Blood samples, intravenous infusions and arterial punctions in thalidomiders with short arms

Puncture of veins or arteries for diagnostic or therapeutic procedures may prove very challenging in thalidomiders with upper extremity impairment due to altered anatomy of blood vessel localization.

Definitions:

Venous blood sample:

Venous blood samples are a standard diagnostic procedure with in- and outpatients.

Puncture of the vein is usually done with a small flexible or rigid needle at the forearm or the back of the hand, (the latter being more painful). Puncture in the inner region of the elbow is less painful but puncture of this region should be limited to emergency situations since the vein in this region is very easy to identify. The Needle is pulled out immediately after the blood sample is drawn.

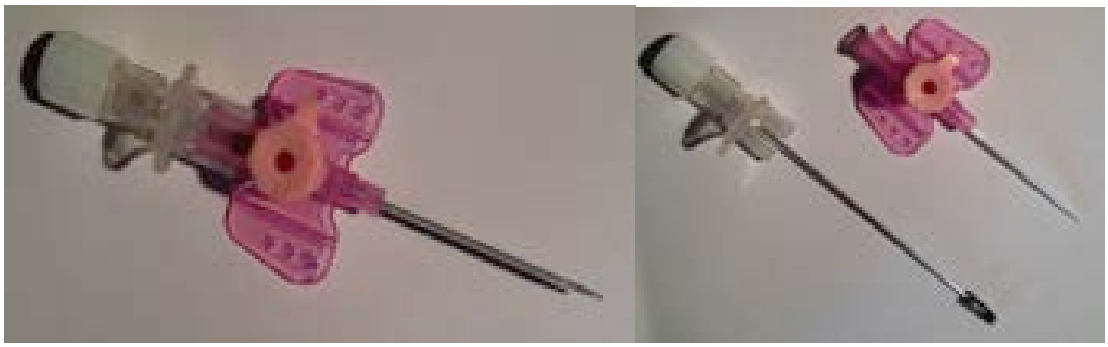
Picture: typical so-called Butterfly (flexible puncture device) Note short needle (approx.. 0.5 inch)

In case of visible veins on the arms or hands of thalidomiders it seems advisable to use flexible puncture sets like a butterfly with a short needle. The back of the hand of thalidomiders with typical club hand deformations is often not flat but rather rounded, making puncture with a

long rigid needle difficult.

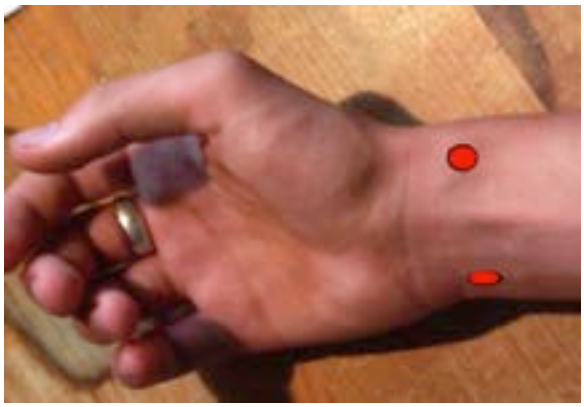
Intravenous infusions:
Intravenous puncture for therapeutic use means that a device is inserted into the vein and stays there for hours or days in order to infuse liquids, medication or blood. Intravenous application of drugs and liquids is much faster than oral application. Higher blood levels of the therapeutic agents are achieved because the drug is not metabolized in the liver as in oral application (no first pass effect).

Cannulation is achieved as follows:
A flexible tube that is kept rigid by a hollow needle (stylette) inside is used to puncture the vein. As soon as blood becomes visible at the other end of the needle, the flexible tube is carefully pushed forward into the vein and the stylette is pulled out. The flexible tube (catheter) is fixed to the skin with a band-aid and is connected to the infusion set. The catheter is flexible and the tip itself is blunt, thus reducing the risk of internal blood vessel injury by movement of the hand.



puncture set before (left) and after(right) puncture. Only the pink part in the right picture stays in place….

Arterial puncture:
Arterial puncture is used to assess blood gasometry or to monitor blood pressure. It is further used as point of entry for coronary catheter. Puncture site is either one of the wrist arteries (radial of ulnar artery) for blood gases assessment or invasive blood pressure monitoring and inguinal/femoral (groin) artery for coronary catheter (access via wrist arteries becomes more and more common for coronary catheter)



common sites for arterial punction

Proof of positive blood flow in both wrist arteries is mandatory prior to puncture because in rare cases, one oft he arteries my be absent. In this case, puncture of the remaining artery is not allowed since injury of the only wrist artery can result in complete loss of the hand.

While in assessment of blood gases only a very thin needle is used and is immediately withdrawn after measurement, the probe for intraarterial blood pressure remains inside the blood vessel for days or weeks.

The best site for all blood vessel punctures is a localization with thin skin over very little fat tissue, thus enhancing visibility and accessibility of the blood vessel.

Vessel diameter of veins can be augmented by application of a tourniquet or cuff at the upper arm, making identification and puncture of the vessel easier since blood enters the arm via the arteries but cannot leave the arm via the veins because of the tourniquet.

This is not possible in arterial puncture. Arterial puncture is a blind puncture of a blood vessel whose localization is determined by common medical knowledge and palpation of a pulse. The localization of arterial vessels is more or less constant in healthy individuals whereas anatomical localization of skin veins widely varies.

Application of the above mentioned cuff enhances blood volume in the veins, making identification and puncture of the vein easier and reducing the risk of perforation of the entire vein by the needle.

Enhancement of blood volume in veins after (below) application of a tourniquet for 30 seconds

Venous puncture of vessels in healthy individuals may prove difficult e.G. in case of obesity.

According to own unpublished data, position of intravenous peripheral catheters was accomplished on the first attempt in 90% of the cases and in 9% after several attempts. In 1 %, a central venous line was necessary (Emergency room, approx.. 4.000 Patients in 18 months)

A normal healthy lower arm is important for successful cannulation of arterial and venous blood vessels.

Puncture ov venous vessels in thalidomiders with upper extremity defects

The majority of the thalidomiders suffers from upper extremity defects making blood vessel puncture very difficult even for the experienced nurse / doctor.

As in healthy individuals, puncture of arm / hand veins should not be given up too quickly in favor of groin vessel puncture, the latter being more painful and bearing the higher risk of complications (infections).

Three visible hand veins after application of a tourniquet for 1 minute in a typical thalidomide club hand. The vein in the middle of the picture with its apparently straight position for an inch should be chosen for puncture. Because of the curved surface of this hand, a flexible blood puncture set like a butterfly should be considered.

In case of hospitalization, it must be taken into consideration, that autonomy of thalidomiders usually bears no redundancy. A hand with an infusion usually means that the patient cannot go to the toilet alone anymore.
Since almost all thalidomiders with hand defects have thumb aplasia, opposition of fingers is achieved by use of both hands. One handed opening of button / fly of pants is not possible. On top of this, usage of urinary bottles for the bedridden is not possible with short arms.

This is not evident for nurses and doctors and patients should tell them so. Often, fixation oft he free part oft he infusion tube on the arm or the shoulder prevents it from getting in the way all the time and may present the critical detail to maintain toilet autonomy.

There are alternative access points for venous puncture that fell to oblivion in times of peace: During war times, multi-amputated patients had made search for alternative puncture sites a necessity.

1.) Femoral vein:
This is the best alternative for drawing blood samples if puncture of the arm veins is impaired. The femoral vein is of large diameter and can be punctured easily. Complication rates (infections) are higher than in puncture of hand veins.
This is why permanent intravenous infusions should not be placed at this location.

2.) Lower leg / foot veins:
The next possible site for a blood sample are the veins of the lower leg. In case of an emergency, an inravenous cathether may be applied here but the long term complications (dislocation, thrombophlebitis, thrombosis) is high. Puncture of leg veins is surprisingly painful.

3.) Neck veins:
The jugular vein at the side of the neck can easily be increased in diameter for easy puncture if the patient is in a supine position with the legs slightly elevated and the head down (shock position).

Puncture at this localisation site should be carried out by the experienced only. Injury of delicate structures in the proximity oft he jugular vein, a pneumothorax or a thrombosis are possible complications in case of a jugular cathether. Special attention must be given to the risk of intravenous air aspiration which can easily lead to a fatal air emboly and cardiac failure.

4.) Intraosseous infusion:
this is achieved by a puncture of the tuberositas tibiae (shin region, approx. 7 cm below knee cap) with a special and strong needle. The tibia (shin) is hollow and is filled with bone marrow. Supprisingly large amounts of liquids can be infused with this procedure that proved successful many thousand times in war medicine. Today it is frequently used with children and does not have a high complication rate (infections) within the first 24 hours. However, diagnostic blood samples are not possible with this approach.

5.) Intraperitoneal infusion:
this is achieved by simple punction oft he abdominal cavity. Large amounts of liquid can be infused this way due to enormous peritoneal resorption capacity. However, diagnostic blood samples are not possible with this approach.

6.) Central venous access:
In case of a scheduled hospital admission, the following 2 methods have proven successful in case of difficult venous situations:

- central venous catheter:
one of the larger body veins in the clavicle region of the body is punctured and a thin catheter is advanced towards the upper hollow vein (vena cava superior). Complication rates are very low and patients can walk around or go home over the weekend with such a device, the external part of the closed tube being carefully bandaged.

- port-a-cath systems: a port-a-cath is a small hollow metal cylinder that is surgically implanted beneath the skin of the thora. An internal catheter connects the port to a large vein. Facing outwards, towards the skin, the

cylinder has a membrane through which drugs can be injected and blood samples can be drawn repeatedly. Puncture of the port is done with a special needle that is removed after drawing a blood sample or after infusion of liquids or medication. Puncture causes a lot less pain than a normal puncture of a peripheral vein. While Ports are used mostly to treat hematologic and oncologic patients, they may represent a feasible solution in case of severe problems to find a suitable peripheral vein in thalidomiders who need frequent venous punctures for diagnostic or therapeutic reasons. The port is usually inserted in the upper chest region, just below the clavicle or collar bone, leaving the patient's hands free.

Port-a-cath: the lower metal part oft he device is implanted under the skin of the collar bone region. The upper part is the puncture needle.
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Puncture of arterial vessels in thalidomiders with upper extremity defects

Like in healthy individuals, proof of blood flow in both wrist arteries is mandatory prior to any attempt of arterial puncture of a wrist artery. In case of upper extremity defects, severe and unexpected alterations of blood vessels are to be expected in thalidomiders.

In some cases, thalidomiders with only very slight impairment oft he upper extremity , e.g. hypoplasia oft he thenar bulge, showed complete absence of the radial artery. In case of only one remaining wrist artery, puncture of this vessel should not be attempted.

Alternative puncture localizations are the femoral artery or, in case of severe tetradysplastic thalidomide malformations, the subclavian artery.