

Axillary catheter for hemodialysis, an alternative vascular access

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SUMMARY

Objective: To establish if the implantation of catheters for hemodialysis in axillary veins is an acceptable alternative in patients with Acute or Chronic Renal Failure (ARF or CRF) with limitations for other type of central catheter. **Place:** Manizales City Hospital's Intensive Care Units and ambulatory procedure rooms of the Renal Unity RTS Ltda Caldas Subsidiary, Santa Sofía Hospital and Infantil Hospital. **Patients:** All the patients with ARF or CRF, who required hemodialysis therapy, but that their pathology of base or the depletion of their classical access routes, required the implantation of catheters bilumenes by non conventional routes, during a period of 10 years that was extended from may 1997 to may 2007. **Methods:** Those patients with ARF or CRF that required tracheostomy as support for ventilation due to their base illness; and those with ARF or CRF in whom the ambulatory or intra-hospital implantation of a central catheter for hemodialysis was not possible were carefully identified. The implantation of a double lumen central catheter for hemodialysis in axillary vein by palpation or anatomical guide was offered as an alternative to both the patients and their families. The procedure was practiced to those that accepted and gave their written consent; radiologically confirming its location; establishing their functionality at the time, as well as the complications associated to the procedure and its permanency. **Results:** 27 procedures were practiced in 26 patients. Average age: 54.6 years; 9 women and 17 men. 7 of them had ARF and 19 CRF. In two patients the axillary vein puncture was not possible. Of the 25 axillary catheters that were implanted, 1 was permanent and 24 transitory. The technique was used by anatomical references in 16 patients and by palpation in 8. In the patients 15 left axillary veins were canalized unlike the remaining 10 that were right axillary veins. 18 patients presented impossibility of obtaining an alternative central venous access (different to femoral) and 7 patients required tracheostomy. The radiological location was satisfactorily confirmed in 24 procedures (96%). The amount of time the catheters were used was an average of 68.6 days; 6 patients died with the catheter in use. The main cause for the catheter's removal was the transference to peritoneal dialysis. The axillary artery was accidentally punctured in 3 patients, one of whom presented a soft tissue hematoma without a major hemodynamics repercussion; this had a spontaneous resolution in a few weeks. The venous canalization was not possible in 3 patients. **Conclusions:** The implantation of bilumenes catheters for hemodialysis in patients with ARF or CRF is a relatively safe alternative to consider when

other classical routes have totally spent or the patients present tracheostomy.

Key words: Acute renal failure. Chronic renal failure. Hemodialysis. Axillary catheter. Axillary vein.

RESUMEN

Objetivo: Establecer si la implantación de catéteres para hemodiálisis en venas axilares es una alternativa aceptable en pacientes con Insuficiencia renal aguda (IRA) o crónica (IRC) con limitaciones para otro tipo de catéteres centrales. **Lugar:** Unidades de cuidados intensivos y salas de procedimientos ambulatorios de los Hospitales de la ciudad de Manizales y sala de procedimientos ambulatorios de la Unidad Renal de RTS Ltda. Sucursal Caldas Hospital Santa Sofía y Sucursal Hospital Infantil. **Pacientes:** Todos los pacientes con IRA o IRC quienes requirieron terapia hemodialítica, pero que por su patología de base o agotamiento de las rutas clásicas para accesos, requirieron la implantación de catéteres bilumenes por rutas no convencionales, durante un periodo de 10 años que se extendió desde mayo del año 1997 a mayo del año 2007. **Métodos:** Se identificaron aquellos pacientes con IRA o IRC en las Unidades de Cuidados Intensivos de la ciudad, quienes requirieron traqueostomía para soporte ventilatorio por su enfermedad de base, y también pacientes con IRA o IRC en quienes no había sido posible la implantación ambulatoria o intra-hospitalaria de un catéter central para la hemodiálisis. A ellos o a su familia se les propuso la implantación de un catéter central bilumen para hemodiálisis en vena axilar por guía anatómica o por palpación, y en aquellos que aceptaron y dieron consentimiento escrito se les practicó el procedimiento, confirmando radiológicamente su ubicación, estableciendo su funcionalidad en el tiempo, y las complicaciones asociadas al procedimiento y a su permanencia. **Resultados:** En 26 pacientes se practicaron 27 procedimientos, edad promedio: 54,6 años, 9 mujeres y 17 hombres, 7 con IRA y 19 pacientes con IRC; en dos pacientes no fue posible la punción de la vena axilar, de los 25 catéteres axilares implantados: 1 fue permanente y 24 transitorios; la técnica fue por referencias anatómicas en 16 pacientes y por palpación en 8. Se canalizaron

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15 venas axilares izquierdas y 10 venas axilares derechas; 18 pacientes presentaron imposibilidad de obtener otro acceso venoso central (diferente al femoral), y 7 pacientes traqueostomía. Se confirmó ubicación radiológica satisfactoria en 24 procedimientos (96%). El tiempo promedio que se utilizó los catéteres fue de 68,6 días, 6 pacientes fallecieron con el catéter en uso, y la principal causa del retiro del catéter fue transferencia a diálisis peritoneal. Se puncionó accidentalmente la arteria axilar en 3 pacientes, uno de los cuales presentó un hematoma de tejidos blandos sin mayor repercusión hemodinámica y con resolución espontánea en pocas semanas, no fue posible la canalización venosa en 3 pacientes. **Conclusiones:** La implantación de catéteres bilúmenes para hemodiálisis en pacientes con IRA o IRC es una alternativa relativamente segura a considerar cuando se han agotado otras rutas clásicas o los pacientes presentan traqueostomía.

Palabras clave: Insuficiencia renal aguda. Insuficiencia renal crónica. Hemodiálisis. Catéter Axilar. Vena Axilar.

INTRODUCTION

Patients with acute (ARF) or chronic (CRF) frequently need the use of central venous catheters to receive hemodialysis therapy. The approach through the femoral vein is the most commonly used to perform acute hemodialysis given its low rate of complications although it has the drawback that it should not be placed for longer than 8 days, mainly because of the risk from infectious complications. The internal jugular veins are the ideal route for placing catheters for longer than 8 days because they may be used for a long time and have not major complications. The route through the subclavian vein has been abandoned by most of the nephrologists due to the complications associated to the canalization procedure (hemothorax and pneumothorax) and the risk for generating infraclavicular venous stenosis, which will further prevent the creation of properly patent arterial-venous fistulas.¹

Sometimes, an mainly when the patients present infectious complications or catheter malfunctioning due to thrombosis, it is necessary to frequently replace them, which leads to fibrosis within the supraclavicular regions preventing further use of the jugular veins for hemodialysis. In patients in the ICU, respiratory support is commonly needed so that, if prolonged, they will require a tracheotomy to avoid the occurrence of tracheal stenosis, with the generation of abundant secretions that contaminate the in-let of jugular or subclavian catheters.

In the last two situations, it is then necessary to use a different route to place a central catheter that will allow continuing with the dialysis therapy required by the patient.

The axillary vein route has been used for many years in patients at intensive care units to place central catheters with purposes different from dialysis, with good results. This led me to review the anatomy of the axillary or infraclavicular region, and initially following anatomical references² and later on through palpation of the axillary artery I decided to place axillary catheters for hemodialysis in a group of patients pre-

senting the characteristics described. My personal experience with this kind of procedure will be reported next.

MATERIALS AND METHODS

From May of 1997 to May of 2007, patients with ARF or CRF were identified at Intensive Care Units or at the Renal Therapy Department of Caldas (Manizales-Caldas-Colombia-South America), meeting one of the two requirements to try the canalization of the subclavian vein: 1) The impossibility of placing a central catheter through the internal jugular veins; 2) Tracheotomy for respiratory support for the underlying disease. They (or their family) were proposed to place a bi-lumen central catheter for hemodialysis, which was always placed first in the femoral vein, but after 8 days or before in the presence of catheter-related infectious complications it was removed, suggesting puncturing the axillary vein with anatomic guidance or by palpation to place a longer-lived catheter. Those patients accepting and giving their written consent (or the family consent) were submitted to the procedure, with radiological confirmation of proper location, and establishing the catheter functioning with time, and recording the procedure-associated complications and the catheter permanence. The technique applied in those cases with anatomical guidance was that proposed by Taylor and coworkers,³ in which it is presumed that the axillary vein lies at a distance of three fingers below the coracoid process, and entering for puncturing from below and upwards, and always avoiding advancing the needle under the collarbone (in which case the subclavian vein would be punctured) in order to avoid major complications. The procedure was done under local anesthesia or with assisted sedation in ventilated patients and using the classical Seldinger's technique.

RESULTS

Twenty-six patients (9 women and 17 men) met the established requirements, with a mean age of 54.6 years. The etiology of acute or chronic renal failure is summarized in Table 1. In two patients we could not puncture the axillary vein, and in the patients remaining 25 axillary catheters were placed: 1 permanent and 24 temporary; in one patient a temporary catheter was used as a guide to place a permanent one later on. The technique was done by anatomical guidance in 16 patients and by palpation in 8, highlighting that the latter technique was only achieved in recent years thanks to the skills developed by the operator. Ultrasound guidance was used in no patient to perform the procedure.

Fifteen left axillary veins and 10 right axillary veins were channeled, and the reason for requiring this procedure was: impossibility to canalize the internal jugular veins in 19 patients (fig. 1), and because of carrying a tracheotomy in 7 patients (fig. 2). Satisfactory location was radiographically confirmed (fig. 3) in 24 procedures (96%), and only one patient showed advance of the catheter to the right jugular vein, without being able to relocate the catheter in spite of the use of fluoroscopic methods, being the reason why we decided to remove it. The mean time the catheters were in

Table I. Patients includes in the study

Renal failure	Acute	Chronic
	7	19
Aetiology		
Acute tubular necrosis	7	
Post-ischemia	3	
Associated to sepsis	3	
Due to radio-contrast media	1	
Unknown		7
Diabetic nephropathy		7
Hypertensive nephropathy		4
Chronic glomerulonephritis		1

use was 68.6 days, currently one is still working, and the remaining were removed due to: transfer to peritoneal dialysis (6 patients), intra-hospital death,⁶ satisfactory use of arterial-venous fistula,⁴ renal function recovery,⁴ switch to permanent catheter,¹ catheter-induced sepsis,¹ and catheter malfunctioning after 30 days.² The axillary artery was accidentally punctured in 3 procedures (12%), one of which led to soft tissue haematoma without hemodynamic repercussion and with spontaneous resolution within few weeks; of the two patients in whom the axillary vein could not be canalized, one was diabetic with severe diffuse vascular compromise, and the other one was a female patient with morbid obesity. There were no other complications such as pneumothorax or paresthesia due to puncture of the brachial plexus.

**Figure 1.****Figure 2.****Figure 3.**

DISCUSSION

Hemodialysis patients frequently require the use of central venous accesses to receive dialysis; the accesses located in the neck region are the most frequently used ones in the long-term, the most popular being the internal jugular and the subclavian veins.⁴ The latter is used less frequently in recent years given the risk for generating jugular vein stenosis,

which blocks the draining blood flow of the upper limb limiting its use for further arterial-venous fistulae, and the common complications associated with the procedure, which some of them may even compromise the patient's life.¹ Other less used alternatives in the neck are the puncture of the innominate vein, with which some experiences have been reported,^{5,6} and none using the axillary vein, underlining that these two latter situations may only be tried when the classical methods have been ruled out.

Axillary veins arise from the axillary fold and proceed into the subclavian vein at the lateral rim of the first rib (fig. 4), and have classically been divided into three segments: proximal, posterior, and distal with regards to the pectoris minor muscle, and its location is completely extra-thoracic; its canalization is difficult since it requires to penetrate all the width of the pectoris major muscle (fig. 5) and palpation is difficult in little skilled hands and in edematous patients or with large adipose panicle; so, its puncture requires either appropriate knowledge of the infraclavicular regional anatomy or getting experience in palpating it. Recently, ultrasound guidance has allowed detecting the axillary veins more easily and accurately, observing that they are located a little bit downwards and close to the axillary arteries,^{7,9} so that it is common that the latter are punctured when trying to canalize the veins. We should underline that the further we go away from the sternum the more the axillary vein separates from the axillary artery and the posterior brachial nerve plexus, although its diameter gets smaller and its location deeper, while increasing the safety margin for puncturing it.¹⁰

Experiences puncturing the axillary veins at the axilla were already described in the year 1967,¹¹ although they were asso-

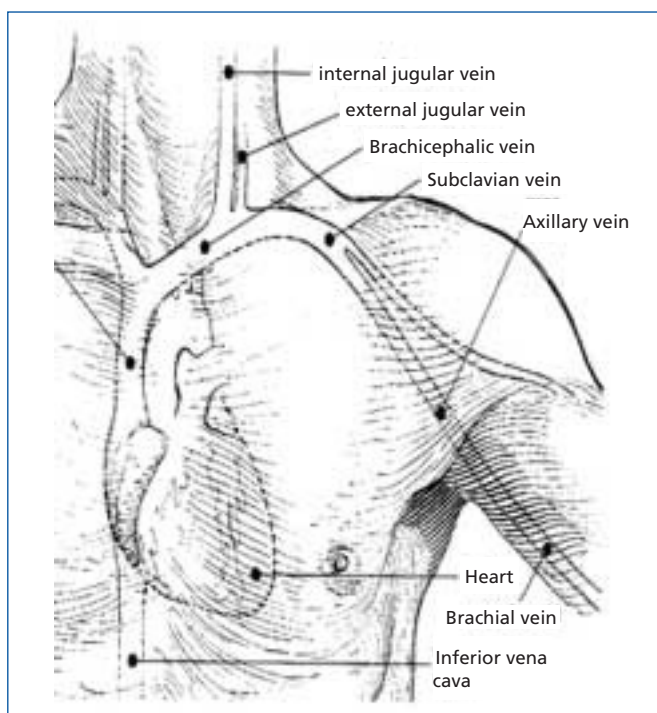


Figure 4.

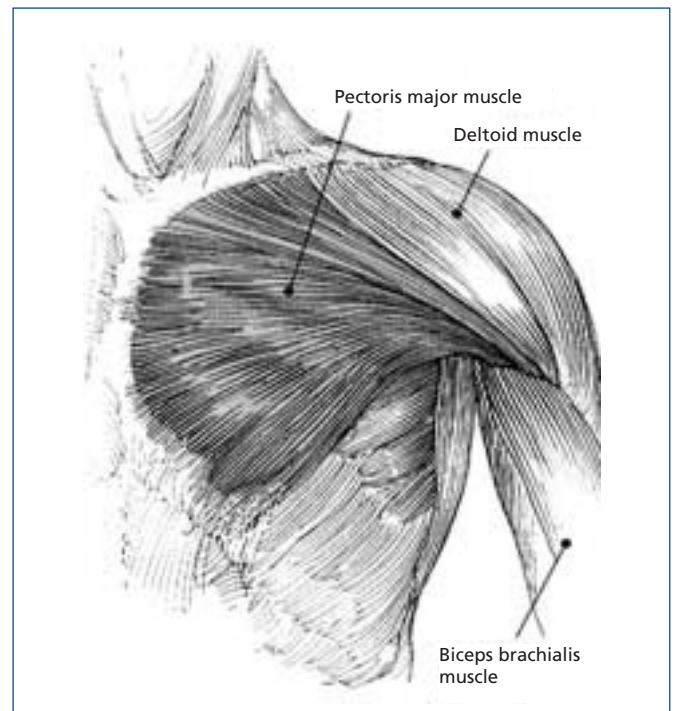


Figure 5.

ciated with a high infection rate¹² due to the high variety of bacteria colonizing this area, as has been shown in patients with severe burns in whom this may be the only territory free from burns allowing for the placement of a central venous catheter.¹³

Puncturing the axillary vein has the advantage of avoiding the complications described for accesses through the internal jugular and subclavian veins;¹⁴⁻¹⁷ moreover, in case of puncturing the axillary artery applying pressure on it for a short period of time prevents the occurrence of big hematomas, by contrast to what happens at the other deeper locations mentioned that do not allow this maneuver. For several decades, the canalization of this access has been used at Critical Care Units with good results;⁹ it is interesting not to find any publication on this matter within the Nephrology field.

In this case report, we found that in only two patients (7.6%) out of 26 needing the use of a route different from the usual one it was not possible to puncture the axillary vein; in the remaining patients in whom the goal was achieved, in only one (3.8%) the catheter followed an abnormal route and in 3 (12%) the axillary artery was punctured without the occurrence of important hematomas, while achieving a good catheter functioning in most of the patients, with an average working time of 2 months.

The purpose of this work was to present the author's experience in channeling this route, which has not been described for hemodialysis until now, in order to obtain a central venous access when the use of other routes is unfeasible or little practical; we do not intend to compare this with other experiences using the usual routes, which have shown their benefit in large published series to date.

REFERENCES

1. Clar DD, Albina JE, Chazan JA. Subclavian vein stenosis and thrombosis: a potential serious complication in chronic hemodialysis patients. *Am J Kidney Dis* 15: 265-268, 1990.
2. Nickalls RWD. A new percutaneous infraclavicular approach to the axillary vein. *Anaesthesia* 42: 151-154, 1987.
3. Taylor BL, Yellowlees I. Central venous cannulation using the infraclavicular axillary vein. *Anesthesiology* 72: 55-58, 1990.
4. Lau EW. Upper body venous access for transvenous lead placement-review of existent techniques. *Pace* 30: 901-909, 2007.
5. Apsner R, Plassmann GS, Muhm M, Druml W. Alternative puncture site for implantable permanent haemodialysis catheters. *Nephrol Dial Transplant* 11: 2293-2295, 1996.
6. Falk A. Use of the brachiocephalic vein for placement of tunneled hemodialysis catheters. *AJR* 187: 773-777, 2006.
7. Sandhu NS. Transpectoral ultrasound-guided catheterization of the axillary vein: an alternative to standard catheterization of the subclavian vein. *Anesth Analg* 99: 183-187, 2004.
8. Sharma A, Bodenham R, Mallick A. Ultrasound-guided infraclavicular axillary vein cannulation for central venous access. *Br J Anaesth* 93: 188-192, 2004.
9. Schregel W, Haller H, Radtke J, Cunitz G. Doppler guided cannulation of the axillary vein in intensive care patients. *Anaesthesist* 43: 674-679, 1994.
10. Galloway S, Bodenham A. Ultrasound imaging of the axillary vein-anatomical basis for central venous access. *Br J Anaesth* 90: 589-595, 2003.
11. Spracklen FHN, Niesche F, Lord PW, Betterman EMM. Percutaneous catheterization of axillary vein. *Cardiovasc Res* 1: 297-300, 1967.
12. Martin C, Bruder N, Papazian L, Saux P, Gouin F. Catheter-related infections following axillary vein catheterization. *Acta Anaesthesiol Scand* 42: 52-56, 1998.
13. Andel H, Rab M, Felfernig M, Andel D, Koller R, Kamolz L-P, Zimpfer M. The axillary vein central venous catheter in severely burned patients. *Burns* 25: 753-756, 1999.
14. Mansfield PF, Hohn DC, Fornage BD, Gregurich MA, Ota DM. Complications and failures of subclavian- vein catheterization. *N Engl J Med* 331: 1735-1738, 1994.
15. McGee DC, Gould MK. Preventing complications of central venous catheterization. *N Engl J Med* 348: 1123- 1233, 2003.
16. Ruesch S, Walder B, Tramer MT. Complications of central venous catheters: internal jugular versus subclavian access- A systematic review. *Critical Care Med* 30: 454-460, 2002.
17. Beltran B, Saurina A, Pou M, De las Cuevas X. Hemotórax masivo a las cuarenta y ocho horas de la cateterización de la vena yugular interna sin control ecografico. *Nefrología* 24: 384-385, 2004.