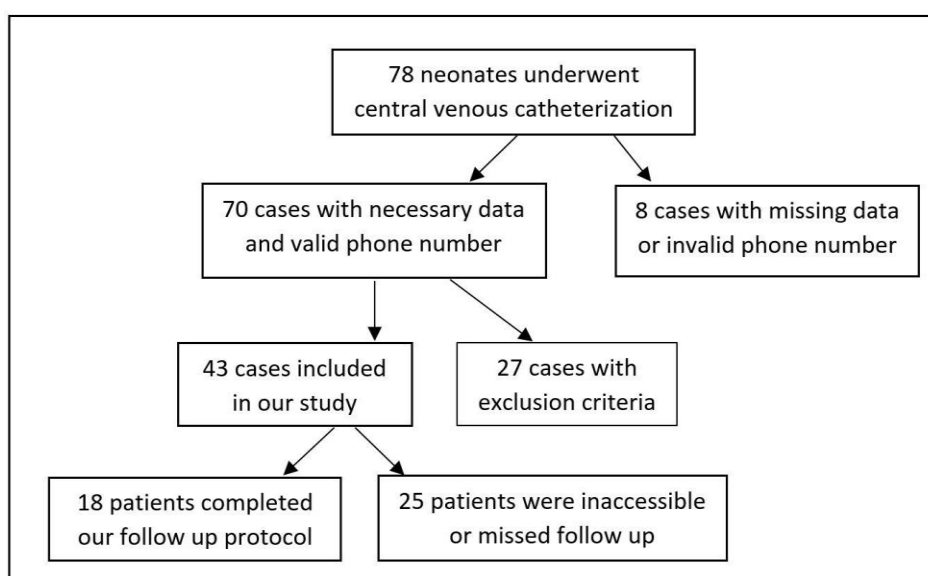


Figure 1. Study data mining and methodologic case selection diagram

Among these 18 patients, 9 cases were male and 9 patients were female. Mean age at the time of catheterization was 16.22 ± 8.14 days while the youngest patient was a 3-day and the eldest was a 30-day neonate.

The catheter was removed at the time of releasing from hospital in most of patients. Mean time of catheter maintaining was 29.5 ± 28.56 days. Patients were followed at least for 1 year and Doppler ultrasound assessment was arranged meanly 29.2 ± 6.53 months after catheter removal.

Indication for central venous catheterization was consisted of congenital gastrointestinal anomalies (GI atresia or malrotation and etc.) in 7, acquired gastrointestinal anomalies (Necrotizing enterocolitis or mid gut volvulus and etc.) in 3, short bowel and total parenteral nutrition in 2 and lack of peripheral venous access in 8 neonates.

External catheter was induced for 12 patients (66.7%) while total implantable port was inserted in other 6 (33.3%) patients.

Doppler ultrasound studies revealed normal patency in 7 (38.9%), stenosis in 5 (27.8%) and occlusion in 6 (33.3%) of cases.

Comparing different variables among patients with patent and occluded internal jugular vein is summarized in table 1.

As it showed, mean age was significantly lower in occluded IJV group while no meaningful correlation was detected between venous thrombosis and patient gender or catheter maintenance time.

Occlusion rate in externalized CV line was 25% and in totally implantable CV line was 33.3% ($P = 0.710$).

IJV occlusion rate among patients who underwent central venous catheterization was 20% in those with congenital GI anomaly, 33.3% in those with acquired GI anomaly, 50% in patients who needed TPN

and 25% in neonates who needed a central venous access. Comparing IJV occlusion rate among patients regarding the indication of catheterization, we didn't detected any significant difference between different groups while p value was 0.868.

Discussion

The use of percutaneous central venous catheters have a great role for the preparation of parenteral nutrition and intravenous drug treatment in newborns. They have become an important part of the treatment of very low birthweight newborns in most intensive care units (8, 2). Internal jugular vein is the preferred central venous access in neonatal period (9) while some articles suggested the external jugular vein induced central catheter as a safe alternative (8).

Technique of percutaneous central venous catheter insertion in the newborns may vary among different pediatric surgery departments. The technique of central venous access placement may be chosen according to the indication, age of patient, estimated catheter maintenance time and accessible devices and skill (2).

Peripherally induced central catheter (PICC) or percutaneous Seldinger method with or without ultrasound guide are considered as the least invasive methods although PICC may not be applicable in very low birth weight neonates and its complication rate is relatively high (10). In our center, this procedure is performed in the setting of open technique under general anesthesia in operating room with open neck exploration and IJV cut down and further venorrhaphy while some other colleagues believe that the tiny neonate IJV will become occluded by the indwelled catheter and in this light they decide to ligate the proximal ipsilateral IJV after insertion of catheter (11).

Table 1: comparing study variables between two groups of patients with or without IJV Occlusion

Study variable	Patent IJV	Occluded IJV	P Value
Male / female ratio	6(46.2%) / 7(53.8%)	3(60%) / 2(40%)	0.599
Age at catheterization (days)	19.15 ± 7.55	8.6 ± 3.2	0.021
Catheter maintaining time (month)	29.3 ± 28.9	30.2 ± 34.7	0.827

This study was designed to evaluate the outcome of central venous catheter insertion and further venorrhaphy at least six months after catheter removal. The results will help the physicians to make a better decision for those neonates who needed frequent admissions and sometimes, CV line reestablishment.

Overall occlusion rate was 33.3% among our cases while IJV thrombosis and occlusion after neonatal catheterization was significantly more common in intervention during first days of life. Other variables such as catheter type, time of catheter maintenance and the underlying disease were not correlated to IJV stenosis or occlusion.

Animal model studies reported some histological changes adjacent to the central venous catheter in an un-ligated vein wall after open cut-down and catheterization in rats (12). Endothelial trauma and inflammation due to foreign body insertion may initiate IJV damage while anatomic narrowing at the venorrhaphy site may also lead to venous thrombosis and occlusion.

Rate of occlusion after IJV cannulation for extracorporeal membrane catheterization was observed as 22% by Kurkluoglu et al (13). Expected complication rate of central venous catheterization supposed to be even higher among low birth weight neonates (14). Our study also revealed higher occlusion rate in younger surgical neonates.

IJV thrombosis and occlusion may happen even at the time of maintaining catheter as the rate of CVC obstruction among neonates in intensive care unit is reported as high as 36% by Gomes et al (15).

Considering frequent admissions of neonates with congenital anomalies and repeated consults for CVC placement and in the light of our findings and review of the literature we recommend meticulous surgical technique in IJV catheterization in neonatal period.

Conclusion

It is necessary to keep in mind the probability of IJV thrombosis and occlusion among those patients with the history of

early neonatal ICU admission and CV catheterization. Ultrasound evaluation could be helpful while re-cannulation will be the best option for those with patent IJV to save the contralateral venous patency.

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Declaration of conflicting interests

The Authors declare that there is no conflict of interest for this study.

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