

Central Vein Catheters Complications at Hemodialysed Patients

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ABSTRACT Venous catheters are used for patients with chronic renal failure who need urgent haemodialysis (HD), but without available mature access, and patients on maintenance HD who have lost their permanent access function. The aim of this retrospective clinical study was to determine the incidence of venous catheter complications in chronic HD patients. We analyzed 80 patients, 47 men and 33 women, with median age 49 years, who underwent chronic hemodialysis in Hemodialysis Center Craiova. 80 patients used 100 venous double lumen catheters giving a total experience of 13.749 catheters days. 40 catheters required at start of HD and 60 catheters used during entire time on HD. 60 catheters was in internal jugular vein, 25 of catheters was in femoral vein and 15 of catheters was in subclavian vein. Complications in the femoral approach were: infection and removal 40%, catheters thrombosis 30%, bleeding from a punctured femoral artery in 5%, groin hematoma 3,5%, poor flow 3,5%. In the jugular vein approach, infection occurred in 30% patients, thrombosis in 20% patients and accidental withdrawal in 3,36%. Blood-culture-proven sepsis severe enough to require hospitalization occurred in 10 patients (17%), 3 patients development infectious endocarditis and 2 patients died. One misplacement into the carotid artery were noted and another complication was punctured carotid artery with development an arterio-venous fistula. In the subclavian vein approach, catheters disfunction was found in 20% patients, infectious in 33% patients and deep vein thrombosis in 6,66% patients. Central venous catheters are still associated with a high rate of complications and may be a regular access choice only no other option available for haemodialysis.

KEY WORDS venous catheter, jugular vein, subclavian vein, femoral vein

Introduction Study justification

The vascular access still represents a problem for hemodialysis treatment (1). Its complications are in first place from all causes of medical examinations in vascular affections, representing 16-25% from all the patients with hemodialysis (HD) that are admitted in hospital (2,3).

The vascular access can be used for a limited amount of time or can be permanent.

The necessity of a vascular access can vary from a few hours (one session of hemodialysis) to a few weeks. The temporary vascular access is obtained from the percutaneous insertion of a catheter into a highly flow vein: femoral vein, jugular vein or subclavian vein (5).

The cannulation of the femoral vein is considered the safest method of obtaining a temporary vascular access (7), and due to the recent technical improvements the catheter can be maintained for a relatively long time (8).

The venous catheters are used for hemodialysis on patients with acute renal insufficiency, on those with chronic renal insufficiency that require urgently hemodialysis but do not have a functional arteriovenous fistula, on the patients

that make HD therapy but lost their vascular access due to thrombosis, and also on patients treated with peritoneal dialysis but that require the repose of peritoneum cavity (5).

The dysfunction of the catheter is defined by absence of a adequate blood flux through its channel (4).

In 1969 Erben made the first temporary cannulation of subclavian vein for hemodialysis (9), and Uldall mounted in 1979 the first subclavian catheter that was maintained for a long amount of time (10).

The most frequent complications that require removing the catheter are thrombosis and infection. If the improvement of technical knowledge of the last years determined the significant loss of the rate of losing the catheter's functionality due to thrombosis, the infection still remain the major cause for losing their functionality. (11, 12).

Objective

The objective of this clinical study was the evaluation of the complications of central venous catheter and the incidence of these complications on the chronic HD patients.

Material and method

Duration

The study is retrospective and it was made on the patients that are in evidence of the Hemodialysis Center of the Clinical Emergency Hospital Craiova between 1st of June 2007 and 1st of June 2008, patients that had mounted at least one catheter in the period of the HD treatment.

For obtaining the biographical data of the patients and also for the clinical and paraclinical data I had access on the computer data based of the Haemodialysis Center, the daily data sheets and the protocols of HD of the patients.

Subjects

The characteristics of the studied patients was 80: 47 (58%) men and 33 (42%) women, with a medium age of 49 years. The medium duration of the HD treatment was 8.3 years, 24% of the patients having more than 10 years of HD treatment and 5% over 15 years of substitutive treatment.

The chronic renal failure was determined in most of the cases by primitive chronic glomerulonephritis (Table I).

Table I. The characteristics of the studied patients

Demographical data	
Age (years)	49±13.1
Sex (men, %)	58
Treatment on HD (years)	8.3±6.8
over 10 years (%)	24
over 15 years (%)	5
Index of body mass (IBM kg/mp)	24.6±4.5
The causes of renal disease in terminal stage:	
Chronic glomerulonephritis (%)	53
Interstitial nephropathy (%)	15
Hereditary and congenital diseases (%)	13
Vascular diseases (%)	9
Systemic diseases (%)	6
Others/unknown (%)	4

Therapeutic intervention

All the patients included in the study have made HD after the standard scheme of the center: 3 sessions per week, each session with a duration of 4.5 hours, in total 13.5 hours in a week.

100 venous catheters were mounted on the 80 patients: 40 (40%) were mounted on the beginning of the renal substitution therapy, the rest of 60

(60%) were implanted during the time of HD therapy when the fistula became nonfunctional. The catheters used were catheters with double lumen made from polyuretan. The mounting of this catheters was made in the jugular vein, subclavian vein and femoral vein, using a Seldinger modify technique, all made without tunneling. To locate the jugular it was preferred the right jugular vein because the trajectory of the vein is directly to the atrium, and the pleura's pulmon and dome is situated lower than the left side. The catheters were inserted using a aseptic technique, and the tegument was disinfected with chlorinehexidine 2%.

The control thoracic radiography was made immediately and all the patients were hemodialysed in the first 24 hours from the catheter's mounting.

The permeability of the catheters was maintained by the instillation of saline solution with heparin on every 12 hours, and the changing of the exit orifice's bandage was made after each hemodialysis.

The catheter's distribution after the vein of implantation was as follows: in jugular vein 60 (60%), in femoral vein 25 (25%), in subclavian vein 15 (15%). In the case of 10 (40%) patients with femoral catheter it was used a bleeding technique by discovering the saphenous internal vein with minimal phlebotomy.

The insufficient flow is defined by flow < 200 ml/min. do not increase due to this maneuvers: Trendelenburg position, Valsalva maneuver, irrigation of the catheter with saline solution, repeated maneuvers of washing the catheter, rotation of the catheter between 90-180 degrees. The catheter was removed if presented insufficient flow to 2 or more consecutive dialysis.

The patients immuno-compromised were considered patients with cancer, diabetes mellitus, pulmonary disease, chronic graft rejection or those with the systemic erithematos lupus on corticotherapy.

The suspicion of bacteraemia associated with the catheter I defined it as fever > 38 degrees or any unspecific systemic symptom on a patient with central venous catheter that didn't had an apparent source of infection during a thorough and complete clinical examination.

The bacteraemia was confirmed related with the catheter if the same germ was found in two peripheral locations or at the catheter and a peripheral location.

I noted for each patient any complication that occurred and the clinical response to the treatment.

Statistic analysis

All the data were processed using descriptive methods: the media and standard deviation for the parameters with normal distribution, respectively the median and the gap between the quartiles for the non-parametric values.

The ANOVA, Mann-Whitney and t-Student tests were used to compare the results. The value $p < 0.05$ was considered statistic significant.

Results

In the 12 months study period there were mounted 100 catheters to 80 patients in total 12 044 catheter-days. 40 (40%) catheters were implanted at the initiation of the treatment on patients that required urgently dialysis without having a mature vascular access, and 60 (60%) catheters were implanted on patients on therapy who had nonfunctional vascular access.

60 (60%) catheters were implanted in the internal jugular vein, 15 (15%) were implanted in subclavian vein and 25 (25%) in femoral vein.

The blood flow and the dialysis liquid were 250 ml/min, respectively 500 ml/min.

The complications associated with the presence of the catheter were classified in reference with the moment of apparition and also based on location. (Table II)

Table II. Classification of the complications determined by catheter

Based on the moment of release	Precocious – associated with the implanting maneuver
	Late – without any connection with the implanting maneuver
Based on the location of the catheter	Complications of the femoral vein's cannulation
	Complications of the internal jugular vein's cannulation
	Complications of the subclavian vein's cannulation

The complications regarding the catheter's mounting were as follows: the puncture of the femoral artery with abundant bleeding on 2 (2.5%) patients, the hematoma on 1 (1.25%) patient, the penetration of the carotid artery with performing a fistula arterio-venous on 1 (1.25%) patient, the accidental cannulation of the carotid artery on 1 (1.25%) patient, the impossibility of the cannulation of the vein on 3 (3.75%) patients, pneumotorax at 0 patients. (Table III).

The complications of the catheters that appeared late were as follows: insufficient flow on 4 (5%) patients, infection on the implantation orifice on 35 (43.75%) patients, bacteraemia on 10 (17%) patients, infectious endocarditis on 3 (3.75%) patients, thrombosis of the catheter on 19 (23.75%) patients, the accidental extrusion of the

catheter on 3 (3.75%) patients, curving with the bent of the catheter on 4 (5%) patients and profound venous thrombosis on 1 (1.25%) patient. (Table III)

Table III. The complications of the catheters due to the moment of release

Associated with the implantation maneuver	
The puncturing of the femoral artery with heavy bleeding	2 (2.5%)
Hematoma	1 (1.25%)
The penetration of the carotid artery with the forming of a arterio-venous fistula	1 (1.25%)
The accidental cannulation of the carotid artery	1 (1.25%)
The impossibility of the vein's cannulation	3 (3.75%)
Pneumotorax	0 0
Late – with no connection with the moment of the implantation	
Insufficiency flow	4 (5%)
Infection of the external orifice	35 (43.75%)
Bacteraemia related with the catheter	10 (12.5%)
Infectious endocarditis	3 (3.75%)
The catheter's thrombosis	19 (23.75%)
The accidental extrusion of the catheter	3 (3.75%)
Curving with the bent	4 (5%)
Profound venous thrombosis	1 (1.25%)

From the patients with femoral catheter: 2 (8%) presented bleeding by puncturing the femoral artery, 1 (4%) patient presented significant hematoma, 10 (40%) patients made an infection on the catheter's level, on 1 (4%) patient the catheter had an insufficient flow, on 7 (30%) patients the catheter made thrombosis, curving with the bent presented 1 (4%) catheter. (Table IV).

Table IV. The complications of the femoral vein's cannulation

Bleeding from puncturing the femoral artery	2 (8%)
Bleeding from ripping the femoral artery	0
Hematoma	1 (4%)
The infection of the catheter	10 (40%)
Flow insufficiency	1 (4%)
Catheter's thrombosis	7 (30%)
Curving with the bent	2 (8%)

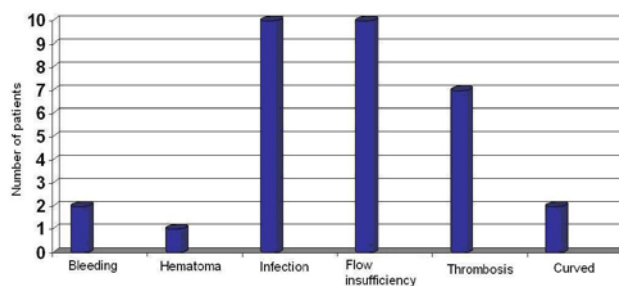


Fig. 1 The complications of the femoral vein's cannulation

The patients whom had mounted internal jugular catheter presented the following

complications: the infection of the exterior orifice 20 (30%) patients, bacteraemia 10 (17%) patients, infectious endocarditis 3 (4.98%) patients, the accidental carotid artery's cannulation 1 (1.7%) patient, making an arterio-venous fistula with the carotid artery on 1 (1.7%) patient, curving with the bent of the catheter on 3 (4.98%) patients, catheter's thrombosis on 12 (30%) patients, the accidental extrusion of the catheter on 2 (3.36%) patients and there was no cases of pneumotorax. (Table V).

Table V. The complications of the jugular vein's cannulation

The infection of the catheter's orifice	20	(30%)
Bacteraemia	10	(17%)
Infectious endocarditis	3	(4.98%)
Carotid artery's cannulation	1	(1.7%)
Making an arterio-venous fistula with carotid artery	1	(1.7%)
Curving with the bent of the catheter	3	(4.98%)
Catheter's thrombosis	12	(30%)
Accidental extrusion	2	(3.36%)
Pneumotorax	0	

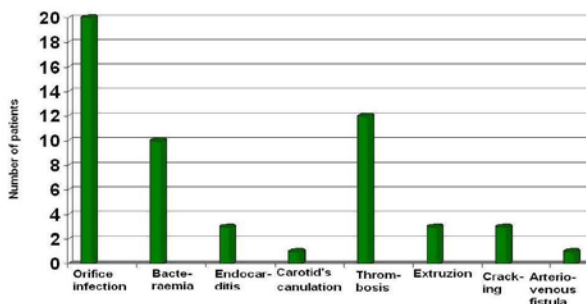


Fig. 2 The complications of the jugular vein's cannulation

The complications of the subclavian vein's cannulation were as follows: the infection of the catheter on 5 (33%) patients, the dysfunction of the catheter (thrombosis or bent of catheter) on 3 (20%) patients, profound venous thrombosis on 1 (6.66%) patients. (Table VI).

Table VI. The complications of subclavian vein's cannulation

Infection	5	(33%)
Curving with the bent	0	
Dysfunction of catheter (thrombosis or bent of catheter)	3	(20%)
Profound venous thrombosis	1	(6.66%)

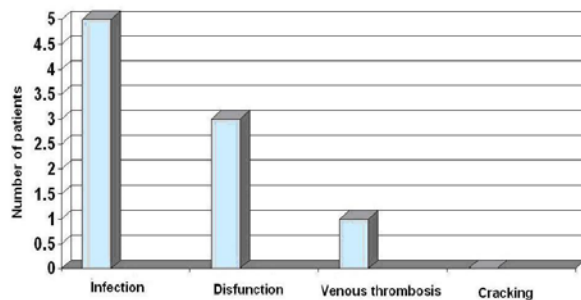


Fig. 3 Complications of subclavian vein's cannulation

10 cases (17%) of the patients presented 15 bacteraemia episodes, the incidence of it was 3.9 episodes/1000 catheter/days. 10 (66%) of 15 bacteremia episodes confirmed were caused by positive coccus gram, 2 (13%) by negative bacillus gram, 1 (7%) by positive bacillus gram and 2 (13%) episodes were caused by more than a germ. The most frequent isolated germ was Staphylococcus aureus. (Table VII).

Table VII. Isolated germs from 15 episodes of bacteremia

Positive coccus gram		
Staphylococcus aureus meticilin resistant	5	(33.33%)
Staphylococcus aureus meticilin sensitive	3	(20%)
Staphylococcus coagulazo-negative	1	(6.66%)
Enterococcus faecalis	1	(6.66%)
Bacillus gram positives		
Corynebacterium diptheriae	1	(6.66%)
Bacillus gram negatives		
Pseudomonas aeruginosa	1	(6.66%)
Klebsiella pneumoniae	1	(6.66%)
Multiple organisms		
Escherichia coli+Klebsiella	1	(6.66%)
Staphylococcus aureus+Acinetobacter	1	(6.66%)

Discussions

The cannulation of a central vein offers the immediate obtaining of an access for dialysis.

The central venous catheter is an attractive alternative of the Scribner shunt having the big advantage to protect the integrity of the peripheral veins.

It is relatively easy to place it into the vein: although, the thickness and the length of this catheter permit the potential erosion of the atrium or of the wall of the venae cavae; so for the cannulation of the jugular vein are used the catheters with smaller dimensions.

Our results show that bacteremia related to catheter appears frequently on patients with dialysis. 17% of our patients developed an episode of bacteremia during the period of the study.

The bacteremia had the highest frequency at 33% on catheters locate in the jugular vein.

The risk to develop a bacteremia related on the catheter was higher on the patients immune-suppressed. The septic metastasis appeared on the infections with coccus gram positives, the bacteraemia caused by Staphylococcus aureus was accompanied by secondary determinations on the cardiac valves level, bones and articulated surfaces. The complication with infectious endocarditis determined the increase of the mortality on this patients.

On the patients with bacteraemia where the catheter was not removed immediately, leaving it there for 3 days waiting for the result of the antibiotic treatment result there was no higher risk

of develop complications in comparison with the patients where the catheter was removed immediately. The suggestion of some authors is that on some selected groups of patients where the mounting of a catheter is difficult, if they are hemodynamic stable and with no signs of tunneling, is to try initial the saving of the catheter by antibiotic treatment.

The most frequent complications that require the removing of the catheter are the thrombosis and the infection. Although in the last years the rate of catheter's thrombosis has diminished significantly due to improvements of technique, the catheter's infection remains the major cause of catheter's removal. In this case it is stipulate that the use of catheters impregnated with silver and antibiotic will reduce the rate of the infections associated with catheters.

The infection of the catheter's implantation orifice had the higher rate in their femoral locating. Our results regarding the incidence of catheter's infection marked out by crust and erythema are accordingly to the results of Hung and col. (13), Kite and col. (14) and Weyde and col. (6) who observed the infection of the exit orifice on 14.2% of their patients. Oliver and col. (15) reported an incidence of bacteraemia of 1.9% in the first day after the insertion of the femoral catheters, but if the catheter was not removed the next day the bacteraemia rises at 13.4%.

The thrombosis of the catheter was frequent on all types of localizations, in our study 19 patients presented catheter's thrombosis despite the periodical treatment with heparin of the catheters. This could happen due to poor quality of the materials which the catheters are made or due to infection. This results are accordingly to those of Bloz and col. (16), Diskin and col. (17) and Weyde (6) who reported a rate of catheter's thrombosis of 17.1%. Al-Wakleel and col.(18) reported the catheter's thrombosis only at 4 from 96 patients.

Contrary to our results, Daeiagh (19) does not consider catheter's thrombosis a problem, probably because he uses tissue plasminogen activator for catheter's maintenance instead of using heparin like us.

Other complications of the catheters found in our study, like hematoma on 1 (4%) patient and bleeding due to puncturing of the femoral artery on 2 (8%) patients, are similar with the data reported by Al-Wakeel (18).

Van Waeleghem (20) mentioned in his observations that an inadequate vascular access causes the inefficiency of the dialysis and also causes the increase of co-morbidities and

mortalities on those patients. Comand and col. (21) show that the blood stream and the dose of dialysis offered by the central venous catheter are smaller with 5-6% in comparison with those offered by the arterio-venous fistula.

Dhingra and col. (2) affirmed that the patients with central venous catheter have a higher mortality rate due to the rising of infection's incidence. And Pastan (23) told that the high risk of infection is associated with the risk of decease of the patients on dialysis. The rate of mortality was higher on patients with central venous catheter dialysis (16.8%) in comparison with those with arterio-venous fistula dialysis (7.3%).

Branger and col. (22) have found frequently the catheter's thrombosis, also the infection, and they reported the accidental extrusion of the catheter in 5% of the cases, accordingly to our study (3.75%).

In a study on patients that presented subclavian catheter, Kamaran and col. (24) affirmed that 21.9% of the catheters were removed due to diverse complications: thrombosis, infection, curving with the bent. There he reported other early complications appeared on mounting of the catheters: the puncturing of the artery in 10.7% of the cases, hemotorax in 0.5%, the puncturing of the thoracic duct in 0.2%, hemomediastin in 0.6%, arrhythmia in 0.2%, infection in 155 of the cases.

Maskova and col. (25) have reported stenosis and thrombosis of the central vein on patients that have had effectuate in antecedents the canualtion of the subcalvian vein. This dates are accordingly with our results.

Conclusions

The central venous catheters still has a major rate of complications, their mounting should be made with lot of discreetness on selected cases that necessitate emergency dialysis.

The patients that had catheter at the initiation of the dialysis presented a higher morbidity and mortality that those who have had a fistula – the survival at 12 months was 60% vs. 83% (The Journal of Vascular Access 2004).

That is why it is necessary a careful monitoring and the performing of a permanent vascular access at the uraemic patients from early stages.

The restrictive using of the central venous catheters involve a decrease of morbidity and a cutting down of costs.

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