ONE SHOOT SELDINGER CENTRAL VENOUS CATHETERIZATION IN DIALYZED PATIENTS

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ABSTRACT

***Introduction**: Central Venous Catheterization is necessary in uremic patient (before dialysis) and many other conditions. In this study we demonstrated the advantages of ultrasonography to perform the procedure.*

***Materials and methods**: 48 uremic patient were submitted to ultrasound-guided central venous catheterization. The procedure was performed following the Seldinger "one shot" technique.*

***Results**: The mean operative time was 4 minutes, with a high rate of success (100%) and a low percentage of complications (2%).*

***Conclusion**: The ultrasound-guided central venous catheterization is a safe procedure, rapid and easy to perform. The procedure has a low rate of failures and complications and a high rate of success. It is suitable in all patients with vascular anatomical variations, "difficult neck", or coagulation disorders.*

***Key words**: Central venous catheterization (CVC), ultrasound guide, end stage renal disease, dialysis.*

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Introduction

End stage renal disease (ESRD) is the final evolution of a progressive loss in renal function that requires a multidisciplinary approach in order to ensure an adequate metabolic and fluid-electrolyte balance; in patients with an effective blood flow, haemodialysis represents a reliable means to purify blood. In Europe, up to 31 December 2012, a total of 451270 patients with ESRD were receiving renal replacement therapy among the renal registries reporting to the ERA-EDTA Registry, corresponding to an unadjusted prevalence of 716.7 per million population[(1)].

Before starting a renal replacement therapy, it is primarily necessary to establish whether it must be performed as a chronic therapy or an urgent measure (hyperkalaemia, acidosis…)[(2,3)]. In the first case, a vascular access must be chosen, creating a surgical arteriovenous fistula (AVF)[(4)] by means of local or regional anaesthesia[(5)]. The patency of a surgical AVF depends on many factors, including the anatomical features and integrity of blood vessels to be anastomized[(6)] and the type of surgical suture, taking into account that some procedures like video-assisted or mechanical anastomosis have been also proposed to improve the operating times and quality, as well as the use of new surgical instruments or experimental

techniques, such as the positioning of a subcutaneous jugular catheter[7-10]. In case of emergency, in absence of a reliable vascular access, a central venous catheterization (CVC) is mandatory to solve rapidly the state of metabolic and hydro-electrolytic impairment, stabilizing patient's clinical conditions. Central venous catheterization is also useful in many other conditions in which a long-term infusion is required (patients with severe malnutrition, cancer, cachexia), or a blood apheresis is necessary (patients with hematological diseases)[11,12]. In most of cases, CVC is performed by using only some anatomical landmarks, and this is associated with a high complication rate and long execution time[13,14]. In this work, we present our decade of experience with ultrasound-guided CVC.

Materials and methods

From June 2002 to March 2013, 48 patients undergoing CVC for dialysis, out of a total of 675 procedures, were considered (Tab. 1); an ultrasound-guided method was always performed in the study group, according to the "one shoot" Seldinger technique.

Patients' features	(n = 48)
Male/Female, n.	33/15
Mean age (years)	62 (38-82)
Body Mass Index	23

Table 1: Patients' features.

All patients lay down on the operating table, in Trendelenburg position (10°-20°) with their head rotated to the opposite side. Lateral cervical region was treated with Povidone iodine and covered with sterile drapes. The surgical site was anesthetized with local injection of mepivacaine 5%. A "Prisma-Diasonics" 10MHz ultrasound system was used. A sterile latex cover was used for the probe. After the preparation of the surgical field, the central vein was visualized along its main axis; patients were invited to perform Valsalva manoeuvre in order to increase the calibre of the vein and thus obtain a better view. According to the modified one shot Seldinger technique, an 18 G needle was then inserted into the internal jugular vein. This manoeuvre was effectively guided by ultrasonography which allowed to confirm the correct insertion of the needle, in real time (Fig. 1).

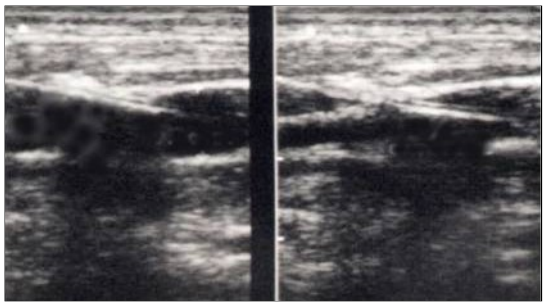

Figure 1: Central Vein Catheterization. Thanks to a 10 MHz ultrasound probe, the needle can be followed into the external jugular vein lumen, during cannulation.

After cannulation, a metal guide wire was pushed within the venous lumen, always under direct vision, avoiding a hazardous blood aspiration to confirm the accuracy of the procedure. With the metal guide wire in situ, after the extraction of the needle, the dilator and subsequently a 12 F double-lumen venous catheter were inserted through the guide wire (Fig. 2).

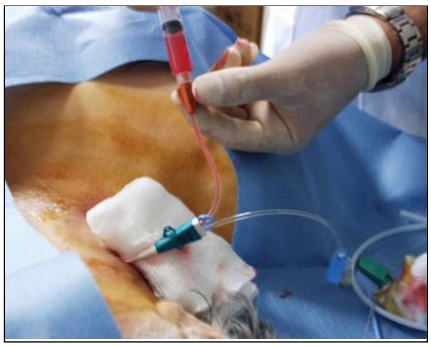

Figure 2: Central Vein Catheterization. Right jugular vein catheter in situ.

At the end of the procedure, ultrasounds confirmed the optimal position of the catheter. After the procedure, selected patients (diabetic, immunocompromised, oncologic, etc.) received third-generation cephalosporin 1 g/day.

Results

The mean operative time was 4 minutes. However, this parameter was burdened by the difficulties of the learning curve; in fact, it was only of about 2 minutes in the last year of the considered study. During the first year, 25% of patients needed many attempts to perform a single vein cannulation;

this ratio was reduced drastically in the last year of the study (1.9% of patients) ($p < 0.001$).

The success rate of ultrasound-guided percutaneous puncture was 100%. Out of 48 punctures, the percentage of early complications, both minor and major, was 2% (represented by one vasovagal response). Cannulation-related lesions, such as pneumothorax, haemorrhage, perivascular hematoma, injury to brachial plexus, phrenic nerve or recurrent laryngeal nerve, were not registered (see table 2).

Outcome	(n=48)
Mean operative time for CVC, min.	4
Success rate of US-guided puncture, n (%)	48 (100%)
Percentage of early complications, n (%)	1 (2% - vagal hypotension)
Cannulation-related lesions, n (%)	0

Table 2: Success rate and complications.

Discussion

Cannulation of a central vein is commonly requested in those subjects who need dialysis or plasmapheresis, it is mandatory for those critically ill patients who will undergo major surgery or for the monitoring of the central venous pressure, for a rapid infusion of fluids and medications and for the total parenteral nutrition[11,12]. A failure of the procedure is possible and it is estimated to range from 10% to 18%, as described by Denys et al[13,14]; this is likely due to the several anatomical variations of the jugular vein course. Since ultrasonography shows contiguous anatomical structures and drive the introduction of the needle, the procedure involves fewer complications, reduces the operative time and patients' discomfort. From the comparison of the data obtained in the first year with those of the following period, it is clear that this method requires a short learning period. An ultrasound-guided CVC appears extremely advantageous, securing a rapid execution, high percentage of success, a lower number of attempts with the needle and a low complication rate[15,16], in comparison with the traditional method, performed using only anatomical landmarks[17]. After the first year of learning, the use of ultrasonography was extended to subclavian vein catheterization, confirming the value of the ultrasound-guided CVC, compared to the standard "blind" technique. However, the use of the internal jugular vein is advisable, because it allows a better resolution, avoiding any possible cause of pneumothorax, and represents an easier access. Obviously, the catheter should be always handled with extreme care, trying to avoid contamination or its accidental displacement. Therefore, a deep cleaning of the wound with sterile procedures and a washing of the catheter lumen with sterile heparinized solutions (100 U/ml)

Conclusions

Ultrasound-guided CVC is a safe procedure and provides a reliable vascular access in uremic patients. The procedure is burdened by few complications and is time-sparing.

Ultrasounds allows the placement of a central venous catheter in a more secure and faster way, plays a decisive role when anatomical landmarks are not visible or palpable, in cases of vascular anomaly, in subjects with abnormal coagulation parameters and where the expectation of complications may be higher compared to the traditional technique.

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