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Ultrasound-guided venous access: "Wire-loaded puncture" technique for paediatric cancer patients

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ABSTRACT

Ultrasound-guided venous access is becoming a standard technique in many centers worldwide. In small veins and in the pediatric population, successful venous puncture is sometimes followed by resistance in passing the wire. The needle seems to miss the small vein during syringe dismounting, wire mounting and wire advancement through the needle.

This work describes a "wire-loaded puncture" technique as a solution for this problem.

Patients and methods: Paediatric cancer patients who needed venous access for different indications were included in the study.

The wire-loaded technique is described in detail, with special emphasis on the pitfalls of needle guidance under ultrasound in the "out of plane" technique. One-hundred and thirty-nine (139) procedures were initially included using different ultrasound and different access sets. Different operators have participated in the work.

Data of patients were retrospectively collected.

Results: One-hundred and thirty-nine (139) paediatric cancer patients were initially included in the study. After exclusion of patients with inaccurate data registration, the number of patients decreased to 132.

The most common primary pathology was leukemia, 47 cases (33.8%), and Porta-cath was the most commonly used catheter in 70 (50.3%) cases. The right internal jugular vein (IJV) was the most commonly used vein for access in 111 (79.8%) cases.

The access was feasible in 130 out of 132 cases from a single puncture. No procedure related complications were recorded.

Conclusion: The "wire-loaded puncture" technique is a useful technique, particularly in small veins overcoming the relatively common problem of "resisting wire" after a successful vein entry. The technique has a reasonable learning curve and has shown to be reproducible by different operators, machines and venous access sets. A high resolution ultrasound machine is recommended.

Introduction

Paediatric cancer patients are characterized by their particular need for long term venous access to meet the demands of the treatment process.

Peripheral veins are out of favor, if ever available in this population, while central veins are often still small.

Accurate punctures on central veins minimize haematoma formation, that might lead to the loss of a good access site with the eventual interruption of the treatment cycles.

Ultrasound-guided venous access is becoming more or less a standard practice in many centers. It is often that despite a successful puncture by the needle, the wire fails to pass smoothly.

The explanation of the problem is as follows: the manipulation done to dismount the syringe and mount the wire and then pass it along the length of the needle to reach the tip causes the needle tip to move from its intravascular position. This is particularly relevant in paediatric patients with their relatively small veins. In addition, the expansion and collapse of an already small vein following the

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pattern of respiration probably adds to pushing the tip of the needle out of position [1–10].

Low platelet counts add to the requirement of an accurate puncture technique in order to avoid haematomas.

Aim of the work

This work presents the wire loaded puncture technique for venous access in paediatric cancer patients as a solution to the problem of the resisting wire after an initially successful puncture.

Patients and methods

Patients included in the study were referred to the surgical department for venous access for one of the following indications, long term venous access for drug delivery, stem cell collection, drug delivery in the context of myeloablation and bone marrow transplantation, hemodialysis, and intracranial pressure decompression by ventriculoatrial shunting, between march 2015 and june 2017.

The technique described below has been applied for venous access for paediatric cancer patients in three different pediatric cancer centers in Cairo, Egypt. On purpose, patients operated upon by more than one operator have been included in the study.

Clinical data were retrospectively collected from the patients' medical records.

Ethical considerations and informed consents for the procedures were systematically done and adhered to all through the treatment process.

General anesthesia was used for all patients included in this study (general anesthesia with intubation or laryngeal mask placement) with a minimum of monitored anesthesia care, local anesthesia coupled with intravenous sedation.

Preparation

- The procedures were done under general anesthesia.
- Ultrasound machines used in the procedure varied in make and in resolution capacity.
- The probe was placed to obtain a transverse section in the right internal jugular vein (IJV). The left internal jugular vein, or common femoral vein were used in selected patients.
- Patients with platelet counts $\geq$ 20,000/μl were admitted to surgery with platelet concentrates being available and transfused intra-operatively and/or postoperatively as needed.
- Patients with platelet counts below 20,000/μl received platelet transfusion preoperatively.

Ultrasound machines used were:

1. Toshiba Xario 200 linear probe 11 MHz. Tokoyo, Japan.
2. BK medical, linear intra-operative probe 5–8 MHz. Herlev. Denmark.
3. Toshiba, My Sono U6, linear probe 12 mhz. Tokyo. Japan.
4. GE; Vivid cardiovascular, linear probe 8 MHz GE health care, Little Chalfont, United Kingdom.
5. Sonosite, M-Turbo. Linear probe 13–6 MHz Fujifilm Sonosite, Bothell, Washington, USA.

Catheters used were a range of totally implantable catheters (TIC), external tunneled catheters (ETC) and external catheters (EC) according to the indication of implantation. These included:

1. *TIC:* Port.-A-Cath.:
   - 5, 7, 9 French Infu- kit. Chanble, France.
   - 6 French. Perouse. France
2. *TIC:* Ventriculoatrial shunt, Medtronic medium pressure, USA
3. *ETC:* Hickman catheter: 7, 9.5, 11 French. Medcomp. Mexico.
4. *ETC:* Permicath.: 8 Medcomp. USA.
5. *EC:* Central Venous Catheter (CVC):
   - 3–5 French. Amecath. Egypt.
   - 4 French. Phobos. Bolsward, The Netherlands.
   - 7–8 French hemodialysis dual lumen catheter. Amecath. Egypt.

Best specifications in the author's practice in general are given in details in the discussion section.

Technique

Figs. 1–3 illustrate the procedure, which entails 4 steps described below.

Equipment and preparation (Fig. 1)

A 3–5 French central venous catheter set was used in conjunction with the wider bore set to be implanted finally.

The wide bore needle was discarded completely and its wire was kept for later use as will follow.

The procedure started by the fine bore needle (less than 0.9 mm outer diameter) and its wire (J, 0.01–0.025 mm). The fine wire- while still outside the patient- was passed inside the needle so that it stopped just before appearing at the tip.

Stab incision at point of entry

Before approaching with the "needle-wire complex", a stab incision was made at the site of skin entry guided by the ultrasound

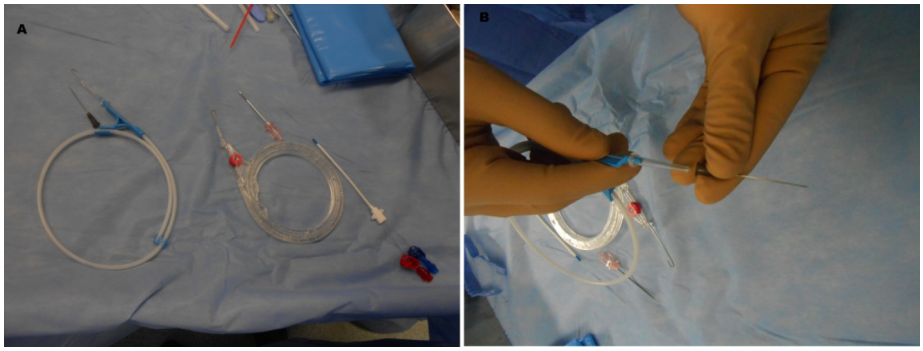

Fig. 1. Lt.) In addition to the wide bore needle and wire coming in the set, a fine bore needle with a fine wire and an 18 gauge cannula were prepared. Fine bore wires and needles were packed in the 3-5F CVC sets. Many of the needles were made with enhanced sonovisibility indicated by a dark distal needle shaft. Rt.) A fine bore wire was mounted on a fine bore needle on the instruments table. The wire passed till near the tip of the needle.