BANTAO Journal 2018; 16(2): 112-117

BJ

BANTAO Journal

Case report

Long-Term Hemodialysis Survivor: 33 Years of Maintenance Hemodialysis in a Diabetic Female with a Non-Cuffed Catheter for the Last 18 Years

Bojan Medved, Milena Andonova, Marija Malgaj, Rafael Ponikvar and Jadranka Buturovic Ponikvar

Department of Nephrology, University Medical Center Ljubljana, Ljubljana, Slovenia, Faculty of Medicine, University of Ljubljana, Ljubljana, Slovenia

Abstract

Introduction. Arteriovenous fistula (AVF) is considered the "gold standard" for dialysis access. In cases of frequent fistula thrombosis or when the possibility for the creation of a new native AVF or arteriovenous graft (AVG) is exhausted, one or two "temporary", precurved, non-tunnelled, non-cuffed, single-lumen jugular dialysis catheters can serve as long-term vascular access for selected patients, with a complication rate comparable to that of "permanent" tunnelled catheters. Double-needle hemodialysis can also be performed with this type of "temporary" catheter (for blood take) and peripheral vein (for blood return).

Case report. In this article we present the case of a 63-year-old patient with diabetes mellitus type 1 and a 33-year history of end-stage renal disease and hemodialysis treatment with different vascular accesses. During her lifetime on hemodialysis, she had two native AVFs on the right arm, one Gore-tex AVG on the left arm, three Gore-tex AVGs on the right arm, one Gore-tex AVG on the right thigh, and a tunnelled Ash-split catheter inserted into the right jugular vein that later adhereed to the right atrium wall. Because of exhausted options for the creation of a new native AVF or AVG, she has been on double-needle hemodialysis with single, precurved, non-tunnelled, single-lumen jugular catheters and the peripheral vein for the last 18 years. During this time, she had one case of bacteriemia and one case of Staphylococcus aureus sepsis and, for the second time, adherence of the catheter tip to the right atrium wall (the first being with Ash Split catheter). Our Dialysis Center's experience, including the case we are presenting, suggests that "temporary", precurved, jugular hemodialysis catheters locked with 30% trisodium citrate and the routine use of antibiotic ointment (gramicidin, bacitracin and polymyxin B mixture) at the exit site can be an efficient long-term access for hemodialysis in patients not eligible for AVF or AVG creation.

Conclusion. The patient described is living evidence that long-term survival on hemodialysis is also possible with the described 'temporary' catheter and peripheral veins as vascular access.

Key words: arteriovenous fistula, arteriovenous graft, hemodialysis, hemodialysis catheters, non-tunnelled catheters, tunnelled catheters

Introduction

A well-functioning vascular access is a mainstay for an efficient extracorporeal procedure and long- lasting hemodialysis therapy. Native arteriovenous fistula (AVF) is considered the "gold standard" as a dialysis access. There are three main types of hemodialysis access approaches: AVF, arteriovenous graft (AVG), and central venous catheter (CVC). AVF remains the first choice and the best approach towards the longevity of patients. AVF has the lowest morbidity and mortality, and its use is therefore strongly recommended in the guidelines of different countries. However, when the options for the creation of AVF or AVG are exhausted, a CVC can be used. Among hemodialysis catheters, double-lumen, tunnelled, cuffed catheters are predominantly used worldwide as permanent vascular access because of the lower incidence of exit site infections and bacteriemias compared to non-tunnelled "temporary" catheters.

Much effort has been devoted in past years to improving function and reducing infectious complications when using "temporary" dialysis catheters. At our Center, we have excellent experience with the use of one or two precurved, non-tunnelled, single-lumen jugular catheters that can serve as long-term vascular access. Double-needle hemodialysis can also be performed with this type of jugular catheter (for blood take) and peripheral vein (for blood return). These "temporary" dialysis catheters with trisodium citrate locking may function as an

Correspondence to: Bojan Medved, Department of Nephrology, University Medical Centre Ljubljana, Zaloska cesta 7, 1000 Ljubljana Slovenia; Phone: + 386 1 522 3328; Fax: + 386 1 522 2292; E-mail: drbmedved@gmail.com, bojan.medved@kclj.si

important long-term vascular access for hemodialysis in selected patients. The removal or exchange of such catheters is much easier to perform in comparison with tunnelled catheters.

Case report

A sixty three-year-old female patient was diagnosed with diabetes mellitus type 1 at the age of twelve. She was very tired, had often urinated, and has been inadvertently losing body weight. Since then, she has been continuously treated with insulin. 12 years after the onset of diabetes, she was diagnosed with diabetic retinopathy and, 28 years later, besides being poor sighted in the right eye, she became blind in the left eye after vitrectomy. She also underwent cataract surgery on the right eye. In October 1985, at the age of 30, she was put on chronic hemodialysis due to end-stage renal disease (ESRD). She had arterial hypertension for many years, ischemic heart disease with 4 myocardial infarctions, several coronary percutaneous coronary interventions, generalized atherosclerosis, hyperlipidemia, paroxysmal atrial fibrillation, parathyroidectomy due to secondary hyperparathyroidism, carpal tunnel surgery on both hands, peripheral occlusive artery disease, and several percutaneous transluminal angioplasty procedures on the arteries of the lower limbs. She had no amputations. Despite all the comorbidities, the patient was able to take care of herself and did not depend on foreign aid.

The first vascular access in the patient was a single-lumen femoral catheter. Two months after she started hemodialysis treatment, a native radiocephalic AVF was created on the right forearm, and thrombosed the next day. After five days, a new anastomosis was created proximally, 10 cm below the right elbow. The fistula was used for a few months. She was then on two non-tunnelled, single-lumen jugular catheters for 5 years. The catheters were routinely exchanged over the guidewire every 1.5-2 years, usually due to mechanical damage. Afterwards, we attempted to create a native AVF on the left upper arm, but because of vein fibrosis the operation failed. A few days later, a Gore-tex AVG was successfully created on the right upper arm, but unfortunately thrombosed after a few months. Later in the same year, a Gore-tex AVG was created on the left upper arm and was successfully used for 3 years. Soon afterwards, 2 pseudoaneurysms developed and the AVG thrombosed. Thrombectomy was unsuccessful. Nine years after starting hemodialysis, a Gore-tex AVG was created on the right thigh, but unfortunately also thrombosed after one month. The next year, a Gore-tex AVG was created on the right upper arm, which also thrombosed soon after surgery. Over the next 5 years, hemodialysis was performed using one precurved, non-tunnelled, single-lumen jugular catheter and the peripheral veins of the legs (for blood return). After 14 years on hemodialysis, a tunnelled Ash-split catheter was inserted into the right jugular vein. Soon afterwards, the arterial line of the catheter thrombosed and the venous line began to be used as an "artery", thus enabling the blood to return to the peripheral vein. Sixteen months after insertion of the tunnelled catheter, an attempt was made to exchange the catheter over the guidewire. The exchange was unsuccessful, as the catheter tip adhered to the right atrium wall. The catheter was removed conservatively by cardiovascular surgeons. After 21 years of hemodialysis, another attempt was made to create an AVF with the end of the right ulnar vein and the side of the ulnar artery, where a Gore-tex jump graft helped to prolong the too short ulnar vein. The surgery was unsuccessful.

Due to exhausted vasculature preventing the creation of an AVF or AVG, double-needle hemodialysis was performed with a single, precurved, non-tunnelled, single-lumen jugular catheter inserted into the right or left jugular vein as the "artery", and the peripheral veins as the "vein" for the last 18 years. The patient has been dialysed in this way 4 times a week for 3 hours. Nine years after using this vascular access, bacteremia occurred with an infection of the thrombus in the right atrium at the tip of the dialysis catheter. The thrombus was reabsorbed with appropriate antibiotic and anticoagulant therapy. Four years ago, during an attempt to exchange the catheter by guidewire, adherence of the catheter tip to the right atrium wall was detected for the second time. After perfusing the catheter with alteplase, it was successfully removed. Due to an ultrasound-visible fibrin formation in the right atrium, she received a therapeutic dose of low-molecular weight heparin for several weeks. After removal of the catheter, a dialysis catheter was inserted into the left jugular vein. Three years ago, the patient developed catheter-related Staphylococcus aureus sepsis. Since then, the jugular catheter has been regularly exchanged by guidewire every 6 months in order to avoid adherence.

During the entire 18-year period, the jugular catheters were locked with trisodium citrate solution-4% from 2001 to 2005, 30% from 2005 to the present day. Antibiotic ointment was used at the exit site-mupirocin from 2000 to 2016, mixture of gramicidin, bacitracin and polymyxin B from 2016 to the present day.

The patien thad never decided to have a transplant. She is also the mother of a 38 year-old daughter.

The patient has signed a Slovenian translation of a BMJ Consent Form concerning all personal and medical information used in this publication.

Discussion

Our case report demonstrates that it was possible to use a precurved, non-tunnelled, single-lumen jugular catheter (Figure 1), with trisodium citrate as locking solution and antibiotic ointment at the exit site, as long-term vascular access, providing double-needle

hemodialysis and using the peripheral vein (Figure 2) for blood return, for 18 years.

Although the best vascular access for chronic hemodialysis is AVF, the incidence and prevalence of hemodialysis catheters in ESRD patients is increasing [1]. Catheters are needed because of the long maturation of AVF, or when AVF or AVG cannot be created due to exhaustion of vasculature [2]. Some patients develop a rapidly progressive kidney disease, which precludes timely planning for arteriovenous access surgery. For these reasons, 68% of patients in Europe initiate dialysis using a central venous catheter as vascular access

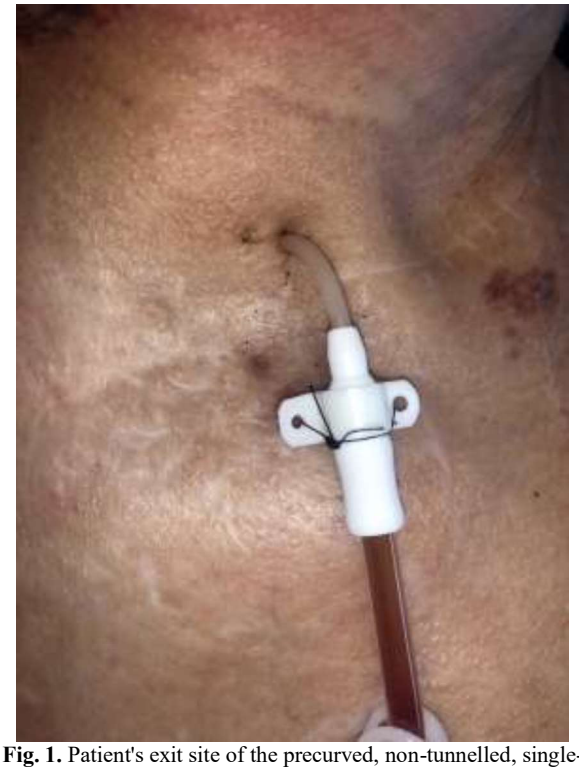

Fig. 1. Patient's exit site of the precurved, non-tunnelled, single-lumen jugular catheter

[3]. Tunnelled, cuffed, double-lumen, central venous catheters are recommended among catheters for chronic hemodialysis [4].

Furthermore, when a catheter is to serve as permanent hemodialysis vascular access, a tunnelled catheter is recommended by various guidelines [5,6], which also strongly discourage the use of temporary catheters, mainly due to higher infection rates compared to tunnelled ones [7]. Despite the guidelines and recomendations, our Center's experience with tunnelled, double-lumen catheters has taught us that dialysis patients and personnel are often confronted with the malfunction of at least one (arterial) or both catheter lumens in tunnelled, double-lumen catheters. The use of the "temporary", non-tunnelled, single-lumen jugular catheter was advised to last for less than 1 week, and femoral catheters for less than 5 days [6]. However, clinical practice at our Center and elsewhere has shown that "temporary" precurved catheters can be used for a much longer period of time, even several months or years, with a complication rate comparable to that of "permanent" tunnelled catheters.

Fig. 2. Patient's peripheral (ulnar) vein for blood return

In spite of the guidelines and recommendations, we have a long-standing practice of using two "temporary", precurved, non-tunnelled, single-lumen catheters inserted into the same jugular vein as permanent vascular access in selected patients not eligible for an AVF, AVG, or a kidney transplant. The recently published observational study has shown that tunnelled and precurved, non-tunneled, jugular catheters are comparable in terms of reaching the combined endpoint of catheter-related infections and catheter malfunction [8]. The observations in recent and our own studies [9-12,22] are of considerable significance, as the most recent KDOQI guidelines [6] recommend the use of tunnelled catheters in the event that central venous catheters are used for more than 1 week. This guideline [6] is of an older age (2006) and does not mention the use of precurved catheters. The recommendations are based on older literature and experience in which non-tunnelled catheters were all straight. This can explain the preference for and advantage of tunnelled over non-tunnelled catheters. At our Center, we have excellent experience with the use of two precurved, non-tunnelled, single-lumen, predominantly jugular catheters for vascular access in patients with acute renal failure [9], and we successfully use "temporary", precurved hemodialysis catheters as long-term vascular access in selected chronic hemo-

dialysis patients [10]. The use of antimicrobial citrate-locking solution in combination with a precurved, non-tunnelled, jugular catheter may have a special advantage. Antibiotic ointment at the exit site may have a lubricating effect on the exit site, avoiding skin damage and enabling maturation of the exit site in addition to the antimicrobial effect. The advantage of using precurved, non-tunnelled, single-lumen jugular catheters is in that the replacement of a malfunctioning catheter is a much less traumatic and easier procedure than the replacement of a much thicker, double-lumen, tunnelled catheter [9]. "Temporary", precurved, jugular catheters could be an optimal permanent vascular access in very elderly patients when the placing of an AVF is not feasible [11]. Two precurved, single-lumen, hemodialysis catheters in the same jugular vein, locked with 30% trisodium citrate, seem to be a safe and long-lasting form of vascular access for hemodialysis and apheresis in selected patients [12].

We have demonstrated that "temporary", precurved, non-tunnelled, single-lumen jugular catheters (one or two), with trisodium citrate as locking solution, can be successfully used as long-term vascular access in chronic hemodialysis patients, with a complication rate (malfunction and infection) comparable to tunnelled, cuffed catheters, and having the important advantage of much easier insertion, exchange and removal. The main reasons for catheter exchange or removal were malfunction and mechanical damage [10]. In the case of thrombosis, catheter thrombolysis is an efficient procedure, otherwise catheter exchange over a guide-wire can be performed [9].

Much effort has been devoted in past years to improving function and reducing complications when using "temporary" hemodialysis catheters, which are much easier to handle and can easily be removed or replaced by guide-wire at the bedside [10]. In contrast, the insertion, removal or exchange of tunnelled catheters can only be performed by a physician with surgical skills. The design of precurved, "temporary", single-lumen jugular catheters, which are bent over the clavicle and fixed to the chest wall, restrain movement of the catheter at the exit site, thus reducing microinjury of the adjacent tissue and consequently improving resistance of the tissue against infection [13]. Locking solutions preserve the patency of the catheter in the interdialytic period, and prevent the formation of intraluminal biofilm and bacterial colonization within the lumen. Until some years ago, tunnelled silastic catheters were the only catheters used for permanent vascular access [15]. The main reason for their use was the significant reduction of bacteremia compared to straight, non-tunnelled catheters [16]. New evidence has shown that thrombosis rates of the "temporary" hemodialysis catheter inserted into the right internal jugular vein was higher with straight versus precurved "temporary" hemodialysis catheter, both during catheter dwell-time and after catheter removal [17]. The newly designed, precurved, "temporary" jugular catheters were comparable to the tunnelled ones, or were even better in terms of incidence of exit site infections and bacteremias. Previously, we presented our excellent results with "temporary", precurved, jugular catheters: only 0.2 exit site infections and 0.2 bacteremias per 1000 catheter days [10]. The bacteremia rate was much lower even when compared with tunnelled, cuffed catheters (1.6–5.5 bacteremias/1000 catheter days) [18-20]. The low incidence of infection observed in this study is probably not due solely to the new design of the catheter, but also its locking with 30% trisodium citrate and the routine use of antibiotic ointment at the exit site (mupirocin or a mixture of gramicidin, bacitracin and polymixin B). Excellent results with precurved, "temporary" jugular catheters have also been observed by others [8,13]. For more than 10 years, a 30% trisodium citrate solution has been used as locking solution for hemodialysis catheters at our Dialysis Center. Besides acting as a local anticoagulant, it has also exerted antimicrobial activity and presumably contributed to the lower infection rate related to catheters. No significant side-effects have been observed so far, which can also be attributed to the smaller priming volume (around 1 ml) of the catheter compared to the tunnelled ones. Nevertheless, careful priming is recommended and we never exceeded the priming volume of the catheter [21].

The nephrologists at our Center have taken care of all kinds of vascular access: the creation and reconstruction of AVF and AVG, and insertions of hemodialysis catheters. As a busy dialysis and apheresis unit and a referral center for vascular access, we performed 822 hemodialysis catheter insertions in 2018.

Conclusion

Long-term hemodialysis survivors, such as the patient described above, are living evidence of the remarkable accomplishment, but also limitations, of hemodialysis therapy. The case of our patient suggests that "temporary", precurved, non-tunelled, jugular hemodialysis catheters with trisodium citrate locking and routine use of antibiotic ointment at the exit site can serve as a chronic, long-term access for hemodialysis in patients not eligible for AVF or AVG creation, even those with severe diabetic complications. Returning blood to the peripheral vein can enable double-needle hemodialy sis, together with the use of this type of catheter. In our patient, who has been dialyzed in this way for 18 years,the peripheral veins of the legs and arms "matured" like a fistula vein, both in vein diameter (about 4.2 mm) (Figure 3) and wall thickness (about 1

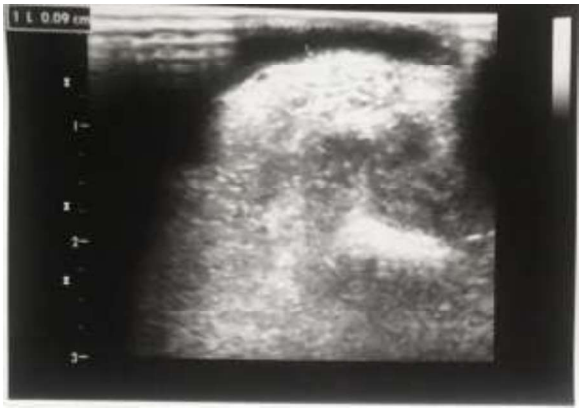

Fig. 3. Patient's peripheral (ulnar) vein 'matured ' like a fistula vein in diameter (about 4.2 mm)

mm) (Figure 4 and 5). During these 18 years she had two catheter-related infections and single occurrence of catheter adherence to the right atrium wall with using a "temporary"catheter (the first being with Ash Split catheter). However, new evidence has revealed that tunnelled and precurved, non-tunnelled jugular catheters are comparable in terms of reaching the combined endpoint of
catheter-related infections and malfunction. Regardless of the possible complications, such hemodialysis catheters can enable the long-term survival of a dialysis patient through proper medical care and teamwork between the patient and dialysis personel.

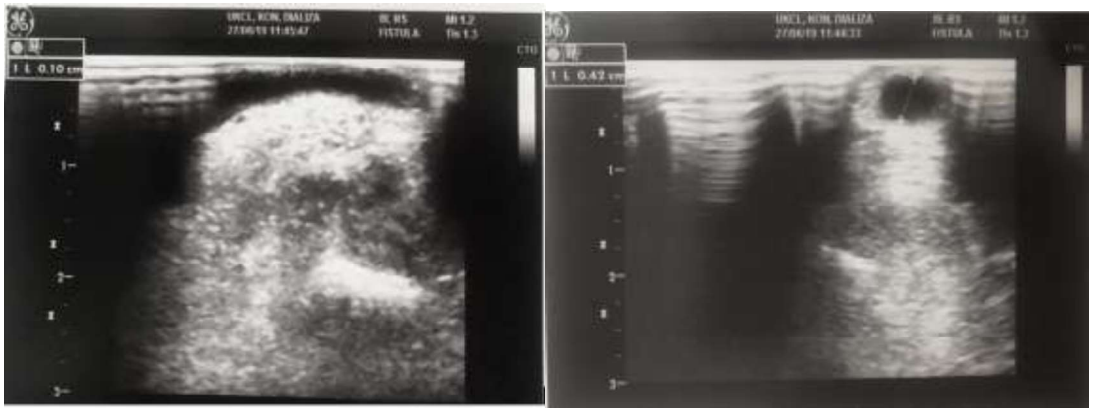

Fig. 4 and 5. Same ulnar vein 'matured' in wall thickness (about 1 mm)

Conflict of interest statement. None declared.

References:

1. Malas MB, Canner JK, Hicks CW, *et al*. Trends in incident hemodialysis access and mortality. *JAMA Surg* 2015; 150 (5): 441-448.
2. Sands JJ. Vascular access: the past, present and future. *Blood Purif* 2009; 27: 22-27.
3. Noordzij M, Jager KJ, Van Der Veer SN, *et al*. Use of vascular access for haemodialysis in Europe: a report from the ERA-EDTA registry. *Nephrol Dial Transplant* 2014; 29(10): 1956-1964.
4. Cetinkaya R, Odabas AR, Unlu Y, *et al*. Using cuffed and tunnelled central venous catheters as permanent vascular access for hemodialysis: a prospective study. *Renal Failure* 2003; 25: 431-438.
5. Tordoir J, Canaud B, Haage P, *et al*. EBPG on vascular access. *Nephrol Dial Transplant* 2007; 22(Suppl 2): 88-117.
6. KDOQI clinical practice guidelines and clinical practice recommendations-2006 Updates. *Nephrol Nurs J* 2006; 33.
7. Vanholder R, Canaud B, Fluck R, *et al.* Diagnosis, prevention and treatment of haemodialysis catheter-related bloodstream infections (CRBSI): a position statement of European Renal Best Practice (ERBP). *NDT Plus* 2010; 3(3): 234-246.
8. van Oevelen M, Abrahams AC, Weijmer MC. Precurved non-tunnelled catheters for haemodialysis are comparable in terms of infections and malfunction as compared to tunnelled catheters: A retrospective cohort study. *J Vasc Access* 2019; 20(3): 307-312.
9. Ponikvar R. Hemodialysis catheters. *Ther Apher Dial* 2005; 9: 218-222.
10. Ponikvar R, Buturovic-Ponikvar J. Temporary hemodialysis catheters as a long-term vascular access in chronic hemodialysis patients. *Ther Apher Dial* 2005; 9: 250-253.
11. Gubensek J, Zrimsek M. Temporary Catheters as a Permanent Vascular Access in Very Elderly Hemodialysis Patients: Frequency of Complications and Interventions. *Ther Apher Dial* 2016; 20(3): 256-260.
12. Kovac J, Premru V. Two Single-Lumen Noncuffed Catheters in the Jugular Vein as Long-Term Vascular Access: A Preliminary Report. *Therapeutic Apheresis and Dialysis* 2011; 15(3): 311-314.
13. Weijmer MC, Vervloet MG and Ter Wee PM. Prospective follow-up of a novel design haemodialysis catheter; lower infection rates and improved survival. *Nephrol Dial Transplant* 2008; 23(3): 977-983.
14. Allon M, Brouwer-Maier DJ. Recommended Clinical Trial End Points for Dialysis Catheters. *Clin J Am Soc Nephrol* 2018; 13(3): 495-500.
15. Ponikvar R, Malovrh M, Premru V, *et al*. Silastic jugular catheter as permanent vascular access in hemodialysis (HD). *Artif Organs* 1995; 19: A 1039.
16. Randolph AG, Cook DJ, Gonzales CA, Brun-Buisson C. Tunneling short-term central venous catheters to prevent catheter-related infection: a meta-analysis of randomized, controlled trials. *Crit Care Med* 1998; 26: 1452-1457.
17. Sahutoglu T, Erinc O, Avsar FN. Which Type of Temporary Hemodialysis Catheter Should Be Used for the Right Internal Jugular Vein? Prospective Observational Study of

Straight vs. Precurved Catheters. *Ther Apher Dial* 2018 Nov 16; doi: 10.1111/1744-9987.12776.-Accepted article.
18. Little MA, O'Riordan A, Lucey B, *et al*. A prospective study of complications associated with cuffed, tunneled hemodialysis catheters. *Nephrol Dial Transplant* 2001; 16: 2194-2200.
19. Saad TF. Bacteremia associated with tunneled, cuffed hemodialysis catheters. *Am J Kidney Dis* 1999; 34: 1114-1124.
20. Beathard GA. Management of bacteremia associated with tunneled cuffed hemodialysis catheters. *J Am Soc Nephrol* 1999; 10: 1045-1049.
21. FDA. FDA Talk Paper. FDA Issues Warning of Tricitrasol Dialysis Catheter Anticoagulant. Available at: http://www.fda.gov/bbs/topics/ANSWERS/ANS01009.html. Accessed April 14, 2000.
22. Buturovic-Ponikvar J, Persic V, Malovrh M, Ponikvar R. Vascular access in patients treated with chronic hemodialysis for 30 years or more. *Ther Apher Dial* 2009; 13(4): 354-357.