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## Cannulation of arteriovenous fistulas by the buttonhole technique: a case study

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### ABSTRACT

**Aim:** To describe the case of a patient with chronic kidney disease (CKD) undergoing cannulation of arteriovenous fistulas by the buttonhole technique for hemodialysis treatment, and comparing it to cases submitted to the conventional technique. **Method:** A case study of an adult male patient carrying CKD, held in the Dialysis Center of São Gonçalo / RJ between March and May 2014, whose analysis was based on the literature. **Results:** We observed no complications three months after cannulation by buttonhole; the patient reported reduction in pain during the procedure; the limb with the fistula remained aesthetically intact. **Discussion:** Results of comparative studies of the two techniques are shown to be different, although they point to major benefits of the buttonhole technique: decreased pain, extended life of the AVF, reduction of bleeding and bruising. **Conclusion:** The buttonhole technique can be useful for new vascular access and hypersensitive patients.

**Descriptors:** Renal Insufficiency, Chronic; Renal Dialysis; Arteriovenous Fistula; Nursing.

## INTRODUCTION

Chronic kidney disease (CKD) is understood to be a national public health problem; epidemiological data point to the existence of approximately 78,000 patients on dialysis and the prevalence of dialysis treatment in 405 patients per million of the population<sup>(1)</sup>. In this sense, it is necessary to understand the complexity of this disease in order to contribute to the biopsychosocial well-being of patients and to improve their quality of life<sup>(2)</sup>.

CKD is characterized by renal injury and/or progressive and irreversible loss of regulatory, excretory and endocrine functions of kidneys<sup>(3)</sup>. In its most advanced stage, hemodialysis treatment – to 90% of patients<sup>(1)</sup> –, dialysis or kidney transplantation is required.

The hemodialysis corresponds to the extraction of excessive water and nitrogenous toxic substances from the blood, with the removal of 1 to 4 liters of fluid in an average period of four hours for three times per week<sup>(2,4)</sup>. For successful hemodialysis treatment appropriate vascular access is essential. The cannulation of arteriovenous fistulas (AVF) in Brazil is traditionally executed by the *ropeladder* technique, in which the puncture sites are alternated to avoid the formation of aneurysms, stenoses and repetitive trauma to the vascular wall using sharp needles. However, after a period of time using this technique, changes in FAV can be perceived – aneurysms, scarring, bruising and thrombi areas, or areas with skin sensitivity that cause pain at the time of cannulation<sup>(5)</sup>.

Currently, as an alternative to the procedure of cannulation the buttonhole technique can be executed. In this method the cannulation site is constant, i.e. the needles are inserted into the AVF, always in the previous cannulation bore, and aim to create a tunnel<sup>(5)</sup>.

The time required to create the tunnel varies and depends on the skill of the professional who must always ensure the needles enter at the same location and at the same angle for at least 10 to 12 cannulation procedures. This technique is considered more expensive for the majority of dialysis services in Brazil, due to the type of needle used (blind / blunt), which has a higher cost in relation to the most common fistula puncture needle: the cutting type.

Furthermore, preparation before puncture with the necessary antiseptic solutions, which allow the removal of the crust formed at the punch sites, in an attempt to remove it easily without complications by object abrasion at the local, is still considered ineffective. These factors are obstacles for the adhesion of this type of puncture. However, promoting the physical and emotional well-being of the patient is contextualized with respect to the punch, since it can ease pain and avoid other complications.

The puncture technique at one location was described in 1977. Through the evaluation of 16 patients it was found that the insertion of needles at the same location was easier, faster and less painful for the patient and was also associated with fewer complications<sup>(6,7)</sup>.

In this context, the aim of this study is to describe the case of a CKD patient undergoing AVF cannulation by the buttonhole technique for hemodialysis treatment, and comparing it to cases submitted to the conventional technique of vascular access.

## METHOD

This is a clinical case study, performed in a private clinic linked to the Public Health

System (SUS), located in the Metropolitan Region of São Gonçalo, from March to May 2014, which had as its subject, a male, adult, CKD patient.

The buttonhole cannulation technique and data collection were carried out by a nurse. For this, a form was created to record data related to the application of the technique, complications, benefits, complications and satisfaction. The results were analyzed and discussed based on the scientific literature of the subject.

The study was submitted to the ethics committee of the Medical School of the Fluminense Federal University, and approved by Opinion ID 531721 of February 21<sup>st</sup> 2014.

## RESULTS

### *Patient's profile and medical history*

The patient is male, black, 46 years old, married, father of two, grandfather of a grandson, and lives in the metropolitan region of the state of Rio de Janeiro. The patient works in the insurance brokerage industry, maintains a social life according to the natural standards of a worker, with no complaints about the interference of treatment in his daily life.

The patient had a previous history of high blood pressure (hypertension), and congestive heart failure (CHF), was a former smoker (exposure for 20 years) and a former alcoholic (exposure for 15 years). There was a family pathological history of hypertension (parents) and diabetes mellitus (DM).

In early 2010 the patient noted a bilateral lower limb edema, however due to the absence of other signs and symptoms he did not seek medical attention. Months later, he began to experience loss of appetite and

paroxysmal nocturnal dyspnea. His condition then progressively worsened, and the patient lost 35 kilos in subsequent months.

The patient was treated by a cardiologist in a public hospital in Niterói, who detected stage 3 hypertension, characterized by systolic blood pressure  $\geq 180$  mmHg and diastolic  $\geq 110$  mmHg. The patient was prescribed antihypertensive ACE inhibitors and ARBs twice a day. The cardiologist also requested blood tests (complete blood count, urea, creatinine and potassium), which showed anemia and increased nitrogenous waste.

The patient was then referred to a nephrologist, who confirmed the chronic pathological condition by the laboratory tests described above; clinical symptoms, presented by nausea, vomiting, loss of appetite and hypertension; and imaging (ultrasound) tests, which identified abnormalities and kidneys with reduced size. The physician indicated dialysis treatment by hemodialysis, which was initiated in August 2010 in a nosocomial environment with the use of double-lumen catheter (DLC) in the right internal jugular vein. The patient was referred to the Outpatient Hemodialysis department, scene of this study, in order to continue the treatment.

At the time of clinical interview he showed no awareness about the disease, nor the treatment and vascular access needed for dialysis. When AVF was presented as a permanent vascular access, the patient demonstrated fear of having his body aesthetics altered as a result of complications. As an alternative, the cannulation technique by buttonhole was presented in order to minimize the complications of AVF, which achieved the patient's compliance.

The patient was referred to a vascular surgeon for the procedure of AVF creation. During the fistula maturation phase, i.e., vein

dilation and development of minimum blood flow volume, the patient presented clinical infectious conditions with fever, chills, nausea, vomiting, loss of appetite and ostium of the catheter with pus confirmed by a blood test. The results indicated leukocytosis, and two samples of blood culture evidencing a colonization by *Staphylococcus epidermidis*. We decided to remove the DLC and administer an appropriate antibiotic therapy with cefazolin – a 2g loading dose, followed by eight doses of 1g post-hemodialysis. The fistula was cannulated eleven days after surgery, and occurred during drug treatment to fight infection due to the need for maintenance of hemodialysis. The patient's condition showed progressive improvements and without complications related to AVF.

#### *The Buttonhole Cannulation Technique*

For realization of the studied technique, the following routine was established:

1. After arriving at the clinic, the usual cleaning of the patient's limb with AVF was done with water and mild liquid soap;
2. A cotton swab with chlorhexidine soap was placed over each puncture site for 15 minutes to mollify the crust. After this, the residue of soap was removed by rubbing the area with gauze moistened with 70% alcohol, and the tip of another gauze rolled in a conical shape and also moistened with 70% alcohol. The antiseptic cleaning must always be done in circular movements, from the less contaminated to the more contaminated areas, using a single gauze sheet for each puncture site;
3. The puncture site was cleaned again with alcohol chlorhexidine, using two sheets of gauze soaked with alcoholic chlorhexidine, and then the cannulation technique procedure starts;

4. During the tunneling stage (four weeks) sharp-type needles were used for 10 consecutive punctures made by the same professional from gauge needle 17G, 16G, 15G, sequentially, according to the specifications for development of AVF use, considering the same angle (30 degrees) and depth of cannulation this technique determines, and without the tourniquet at AVF limb. Then, the needles are fixed using two pieces of adhesive tape of 10cm each to attach the butterfly needle in a similar way to the traditional technique;
5. After the tunneling period passes, blind / blunt needles begin to be used, after the crust removal as above, without using the tourniquet in AVF. After obtaining success in the puncture attempts, there is a satisfactory blood flow maintenance for a hemodialysis event;
6. After four weeks, the patient is guided by a trained professional to perform the procedures of: antiseptis, crust removal, new antiseptis and puncturing, respecting the established depth and angle.

#### *Complications and benefits*

To date, three months after the use of the buttonhole cannulation technique, there have been no complications such as hematoma, infection, infiltration or the presence of aneurysm in AVF.

The left upper limb where the AVF is located is aesthetically intact, with only cannulation points discreetly marked. There was: an improvement in the patient's self-esteem due to the preservation of body aesthetics; a reduction in self-reported pain during the procedure, allowing the patient to initiate the process of self-cannulation; and a greater adherence to treatment based on safety

and quality provided by the technique in question.

The time required for professionals to prepare to perform the technique; the extra time for the preparation of skin and crust removal prior to cannulation; and the anxiety of some professionals when tunnels presented some resistance during use of the blunt needle for the puncture, were difficulties related to the service in this study.

## DISCUSSION

There is no universally accepted technique for cannulation of AVF. In general, it is recommended to change the punch locations for each dialysis, because this method would allow for better healing and reduction in complications such as hematoma, infection and stenosis<sup>(6)</sup>.

In this case study no apparent complications related to the technique were reported. The greatest benefit was the reduction of pain during the procedures as described in another study with 21 patients, which found no bruising or intra and post-hemodialysis bleeding; in the study a reduction or absence of pain was also observed. On the other hand, it described an increased risk of infections when there was another professional performing the procedure, detected through the Chi-square test<sup>(5)</sup>.

The literature recommends that the cannulation is performed by a single professional, as each professional chooses the insertion angle based on his/her independent judgment about the appropriate depth of access<sup>(5,6)</sup>. Because of this, two different individuals may determine two slightly different entrance angles. The result is a tunnel that will not have the same format as the needle,

resulting in a drip (leakage) when the patient is heparinized.

As seen in the study, the application of the buttonhole technique produced events concerning the punch, as seen in a research performed with 16 patients. In this, one of the biggest barriers to overcome was that, in punches with a blunt needle, sometimes it is necessary to apply a greater force to the introduction of the needles. Although the patients did not refer pain, it generated anxiety among professionals who performed cannulation and, occasionally, began the puncture with a sharp needle or exchanged a blunt needle for a cutting needle during the procedure of puncture of arteriovenous fistula<sup>(6)</sup>.

A case-control study of 30 patients in Barcelona, in which the buttonhole technique was used in 10 of them, and a conventional technique was used in the others, pointed out that the feeling of pain and the hemostasis time were lower in patients undergoing the buttonhole technique<sup>(8)</sup>. Similarly, a systematic research review found that in most of the publications analyzed, they indicated this technique as less painful and less associated with infiltrations, bruises and aneurysm<sup>(9)</sup>. These benefits must be counterbalanced with the increased risk of infection<sup>(9,10)</sup>.

A survey of 140 hemodialysis patients randomized regarding the use of the buttonhole and traditional techniques, found that the hematoma formation rate was higher with the traditional technique, although the infection rate was lower<sup>(11)</sup>.

The results of comparative studies of both techniques are still shown to be different. They pointed out the main benefits of the buttonhole technique were to decrease the sensation of pain; the use of blunt needles which reduce the cutting of the tunnel and subsequent extravasation during dialysis; the

possibility of self-cannulation; increased patient satisfaction and, hence, greater adherence to the treatment; no aneurysm formation; life of the AVF extended; reduction of bleeding and bruising; and better esthetical aspect<sup>(5-14)</sup>.

The buttonhole technique can be seen, therefore, as a useful and efficient method, although some difficulties compromise its generalization: specialized personnel to execute the technique, which requires specific and more complex training than the traditional technique; and more time expended to perform the initial phase of the technique. These factors directly affect the increased risk of infection and resistance to the adoption of the technique by the institution, professionals and even patients<sup>(12)</sup>.

Despite the difficulties mentioned above, the use of the buttonhole technique is recommended over the traditional technique, since its benefits show great relevance and superior acceptance. A recent study found that out of a total of 23 patients who were treated by traditional procedure and who also underwent the new technique, 86% chose to stay with the new one<sup>(15)</sup>.

Nevertheless, the technique of choice must be defined from the analysis of the individual patient. In this scenario, interaction between individuals - professionals, patient and family - is essential. It is necessary to provide the opportunity for patients to express their conflicts and expectations related to the disease and treatment. The performance of hemodialysis nurses and other professionals must be established considering the setting, the context of the work and especially the patients<sup>(16,17)</sup>.

## CONCLUSION

With the experience of the case with the patient in question, the applicability of the

buttonhole technique contributed to the reduction of events that traditional cannulation provides, thus allowing a proposal for adhesion to a cannulation alternative that eases physical and emotional injuries to the patient.

The main note about the purpose of this study is that the buttonhole technique can be useful for new vascular access and similarly, to minimize the pain caused by cannulation using sharp needles by novices, or in hypersensitive patients. As a limitation, we cite the short period of patient observation in question, which may have been insufficient to observe later complications. Nevertheless, and despite the difficulties related to the use of the method, we conclude that the benefits highlighted by the use of the buttonhole technique were satisfactory.

However, for a cannulation technique to be validated, it must be proved as beneficial to the fistula, so each case needs to be assessed individually, for the care team and the patient.

Given the scarcity of publications related to the technique in this country, it is recommended that experimental design research is carried out to confirm or refute the benefits and complications observed in international studies.

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