

Tunneled catheters. Complications during insertion

P. Royo, A. García-Testal, A. Soldevila, J. Panadero and J. M. Cruz

Servicio de Nefrología del Hospital La Fe.

Nefrología 2008; 28 (5) 543-548

SUMMARY

Introduction: The creation of vascular accesses for hemodialysis in patients affected with terminal kidney failure affections, is presented periodically as a problem. Because of it, the availability of alternatives to the arteriovein fistula is something necessary; different types of tunneled dialysis catheters are being developed, among which the Tesio catheter is the most well known and most widely utilized. Often it is implanted by vascular surgeons or radiologists; this creates dependence for the nephrology services that can delay obtaining the new vascular access and initiating or reinitiating the treatment.

Material and methods: A descriptive study with the objective of analyzing the immediate complications during the insertion of tunneled central catheters for hemodialysis and to evaluate the possibility of its attainment was carried out by nephrologists and personnel specialized in dialysis. Between January of 2003 and December of 2005, 175 Tesio tunneled central catheters were implanted in our hemodialysis unit. Age and sex of the patient was registered, time in dialysis, diagnosis of hypertension, diabetes mellitus or prior heart disease, previous anticoagulant or platelet antiaggregant treatment, difficulty perceived by the nephrologist for the development of the technique, bleeding, systolic and diastolic arterial pressure, cardiac frequency, oxygen saturation and changes in the monitoring of electrocardiogram, at the beginning of the intervention, during the channelling of the vein, insertion of the dilators and catheter, and at the end of it. **Results:** The patients were 88 men and 82 women, with an average of age of 64. 21% of the patients habitually followed a treatment with platelet antiaggregant or anticoagulant, which had been withdrawn in the prior days. The ultrasound size of the vein was greater than one cm in 79% of the cases. Of 175 insertions only three patients (2%) presented signs of hemodynamic instability, two of them due to a descent of arterial tension and one by oxygen saturation descent; none of them required assisted backup, neither hemorrhage nor other complications appeared.

Conclusions: The implant of tunneled catheters, under local anesthesia, presents minimal complications and incidents during its insertion. It can be carried out by a nephrologist and specialized personnel, in hospitals with backup units that can undertake any possible complications

Key words: Permanent Tesio catheters. Vascular accesses. Insertion catheters.

Correspondence: Alicia García Testal
Hospital La Fe
Campanar, s/n
46009 Valencia. España
testal@ono.com

RESUMEN

Introducción: La creación de accesos vasculares para hemodiálisis en pacientes afectos de insuficiencia renal terminal, se presenta periódicamente como un problema. Por ello, la disponibilidad de alternativas a la fistula arteriovenosa es algo necesario; distintos tipos de catéteres tunelizados se vienen desarrollando, entre los cuales el catéter de Tesio es el mejor conocido y utilizado. Frecuentemente es implantado por cirujanos vasculares o radiólogos, lo que conlleva una dependencia para los servicios de nefrología que puede retrasar la obtención del nuevo acceso vascular y el inicio o reinicio de tratamiento.

Material y métodos: Se realizó un estudio descriptivo con el objetivo de analizar las complicaciones inmediatas durante la inserción de catéteres centrales tunelizados para hemodiálisis y evaluar la posibilidad de su consecución por nefrólogos y personal especialista en diálisis. Entre enero de 2003 y diciembre de 2005 se implantaron 175 catéteres centrales tunelizados de Tesio en nuestra unidad de hemodiálisis. Se registró edad y sexo del paciente, tiempo en diálisis, diagnóstico de hipertensión, diabetes mellitus o cardiopatía previa, antecedentes de tratamiento anticoagulante o antiagregante, dificultad percibida por el nefrólogo para el desarrollo de la técnica, sangrado, presión arterial sistólica y diastólica, frecuencia cardíaca, saturación de oxígeno y cambios en la monitorización de ECG, al inicio de la intervención, durante la canalización de la vena, inserción del dilatador y catéter, y al final de la misma.

Resultados: Los pacientes fueron 88 hombres y 82 mujeres, con media de edad de 64 años. El 21% de los pacientes llevaban habitualmente tratamiento con antiagregante o anticoagulante, que había sido retirado en los días previos. El tamaño ecográfico de la vena era mayor de 1 cm en el 79% de los casos. De 175 inserciones sólo 3 pacientes (2%) presentaron signos de inestabilidad hemodinámica, dos de ellos por descenso de tensión arterial y uno por descenso de saturación de oxígeno; ninguno de ellos requirió soporte asistido, no apareció hemorragia ni otras complicaciones.

Conclusiones: La implantación de catéteres tunelizados, bajo anestesia local, presenta mínimas complicaciones e incidencias durante su inserción. Puede llevarse a cabo por un nefrólogo y personal especializado, en hospitales con el respaldo de unidades que permitan abordar las posibles complicaciones.

Palabras clave: Catéteres tunelizados. Catéteres permanentes. Implantación de catéteres. Catéteres de Tesio. Complicaciones.

INTRODUCTION

Availability of a good vascular access is one of the mainstays for performing an adequate dialysis treatment. There is no

doubt that an autologous vascular access such as the arteriovenous fistula is most suitable for dialysis,^{1,2} but the type of vascular access depends on many factors, including the urgency for starting renal replacement therapy, the vascular anatomy of each individual patients, his/her life expectation and preferences, prior unsuccessful vascular accesses, or other pathological history.

Different types of venous catheters have appeared in recent years. Canaud was the first author who described them in 1986. Tesio in 1994 and Milner in 1995 developed a procedure using a dual puncture catheter system. The Tesio tunneled catheter, the best known and most widely used, has been shown to be effective for adequate dialysis.

Assessment of a vascular access is usually based on its ability to provide for adequate dialysis, its durability, and its attendant complication rate.³

In the US, more than 200,000 required hemodialysis (HD), and it is estimated that approximately 250,000 catheters are inserted every year. A catheter is used in 70%-60% of patients who start dialysis, and a tunneled catheter in 27%. The proportion is lower in Europe, ranging from 15% and 50%. In Spain, a recent study on distribution of vascular accesses (VAs) showed that central venous catheters (CVCs) rank first. It was estimated that 12,000 CVCs, most of them temporal (60%), are implanted every year.^{4,5}

Spanish guidelines for vascular access recommend use of central catheters for vascular access for HD in special situations such as patients with acute or exacerbated chronic renal failure urgently requiring a VA for hemodialysis (*Evidence A*); the need for HD with a permanent VA in the maturation stage or complicated with no possibility of puncture, while waiting for a new VA (*Evidence A*); the impossibility or difficulty for creating an adequate VA because of either a poor vascular bed or lack of venous development (*Evidence B*); short hemodialysis periods while waiting for kidney transplant from a living donor (*Evidence C*); and finally in patients in special circumstances (life expectation shorter than one year, cardiovascular status contraindicating VA creation, express wish by patient, etc.) (*Evidence C*).⁴

The profile of patients undergoing hemodialysis at our centers has changed in recent years. Life expectation and age of patients have increased, which has resulted in increasing difficulties for creating and maintaining vascular accesses that have led to search for alternatives to AVFs that ensure a long-term use with minimal incidents and complications. The United States Renal Data System shows that vascular access failure in hemodialysis is the most common reason for hospitalization in patients with end-stage renal disease.⁶

Implantation of indwelling catheters by interventional or vascular radiology creates a dependence on departments different from nephrology that may limit fast achievement of vascular access for starting or restarting dialysis.

OBJECTIVE

To analyze the early complications occurring during insertion of tunneled central catheters for hemodialysis by nephrologists and staff specialized in dialysis.

MATERIALS AND METHODS

A descriptive study was conducted of the complications and incidents occurring during insertion of 175 Tesio tunneled central catheters at our unit from January 2003 to December 2005. Patient age and sex, time on dialysis, prior diagnosis of arterial hypertension (AHT), diabetes mellitus (DM), dyslipidemia or heart disease, and current anticoagulant or antiaggregant treatment were recorded. Systolic and diastolic blood pressure (BP), digital oxygen saturation (SAT), and electrocardiographic (ECG) changes were also monitored at procedure start, during vein cannulation and insertion of dilator and catheter, and at the end of the procedure. BP changes by more than 20 mmHg, occurrence of bradycardia or tachycardia (< 50 bpm or > 100 bpm), a SAT decrease greater than 5%, and ECG changes not previously recorded, as well as early bleeding complications were considered relevant changes. The difficulty perceived by the nephrologist for vein cannulation and dilator and catheter insertion, and the ultrasonographic size of the jugular vein were also recorded.

Catheters were implanted at our dialysis unit under local anesthesia and surgical aseptic conditions by a nephrologist and a nurse specialized in dialysis. The right internal jugular vein—or the left vein in the event of prior disease in the right venous system—was cannulated using real time ultrasonographic control. A dual puncture was performed, metallic guidewires were inserted, and an 11F sheath dilator was advanced through them. At this time, patient was asked to cooperate by holding his/her breath for a few seconds while the dilator was removed and the catheter was inserted through the sheath, that was subsequently torn. The catheter was then tunneled. The intended length of subcutaneous tunnel ranged from 12 and 15 cm. The catheter was used for hemodialysis 12-24 after insertion, and antibiotic prophylaxis consisting of vancomycin 1 g and gentamicin 80 g was administered in the first hemodialysis session through the catheter. Five percent heparin sodium was used for catheter sealing as instructed by the manufacturing pharmaceutical company.

The clinical criteria used to indicate placement of a tunneled catheter included advanced age, decreased life expectation due to a concomitant condition, failure of other prior vascular accesses or poor vascular development, required start and prospects for continued replacement therapy with no possibility of a usable vascular access in the short term.

RESULTS

Mean patient age was 64 years (range, 18-89 years). No significant differences were seen in patient sex (88 males/82 females).

Table I shows the prevalence of cardiovascular risk factors.

Twenty-one percent of patients were on antiaggregant or anticoagulant treatment. Antiaggregant therapy was discontinued one week before the procedure, while anticoagulation was modified by the hematological department in order to prepare patients for minor surgery.

Ultrasonographic size of the jugular vein was greater than 1 cm in 79% of patients.

Table I. Prevalence of cardiovascular risk factors

AHT	DM	Heart disease	Dyslipidemia
64%	40%	45%	27%

Changes in systolic blood pressure (SBP) occurred as a > 20 mmHg increase in 9% of cases (16/175), but SBP was not higher than 180 mmHg in any patient during the procedure. SBP decreases > 20 mmHg as compared to baseline occurred in 20% of patients (35/175). Three of these patients showed values under 110 mmHg. As regards diastolic blood pressure (DBP), values remained within a range from 50 and 100 mmHg in 95% of patients. A > 20 mmHg increase occurred in 2% (3 insertions), and > 20 mmHg decreases were seen in 7% of patients (12 insertions). Baseline values were recovered at the end of the procedure in 10 of the latter cases.

Digital oxygen saturation (SAT) was maintained between 92% and 100% in 96% of cases. SAT decreased by more than 5% as compared to baseline in 3 insertions (2%). Two patients recovered spontaneously, while a third patient required oxygen therapy.

Bradycardia and tachycardia were recorded in 2% and 5% of the procedures respectively. Atrial or ventricular extrasystole occurred in 23 procedures (13%), and resolved in all cases with partial guidewire withdrawal. The analysis showed a statistically significant relationship between extrasystole occurrence and catheter location into the left internal jugular vein (fig. 1).

Thus, three patients (2%) showed signs of hemodynamic instability, two because of a decreased BP and one due to a decreased SAT. None of these events was related to diagnosis of bleeding or other complication resulting from catheter insertion, and baseline values were recovered after fluid and oxygen administration. No extraordinary measures were required.

Bleeding occurred as a complication during the procedure in 10 patients (5.6%), and was controlled with local hemostasis in all cases. No statistically significant relationship was seen with hemodynamic changes or with use of antiaggregant or anticoagulant drugs. An association was found with vein size smaller than 1 cm and the difficulty of the procedure ($p < 0.0000$) (figs. 2 and 3).

DISCUSSION

The profile of patients undergoing dialysis at our centers has changed. Vascular access difficulties have increased, and vascular access failure has become the most common reason for

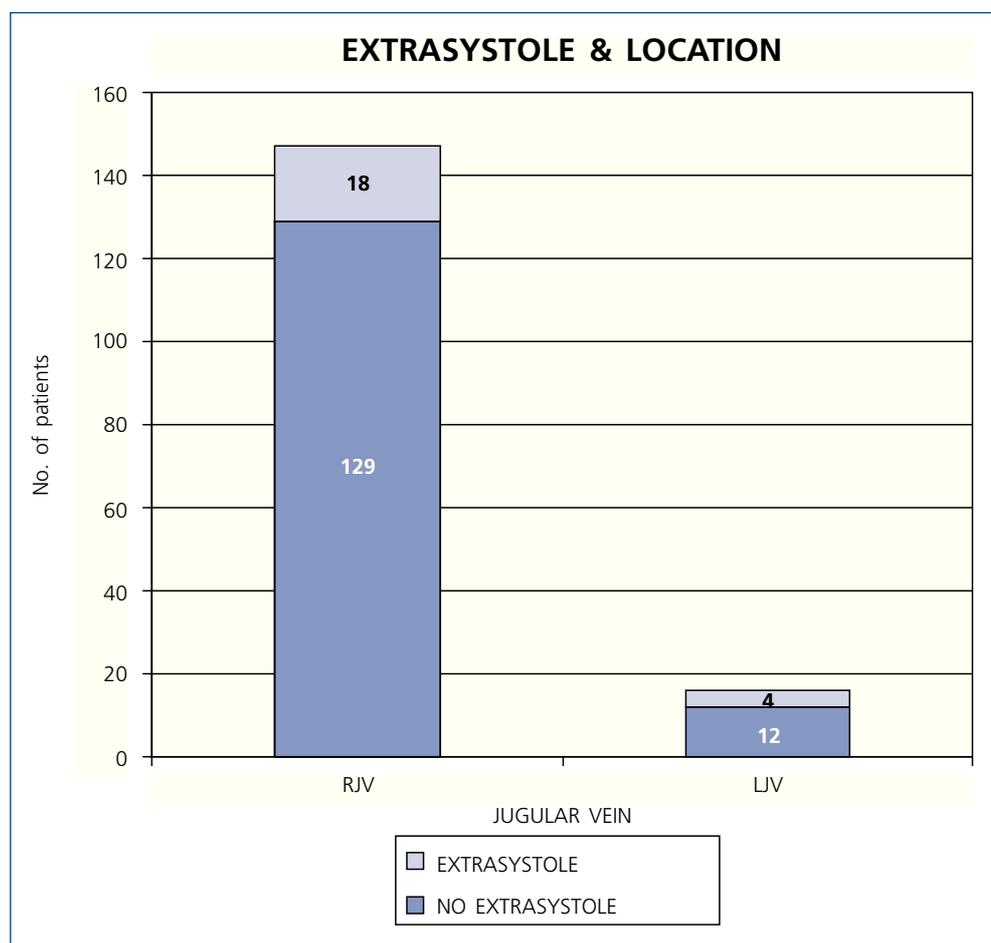


Figure 1.

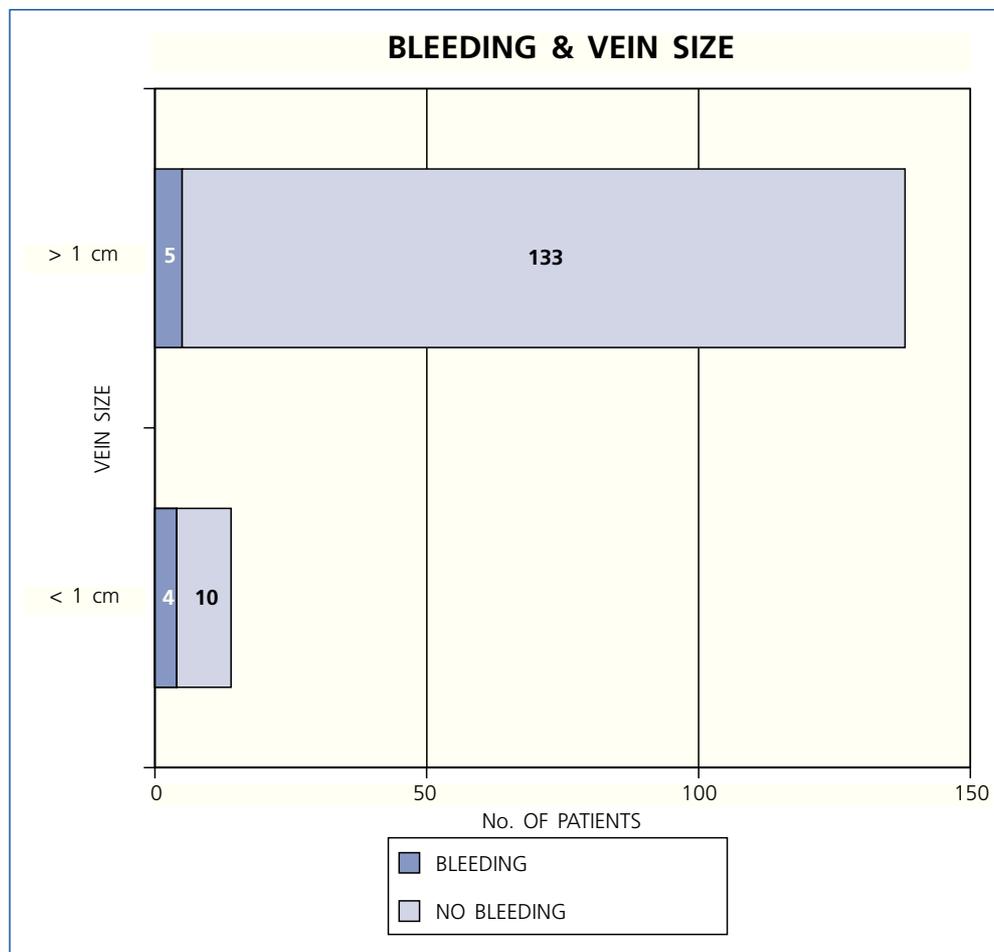


Figure 2.

hospitalization of patients with end-stage renal disease, according to the United States Renal Data System. Alternatives to arteriovenous fistula (AVF), considered the best option for vascular access for hemodialysis, that ensure long-term use with minimal incidents and complications should therefore be searched for.⁶

As regards the concomitant conditions analyzed, a high proportion of patients also had vascular disease or DM, as supported by other publications such as the Álvarez Navascues study at Hospital de San Agustín in Aviles (Asturias), reporting angiosclerosis in 40% and diabetic nephropathy in 26.66% of patients.⁷

Most published studies reported a high success rate of implantation of tunneled catheters. Thus, Wayne MD et al, in a retrospective study on 132 patients with Tesio catheters implanted between 1996 and 1997, found early complications in 2.2% of patients, 2 cases of pulmonary embolism and 2 cases of bleeding requiring surgery, which agrees with the results of other publications on hemodialysis catheters placed by interventional radiology (0.1%-3.6%).⁶ Álvarez R. et al, in a study where 30 patients with end-stage renal disease were implanted Tesio catheters, reported minimal complications during insertion. A single patient required hemostasis at the operating room, and no catheter was removed.⁷

Trerotola et al reported in their study incidence rates of 1.8% for pneumothorax, 0.6% for hemothorax, 1.2% for hemomediastinum, and 4.7% for bleeding requiring exploration or blood transfusion.⁸

Several studies have examined the frequency of air embolism during insertion of central catheters. Thomas M et al analyzed insertion of 11,583 catheters, 4,404 of whom were tunneled catheters. Air embolism was detected in 15 patients by hearing air entry or by fluoroscopic visualization of air within the atrium or pulmonary artery. Embolism occurred in all patients during catheter insertion through the dilator sheath. No symptoms were noted in 4 patients; 6 patients experienced chest pain, dyspnea, or a transient SAT decrease that improved on administration of 100% O₂; 4 patients had a more severe embolism; and the remaining patient suffered massive embolism resulting in death. Authors concluded that air embolism during insertion of central catheters is uncommon, and supplemental oxygen administration is an effective treatment in most patients. The significance of prevention of this complication by maneuvers to increase central venous pressure was also emphasized.⁹

Results of this study are similar to those reported in other series. Two percent of conditions were associated to hemody-

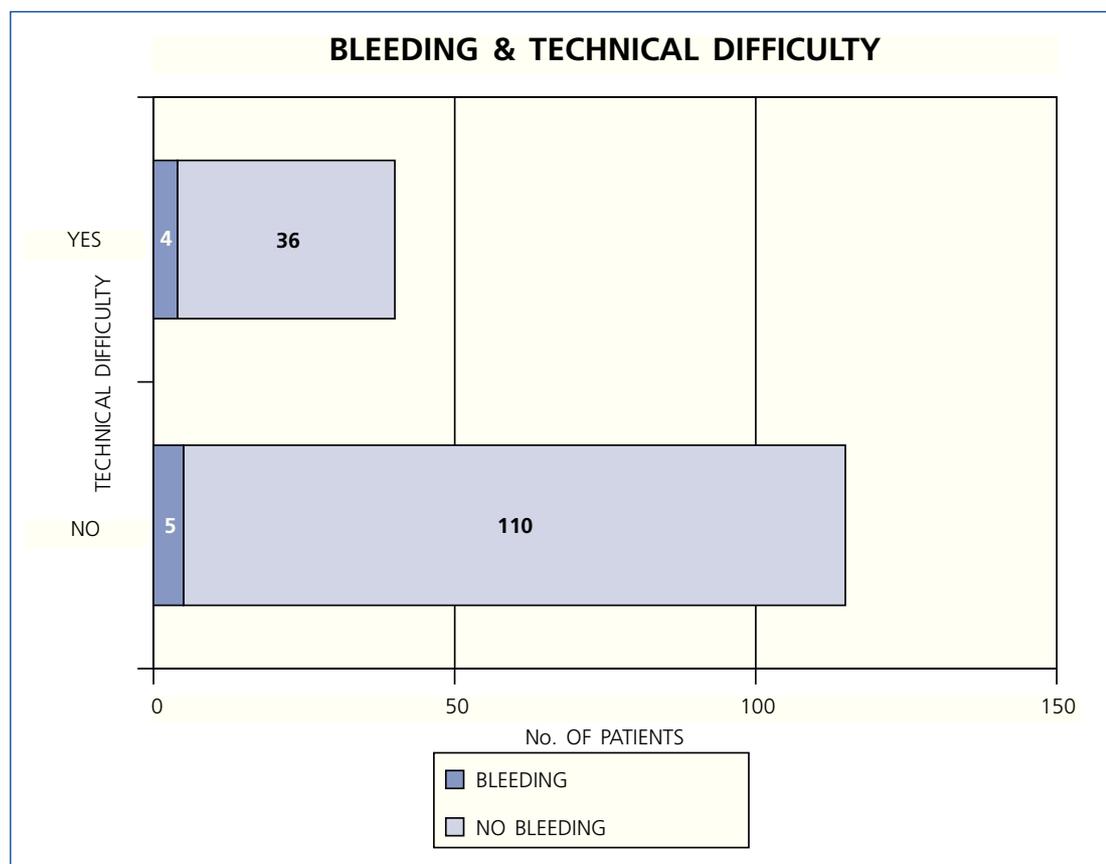


Figure 3.

dynamic instability and, as reported, were resolved with basic measures. Bleeding could always be controlled with local hemostasis using compression, and no patient required surgery or blood transfusion. In this regard, our results are better than those reported in other series. The fact that our experience was analyzed after the staff had overcome the training phase, and also at a time when this type of catheters and their implantation procedure are better understood, may have influenced these results.

Other studies support the Tesio tunneled catheter as a definitive access for dialysis treatment because of its good tolerance and minimal complications as compared to temporal catheters.¹⁰

Use of these catheters in elderly patients not having a long life expectation at the time of entry into hemodialysis could be a valid clinical and financial alternative considering the cost of creation of arteriovenous fistulas, referral to other specialties, use of different temporal catheters, and the potential associated complications.¹¹

In addition, implantation of indwelling catheters by vascular surgeons, radiologists, or endoscopists represents for dialysis units a limitation and dependence that may make it difficult to obtain an effective vascular access as fast as required for treatment start or resumption.^{6,7,12}

In conclusion, implantation of tunneled catheters by a nephrologist and specialized staff is associated to minimal complications and incidents during insertion under

local anesthesia and aseptic conditions. The procedure may therefore be performed at nephrology departments from hospitals having the support of units allowing for addressing the uncommon but possible complications of the procedure.

REFERENCES

1. Jackson J, Litchfield T. How a dedicated vascular access center can promote increased use of fistulas. *Nephrol Nurs J* 2006; 33 (2): 189-96.
2. Huijbregts HJ, Blankestij PJ. Diálisis access-guidelines for current practice. *Eur J Vasc Endovasc Surg* 2006; 31 (3): 284-7.
3. Duncan N, Singh S, Cairos T, Clark M et al. Tesio-Caths provide effective and safe long-term vascular access. *Nephrol Dial Transplant* 2004; 19 (11); 2816-22.
4. Guías de acceso vascular. Catéteres venosos centrales. Capítulo 6. *Nefrología* 2005; 25 (1): 64-92.
5. Asif A, Merrill D, Leon C et al. Strategies to minimize tunneled hemodialysis catheter use. *Blood Purif* 2006; 24 (1): 90-4.
6. Wayne MD, Bettmann M, Baxter B, Langdon D. Outcomes and performance of the Tesio twin catheter system placed for hemodialysis access. *Radiology* 2001; 221: 697-703.
7. Álvarez R, Quiñones L, Guerediaga J. Servicio de Nefrología. Hospital San Agustín. Avilés. Asturias. Catéteres de Tesio permanentes para realización de hemodiálisis crónica: nuestra experiencia en un hospital comarcal. *Nefrología* 2005; 25 (4): 407-11.
8. Trerotola SO, Jonson MS, Harris VJ et al. Outcome of tunneled hemodialysis catheters placed via the right internal jugular vein by interventional radiologists. *Radiology* 1997; 203: 489-495.
9. Thomas M, Vesely. Air embolism during insertion of central venous catheters. *J Vasc Inter Radiol* 2001; 12: 1291-1295.

10. Webb A, Abadía M, Harden PN, Russell G. Use of the Tesio catéter for hemodialysis in patient with end-stage renal failure: 2 years prospective study. *Clin Nephrol* 2002; 58 (2): 128-33.
11. Hernández-Jaras J, García-Pérez H, Torregrosa E et al. Servicio de Nefrología. Hospital General de Castellón. Seguimiento a largo plazo de catéteres permanentes en pacientes con dificultad en la obtención de un acceso vascular definitivo. *Nefrología* 2004; 24 (5).
12. Santos Barajas J, Abáigar P, Stefan G, De Toro R, Carrasco ML. Revisión de las Técnicas Intervencionistas en Nefrología en un Hospital General. Hospital General de Yagüe. Burgos. *Nefrología* 2003; Vol. XXIII (Supl. 6).