Ain Shams University

Faculty of Medicine

Department of Anesthesia, Intensive Care and Pain Management.

Venous Access In Pediatric Anesthesia And Intensive Care

An essay submitted for partial fulfillment
Of The Master Degree of Anesthesia

By
Mohammed Farouk Abd El monem Mohammed

M.B.B. Ch .

Supervision by

Prof. Dr. Gamal Fouad Saleh Zaki

Professor of Anesthesia and Intensive care
Faculty of Medicine
Ain Shams University

Prof. Dr. Noha Mohamed Elsharnouby

Professor of Anesthesia and Intensive care
Faculty of Medicine
Ain Shams University

Dr. Fady Adib Abd El malek

Lecturer of Anesthesia and Intensive care
Faculty of Medicine
Ain Shams University

Faculty of Medicine
Ain Shams University
2014

Acknowledgment

*Thanks first and last to **ALLAH** as we owe him for his great care, support and guidance in every step in our life.*

*I would like to express my deeply felt gratitude to **Prof. Dr.Gamal Fouad Saleh Zaki,** Professor of Anesthesiology and Intensive Care, Faculty of Medicine, Ain Shams University, for giving me the chance of working under his supervision. I appreciated his constant encouragement.*

*Many Thanks for **Dr. Noha Mohammed Alsharnoby,** Professor of Anesthesiology and Intensive Care, Faculty of Medicine, Ain Shams University, for her kind supervision and great help.*

*Great appreciation and gratitude to **Dr. Fady Adib Abd El malek,** Lecturer of Anesthesiology and Intensive Care, Faculty of Medicine, Ain Shams University,for his great efforts, valuable guidance and great concern that really supported the work.*

Finally, I cannot forget the support & patience of my lovely family.

Mohammed Farouk Abd El monem

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ATLS	Advanced Trauma Life Support
CVC	central venous catheter
CVP	central venous pressure
EMLA	eutectic mixture of local anesthetic
ICU	intensive care unit
IJV	internal jugular vein
IO	intraosseous
IV	intravenous
NIR	near-infrared
PALS	Pediatric Advanced Life Support
PICC	peripherally inserted central catheter
SCV	subclavian vein
SVC	superior vena cava
US	ultrasound

INTRODUCTION

Intravenous cannulation is one of the most widespread medical procedures performed in children ***(Zempsky WT, 2008).***

Pediatric intravenous cannulation is an integral part of modern medicine and is practiced in virtually every health care setting. Venous access allows the sampling of blood, as well as administration of fluids, medications, parenteral nutrition, chemotherapy, and blood products ***(Scales K, 2008).***

Peripheral vascular access in pediatrics can be very challenging especially in small, obese, or dehydrated children or in those with previously failed venipuncture ***(Oakley E and Wong A-M, 2010).***

Multiple puncture attempts cause pain and distress, and increase the risk of complications, such as hematoma or nerve injury ***(Kennedy RM, 2008, Newman BH, 2004).***

Visualization of veins that are invisible to the naked eye could be an aid to facilitate intravenous punctures ***(Doniger SJ; et al., 2009).***

Ultrasound guidance increases the likelihood of successful peripheral cannulation in difficult-access patients ***(Egan G; et al., 2013).***

Transillumination with visible (mostly red) light might be another option; however, penetration depth of visible light is limited and therefore most suitable for neonates ***(Goren A; et al., 2001).***

Central venous lines are essential in anesthesia for major surgical procedures, for treatment in the ICU as well as for nutrition and drug administration in patients with enteral malnutrition or malignancy .The most common insertion sites are the access via the femoral vein, the internal jugular vein and the subclavian vein. In addition in neonates, there are possibilities for peripheral access with long line silastic catheter via the cubital or the saphenous vein ***(Trieschmann U; et al., 2007)***.

Advantages of ultrasound-guided central venous catheterization include identification of the vein, detection of variable anatomy and intravascular thrombi, and avoidance of inadvertent arterial puncture. It is safer and less time consuming than the traditional landmark technique ***(Kumar A and Chuan A, 2009, Lamperti M; et al., 2012).***

Umbilical vein catheterization may be a life-saving procedure in neonates who require vascular access and resuscitation. The umbilical vein remains patent and viable for cannulation until approximately 1 week after birth. After proper placement of the umbilical line, intravenous fluids and medication may be administered to critically ill neonates ***(Butler-O'Hara M; et al., 2006).***

Peripherally inserted central venous catheters (PICC) are the other type of catheters which are inserted through peripheral veins and can diminish the complications of conventional central catheters ***(Matsuzaki A; et al., 2006, Yamadi R; et al., 2010).***

The insertion of this device involves a puncture of a peripheral vessel and intravenous progression of the catheter until its tip reaches the central venous system ***(Costa P; et al., 2009).***

The use of Intraosseous access has gained acceptance over the past 15 years, but the technique has been used since the 1930s. Intraosseous access techniques have fewer serious complications than central lines and can be performed much faster than central or peripheral lines when vascular collapse is present ***(Neuhaus D; et al., 2010).***

The venous cutdown has largely been replaced by central lines ***(Boon JM; et al., 2007)***.

However it remains an excellent alternative when other approaches have failed ***(Chappell S; et al., 2006).***

CHAPTER 1:

ANATOMY OF THE MOST COMMON VEINS ACCESSED

ANATOMY OF THE MOST COMMON VEINS ACCESSED

I. The Internal Jugular Vein:

The Internal Jugular Vein (IJV) can be used as a route of access for any part of the systemic venous system. It is chosen because it is a large superficial vein that has reasonably consistent surface landmarks and easy ultrasound visualization, making cannulation generally predictable ***(Sheppard DG; et al., 1998)***.

In addition, the straight course into the superior vena cava (SVC) means that devices do not have to traverse corners, and the catheter tip generally passes into the SVC or right atrium, so reducing the requirement for screening during insertion. This also allows the insertion of large bore and relatively inflexible devices ***(Sheppard DG; et al., 1998)***.

The IJV commences at the jugular foramen in the posterior cranial fossa as the direct continuation of the sigmoid sinus. From the dilation at its origin, the superior bulb of the IJV, the vein runs inferiorly through the neck in the carotid sheath (figure 1) with the internal carotid artery superior to the carotid bifurcation and the common carotid artery ***(Yang WT; et al., 1998)***.

The vein lies laterally within the sheath, with the nerve located posteriorly. The cervical sympathetic trunk lies posterior to the carotid sheath and is embedded in the prevertebral layer of deep cervical fascia. The IJV leaves the anterior cervical region by passing deep to the sternocleidomastoid muscle. Posterior to the sternal end of the clavicle, the IJV unites with the subclavian vein (SCV) to form the brachiocephalic vein ***(Yang WT; et al., 1998)***.

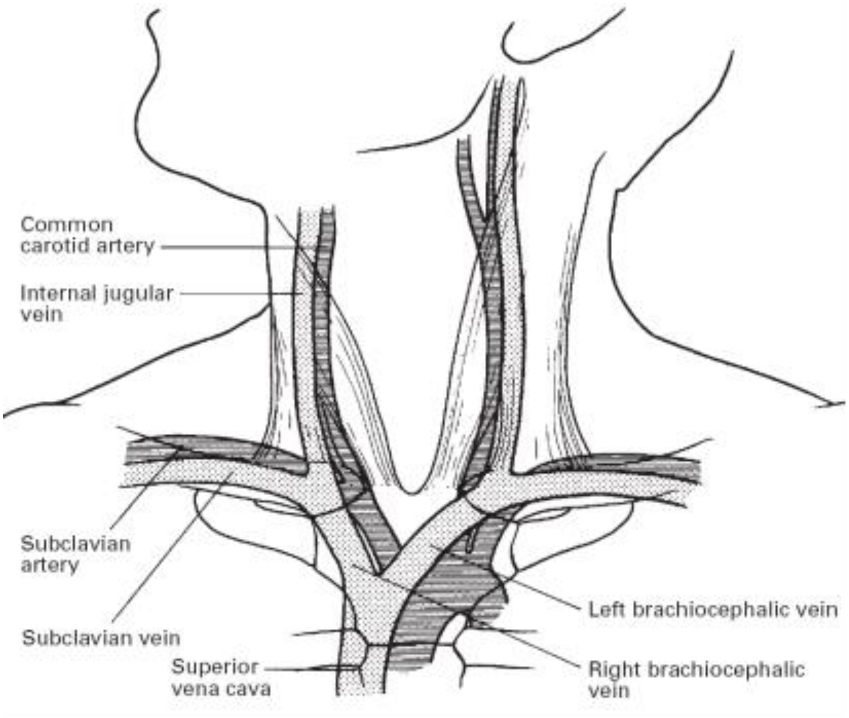

Figure (1): The great vessels of neck ***(Yang WT; et al., 1998)***.

II. The Subclavian Vein (SCV):

The SCV, the continuation of the axillary vein, extends from the outer border of the first rib to the sternal end of the clavicle, where it unites with the IJV to form the brachiocephalic vein (figure 1). It is in relation, in front, with the clavicle and subclavius; behind and above, with the subclavian artery, from which it is separated medially by the scalenus anterior and the phrenic nerve. Below, it rests in a depression on the first rib and upon the pleura. At its junction with the internal jugular, the left subclavian vein receives the thoracic duct, and the right subclavian vein receives the right lymphatic duct ***(Giaufre E; et al., 1996)***.

III. The Femoral Vein:

The femoral vein is widely used for central venous catheterization. It is often considered a safer option compared to other sites, but the anatomy is more complicated than commonly realized ***(Bosenberg A; et al., 2003)***.

The femoral vein accompanies the femoral artery through the upper two-thirds of the thigh (figure 2). In the lower part of its course it lies lateral to the artery; higher up, it is behind it; and at the inguinal ligament, it lies on its medial side, and on the same plane. It receives numerous muscular tributaries, and about 4 cm below the inguinal ligament is joined by the vein profunda femoris; near its termination it is joined by the great saphenous vein. The valves in the femoral vein are three in number ***(Giaufre E; et al., 1996)***.

Use of the femoral vein can be for either short- or long-term use. Advantages of the femoral approach include the straight route of access to the inferior vena cava and its ease of access. As a result of its straight course, the long length of the inferior vena cava and the absence of the pleura, X-ray verification of the position of the catheter is not generally required ***(Marhofer P; et al., 1998)***.