影像导引下中央静脉长期留置导管的置放:技术与失误

摘要:在美国每年约有 50 万患者放置各类中央静脉导管,用于进行化疗、长期抗生素输注、肠道外给养、长期而定时的血样监测、持续输液、血液透析等各种治疗。在外科手术室置放导管为一盲目的置管操作,其失败率可高达 9%,而且导管位置不当、气胸、血胸等手术并发症的发生率也比较高。对照之下,采用超声、透视等影像手段作引导,在血管造影机房内进行置管操作,手术就十分安全可靠,不仅可减少并发症,还可通过造影来明确有关静脉的解剖关系而有助于导管顺利到位。

本文以概要的方式列出有关中央静脉导管的皮下药盒的置放技术,包括术前准备、导管及血管进路的选择、用超声或透视作引导的操作要点、导管及皮下药盒的置放技巧、以及术后护理和拔除导管的步骤。另外,对置管操作中较常遇见的困难和解决办法,以及术后可能发生的各种近期和远期并发症,也进行了简要的阐述。

Radiologically Guided Placement of Long – term Central Venous Catheters: Techniques and Pitfalls

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INTRODUCTION

Approximately 500,000 long term central venous access catheters are placed annually in the U.S.A. Tunneled Hickman catheters, double – lumen cuffed dialysis catheters and chest wall subcutaneous ports can all be placed either in the operating room (bling placement) or in the angiographic suite (imaging guided placement). Major concerns when placing these catheters include obtaining a suitable access site, avoiding complications of venipuncture, avioding pneumothorax, ensuring correct final position of the catheter and avioding infection.

USES OF CENTRAL VENOUS CATHETERS

Chemotherapy; Long – term antibiotic administration; Parenteral nutrition; Frequent blood samples; Transfusions; Hemodialysis; plasmapheresis (fig1)

COMPLICATIONS OF BLIND (SURGICAL) PLACEMENT)

Failure to gain access: 5 to 8.9%; Catheter malposition: 1.2 to 2.5%; Pneumothorax: 0 to 7.5%; Hemothorax: 0 to 2.5%; "Pinch – off syndrome" 0.6%。

IMAGING GUIDED ACCESS: POTENTIAL ADVANTAGES

(1) Identification of venous anatomic variants, venous stenosis and thrombosis.

(2) Direct visualization of the subclavian vein by ultrasound or injection of intravenous contrast.

(3) Reduce risk of pneumothorax by visualization of lung.

(4) Better control of catheter placement under fluoroscopy.

PREPARATION

Review CXR; if mastectomy, place catheter on contralateral side

Place IV line in ipsilateral

Administer 1 gram cefazolin IV

Sterile preparation

Identify target vein with ultrasound (7.5MHz transducer or if patient large, 5MHz) or by IV contrastand fluoroscopy

CAIHETER SELECTION

All catheters for long term venous access are made of silicone, and are either attached to a subcu-

taneous access port, or have a dacron cuff close to the skin access site. The portion of the catheter with the dacron cuff lies in a subcutaneous tunnel which runs from the skin exit site to the venous puncture site. The catheter may have one to three lumens, and size varies from 3 to 21 French.

Peripherally inserted central venous catheters are also available, with oor without subcutaneous ports. They range in size up to 5.8 French and are often placed by specially trained nurses. (Fig2)

Tunneled catheters for long term intravenous therapy include a number of different makes, the commonest in our practice being the Hickman.

Characteristics of the Hickman include: single, double or treple lumen, needs to be flushed daily, cut length to fit patient.

Dialysis catheters (Permacath/Vascath) are a fixed length and have an appearance similar to the Hickman catheter, the major difference being the size of the double lumen which is wide for the purpose of dialysis. Insertion is identical to the technique used for Hichman catheters, the one difference being that the length cannot be tailored to suit the patient. The catheters are heparinized following insertion to maintain patency.

Subcutaneous ports have been available since 1982. Their characteristics include: single or dual lumen, more defficult to place, lower infection rate (0 - 16%), flush once per month, access using 22 G port Huber needle, cosmetically more acceptable. (Fig.3)

GAINING VASCULAR ACCESS

Central venous access can be obtained through the axillary/subclavian veins, the internal jugular vein, the deep veins of the upper arm, the inferior vena cava and the hepatic veins. In practice the axillary/subclavian veins are the primary access.

The axillary or subclavian vein can be identified by ultrasound or injection of contrast under fluoroscopy.

Under fluoroscopy a site 2 to 3 cm inferior to the clavicle, lateral to the lateral border of the bony thorax, is selected, and 1% lidocaine infiltrated into skin.

A lateral approach is preferred, both to avoid the "pinch - off" syndrome, and to avoid lund. (Fig.4)

ULTRASOUND GUINANCE

If ultrasound is used, the transducer (7.5 MHz or if the patient is large 5 MHz) is held over the vein which is imaged in longitudinal section. The vein is easily identified because it is compressible, enlarges with the valsalva maneuver and does not pulsate.

A 21G 7.5 cm micropuncture needle is used to gain access, attached by short flexible tubing to a syringe for aspiration to comfirm venous access. The needle is angled at 20 degrees from the sken surface. If the patient is large, a 20G Chiba needle may be required instead.

The needle tip is advanced under ultrasound and identified before final pass into the subclavian vein by moving it from side to side. It is necessary to see the needle tip to avoid arterial puncture.

Longitudinal US image of the axillary vein shows the needle indenting the wall of the vein (Fig.5a white arrow). On the right the needle has entered the vein and is seen as a focal echogenic structure within the lumen (Fig.5b white arrow).

FLUOROSCOPIC GUINDANCE

We favor injection of contrast and fluoroscopic control. The needle tip can be seen tenting the vein and pleura can be avoided.

An initial injection of contrast is performed to select the venous access site.

During a second contrast injection the needle is advanced into the vein. The needle tip can be seen tenting the vein.

Free blood return indicates venous access, which can be confirmed by direct contrast injection

under fluoroscopy if indicated.

A 0.018 steerable guidewire is then passed through the needle to the superior vena cava and exchanged through a 5 French dilator for a 0.035 guidewire. At this point the tunnel or pocket for the subcutaneous port may be created.

The access is subsequently dilated to the required caliber to permit catheter placement.

ALTERNATIVE CHOICE OF ACCESS SITE

Internal Jugular Vein

The internal jugular (IJ) vein runs posterior and lateral to the carotid artry, between the two heads of sternocleidomastoid muscle. The IJ is punctured between the two heads of sternocleidomastoid, with the tip of the needle directed towards the ipselateral breast. This is simplified by use of ultrasound guidance. IJ access is favored for placement of dialysis catheters, because subclavian stenosis is a risk of placing a subclavian catheter, and this may interfire with functuon of a dialysis fistula.

Inferior Vena Cava

The patient is placed prone and the inferior vena cava is accessed percutaneously using a 21G needle. Ultrasound guidance or placement of a guidewire in the IVC as a target is helpful. If the patient is large and the 21G needle bends, an 18G needle can be used. The track is dilated and the catheter placed with its tip in the right atrium.

Transhepatic access

Under ultrasound guidance the IVC can be approached through the liver, or via the hepatic veins (usually the middle).

Hepatic veins

Performed as a transhepatic procedure in a manner simelar to transhepatic cholangiography.

CATHETER PLACEMENT

To create a subcutaneous tunnel a skin site near the venous access site is selected. In the case of subclavian catheters, a site lateral to the sternum, is chosen and infiltrated with lidocaine 1%. The tunnel is selected to run along an anterior rib interspace. A skin incision is made and blunt dissection into the subcutaneous tissues perfoumed. The entire subcutaneous tunnel from the venous puncture site to the skin exit site is infiltrated with local anesthetic. The catheter is attached to the back end of a tunneling tool provided in the manufacture's kit and pulled through the tunnel until its Dacron cuff is 1 – 3 cm into the tunnel. The Dacron cuff produces a fibrous reaction which acts as an anchor to prervent migration of the catheter, and as a barrier to infection. (Fig.6)

A large bore peel – away sheath is placed into the venous tract. Using a guidewire the distance from the venous access site to the right atrium is measured and the catheter trimmed to the appropriate length.

The catheter is then advanced through the peel – away sheath into the superior vena cava. The patient is instructed to perform a valsalva maneuver during removal of the dilator and introduction of the catheter into the sheath, in order to avoid an air embolism. When the catheter tip is in satisfactory position, the sheath is peeled back with a finger placed on the catheter to avoid accidental loss of access.

Suture both skin sites and dress exit site. The suture at the skin exit site is tied around the catheter for added stability.

Tape external catheter to chest.

CXR to exclude pneumothorax.

Confirm good blood return and forward flush catheter.

PORTACATH PLACEMENT

When placing portacaths, a site just inferior and medial to the venous site is chosen, usually in a rib space with sufficient tissue to accommodate a port. Lidocaine with epinephrine is used for local anesthesia. A subcutaneous pocket is fashioned with blunt dissection through an incision approximately 5 cm in length. The pocket should be created to en-

sure that the port does not lie under the incision. A tunnel is created from the pocket to the venipuncture site. Both pocket and tunnel should be flushed with an antibiotic solution.

The catheter is cut, tunneled and inserted as for Hickman catheters. Its proximal end is attached to the prot which may then be sited in the pocket.

Anchoring non – absorbable sutures (e.g. 4/0 Proline) are placed in the subcutaneous tissues of the pocket. When the port is placed, it is secured in the pocket with anchoring sutures, and the incision closed with subcutaneious absorbable suture (e.g. 4/0 Vicryl) and interrupted or running skin sutures.

FOLLOW UP

Oncology nurse care, regular catheter flush.

Remove sutures in ten days at subclavian puncture site, in three weeks at catheter exit site.

CATHETER REMOVAL

Aseptic technique; local anesthesia; secure hemostasis

Reincise to remove ports

PITEFALLS, EARLY COMPLICATIONS AND HOW TO AVOID THEM

Difficulty dilating the venous access

This may occur due to unfavorable angle of entry into the vein. The wire may buckle. This can be overcome by rotating the dilator while advancing, or using a stiffer guidewire.

Difficulty advancing catheter through sheath

If the angle of access into the vein is too steep, the sheath may kink and obstrust passage of the catheter. This is most common in large or obese patients and can be avoided by chosing a lateral skin entry site which may even be in the axilla but reduces the angle of venous access.

If it occurs it is overcome (a) by passing a hydrophilic guidewire through the catheter, which both stiffens its passage through the sheath and can be used to negotiate the kink.

(b) Alternatively a hydrophilic guidewire, is placed through the sheath into the central veins, preferably the IVC. The proximal end of the wire is then backloaded into the distal tip of the Hickman catheter. With this support, the catheter can usually be advanced past the kink in the sheath.

(c) If the sheath is severely kinked and cannot be negotiated, it may be replaced over a guidewire by a stiffer Teflon peel – away sheats.

Difficulty negotiating the central veins

The catheter may not advance readily from the brachiocephalic vein into the superior vena cava. It may be Malposition of catheter tip manipulated into place over a hydrophilic guidewire.

MALPOSITION OF CATHETER TIP

The tip of the catheter should be placed at the junction of the superior vena cava with the right atrium. More peripheral placement as in this example on the right increases the risk of the catheter thrombosis. The catheter tip may come to lie too peripheral in obese patients (especially female), as sagging of the soft tissues when the patient assumes the upright position will cause the catheter to withdraw. The catheter should therefore be cut long in these patients. To ensure catheter length is sufficient, caudal retraction on the breast with the catheter in situ will simulate gravity and show the final position of the catheter.

The catheter tip nay also come to lie in the azygous vein; the tip is more likely to be occluded againgst the side wall of the vein.

If the catheter is found to be malpositioned and the sheath has been removed, the tip of the catheter can be snared by a "gooseneck" snare introduced via the femoral vein.

Early mechanical obstruction

Tip against vessel wall ; Catheter clamped; Suture too tight ; Anatomec blockage.

The radiograph shows a catheter obstructed at the sken exit site because the silk suture bas been

tied too tinhtly around the catheter.

Pneumothouax

This is rare with use of imaging guidance and can be treated in the standard manner. It is more common in emaciated patients.

Nerve Damage

Like pneumothorax, far less likely with imaging guidance.

Hematoma

May occur with inadvertent arterial puncture, but is minimized by use of 21G meedle. Incorrect heparinization of the catheter can also cause bleeding if excessive heparin enters the circulation.

Vessel perforation

The wall of the SVC can be perforated by the rigid sheath – dilator combination. This can be avoided by not advancing the sheath beyond the brachiocephalic vein.

This Hickman catheter check shows comtrast opacifying the right hemithorax because the catheter tip is extravascular.

Air Embolism

May occur if patient inhales while dilator is removed prior to passing catheter through sheath. Most patients can cooperate to hold their breath in the Valsalva maneuver for this part of the procedure, but squeezing the sheath shut during the exchange minimizes the resk.

Unsuitable placement of the subcutaneous port or rotation of the subcutaneous port

The port must not be sited under the shin incision used to create the subcutaneous pocket, as this will make access painful for the patient. If the port is not sutured in place it may flip and the metal undersurface will make access impossible.

Lacerated catheter

The catheter may leak, due to being inadvertently damaged during insertion. Theexample on the right shows a catheter which leaked due to a laceration caused during suturing at the time of placement.

Fragmented catheter

"Pinch – off syndrome" is the term used to describe a catheter which becomes compressed when access to the subclavian vein is medial to the junction of the first rib and clavicle. Radiological insertion tends to be more lateral and "pinch – off syndrome" therefore is more a problem associated with surgical placement.

The catheter may fragment, as shown on the right.

LONG TERM COMPLICATIONS

	Surgical Placement	Radiological Placement
Infection < 30 days	3 – 13%	8.9%
Infection > 30 days	30 – 45%	30%
Removal because of infection	8%	7%
Thrombosis	10%	5%
Fibrin sheath formation	1.4%	1.4%

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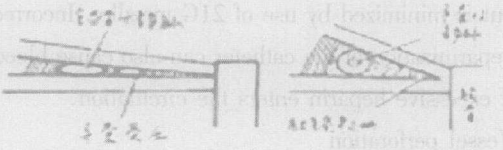
fig1



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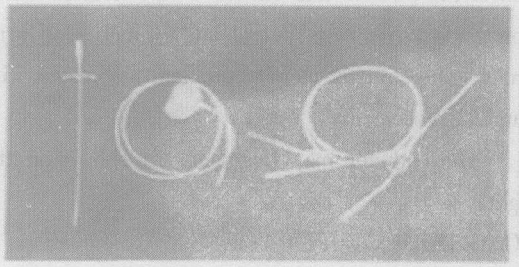

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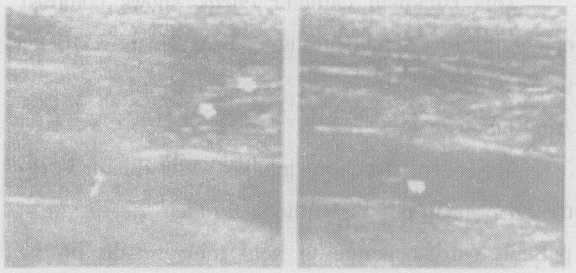

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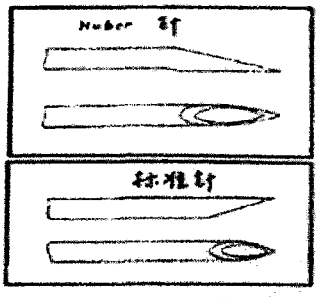

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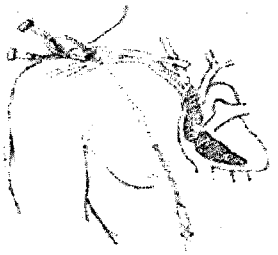

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