

The impact of Vascular Access on the Adequacy of Dialysis and the Outcome of the Dialysis Treatment: One Center Experience

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ABSTRACT

Introduction: Chronic kidney disease (CKD) is a gradually reduction in glomerular filtration rate (GFR) caused by destruction of a large number of nephrons. Kidney failure is the final stage of CKD with GFR <15ml/min/1.73m² or requiring dialysis. Patients must provide vascular access, which is also the “life line” and “Achilles heel” of hemodialysis treatment. **Aim:** The purpose of this research is to show the demographic structure of the hemodialysis center in Konjic, and also demonstrate the impact of vascular access to the adequacy and the outcome of dialysis treatment. **Methods:** This cross-sectional study included 36 patients on hemodialysis in Center in Konjic from September 2010 to December 2014. The method of collecting data is performed through medical records and the quality of dialysis is taken to be Kt/V > 1.2. Statistical analysis was performed using SPSS software and Student T-test. **Results:** The mortality of patients treated by dialysis is 37.8%. The ratio of male and female patients is 55.6% vs. 44.5%, with an average age of 52.91±14.36 years and an average duration of hemodialysis of five years. The highest percentage of patients dialyzed through arterio-venous fistula (AVF) on the forearm (72.2%). In that patients the most common complication is thrombosis with 30.5%, which require recanalization in 11% and replacement in 19.5% of patients. Of the other dialysis patients, 16.7% of patients are dialyzed via a temporary and 11.1% via a permanent catheter (the most common complication in that patients is infection in 83.3% cases) in v.subclavia. Although the AVF is more frequently, experience shows frequent implantation of a permanent catheter in elderly patients due to the less quality of their blood vessels. Although the Kt/V by patients who are dialyzed through temporary catheter is less than 1.2 and by the other two access is greater than 1.2, our results confirm that vascular access does not have an influence on quality of dialysis. Average Kt/V shows that the adequate dialysis dose is delivered in this Center, which means that despite the impact of vascular access in HD quality, other factors also can affect on dialysis treatment, which was noticed by patients and staff. **Conclusion:** Despite the largest mortality rate in patients with a permanent catheter and least in patients with AVF, the type of vascular access does not affect the outcome of dialysis treatment.

Key words: hemodialysis, vascular access, Kt/V.

1. INTRODUCTION

Chronic kidney disease (CKD) is a gradually reduction in glomerular filtration rate (GFR) caused by destruction of a large number of nephrons for three months or more regardless of the cause. Kidney failure is the final stage of CKD requiring dialysis (1). GFR is considered the best index of kidney function, and CKD is widely accepted as GFR <60 ml/min/1.73m². End stage of renal disease (ESRD) is defined as GFR <15 ml/min/1.73m² or requiring dialysis (2). World data suggest that each year 100 patients per million requires a form of renal replacement therapy (dialysis, transplantation) and the number is also growing in Bosnia and Herzegovina (3).

In order to carry out hemodialysis, patients must provide vascular access, which is also the “lifeline” and “Achilles heel” of hemodialysis treatment (4, 5). Three basic forms of permanent vascular access are: native arterio-venous fistula (AVF), synthetic grafts and permanent catheters. Arteriovenous fistula is considered the best long-term access because it provides adequate blood flow, lasts longer and has fewer complications than other accesses with a lower rate of mortality and morbidity. If AVF can not be constructed, AV graft or venous catheter are then constructed to provide adequate hemodialysis treatment (6, 7, 8). Complications of the fistula are thrombosis and pseudo aneurysm, while the most common complications of the catheter

is infection (9, 10).

One of the indicators that can be used to determine the dose of delivered dialysis is fraction removal of urea (Kt/V). Kt/V of 1.2-1.4 is considered to be favorable, while the value of Kt/V below 1.0 is associated with a significantly higher chance of worse outcomes (10).

2. AIM

The aim of this research is to show the demographic structure and the medical profile of patients who are on hemodialysis in Dialysis Center Konjic, the presence of certain vascular access with their complications, the prevalence and mortality rate of the dialysis patients in this Center, and addition, to prove whether vascular accesses have an impact on the adequacy of dialysis and the outcome of dialysis treatment.

3. PATIENTS AND METHODS

This cross-sectional study with an analytical and prospective character included 36 outpatients with diagnosed ESRD, who are dialyzed into the Dialysis center in General Hospital Konjic in the period from September 1 st 2010 to December 31 st 2014. We included patients all age groups with the diagnosis above, and excluded pre dialysis patients with other stages of chronic kidney disease and patients on acute hemodialysis.

The method of collecting data is performed through medical records in this period, where we monitored the following parameters: the prevalence and the mortality of the Center, transfer of patients from other centers, patients profile (age, gender, comorbidities, positive family history, duration of the hemodialysis expressed in months, representation of certain vascular access and complications), adequacy of dialysis expressed with Kt/V (preferred value is 1.2-1.4).

Statistical analysis

Descriptive statistics has been used for determination of baseline characteristics. Prevalence estimate during observed period was estimated based on the total number of cases detected and the number of inhabitants according to latest population estimates. Data are presented as mean ± standard deviation (SD). In case of a normal distribution and no differences in variances, the significance of differences between the two groups was assessed using paired sample t-test. Statistical analysis was performed using SPSS software. Statistical level of 95% (p<0.05) was considered as significant for all performed tests.

4. RESULTS

Of the total number of patients who were on chronic hemodialysis program at the Center in Konjic, 69.4% of them started with the treatment in an another institution, mainly in the tertiary healthcare (Clinical Centre of Mostar or Sarajevo) and the other percent (30.6%) started with hemodialysis program in Konjic. Of the total amount of patients, 51.4% is still undergoing chronic dialysis, and by the other 10% the treatment is replaced by peritoneal dialysis.

The mortality rate of patients in this Center is 37.8%. Most patients were males (55.6%), while there was 44.5% of females, with the average age of 52.91±14.36 years, the youngest patient was 28 years old and the oldest 77 years old. Modus of this sample is 62 years, and there was no significant age difference between men (53.30 ±15.47 years) and women (52.91±13.34 years). There were no patients in the age group of 0-19, in the

mature age group were the most (58,34%) while older patients are present with 41.6%. Most patients were in the age range of

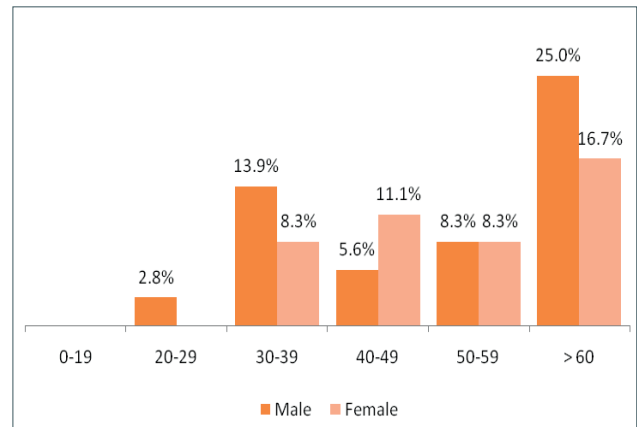


Figure 1. Age and gender structure of the sample 30-39 years (22.22%)(Figure 1).

In the most prevalent age range (30-39 years) frequency of males is higher (13.9%) while in the most common age group (40-49 years) were most females (11.1%). In the older age group is mostly dominated by men with a percentage of 25%, the same as in the age group of 20-29 years.

The average duration of hemodialysis expressed in months is 63.83±62.44 months (5 years), with the shortest period of 3 months and the longest period of 251 (20 years). The mode is 36 months on HD, where men were longer on hemodialysis.

From total number of dialysis patients, 13.9% of patients had a positive family history with a present renal disease within the family. It is recorded a total of 7.5% of patients with renal osteodystrophy as a late hemodialysis complications. Cardiovascular comorbidity was presented in 25% of patients,. The most common cardiovascular comorbidity is cardiac insufficiency and aneurysms of the abdominal aorta with 22.5%, angina pectoris, vessel coronary artery disease, atrial fibrillation, mitral insufficiency and atrial myxoma with an equal representation of 11%. Cerebrovascular incident had 13.9% of patients, in which 60% of cases develop epilepsy. In addition to neurological and cardiovascular comorbidity, the most common is malignancy with 13.5%.

There were no cases of HIV-positive patients. Positive serology on hepatitis C had 5% of patients and 2% with hepatitis B. The Dialysis Center in Konjic has 19.3% patients with diabetes, in which 14.3% of them have developed late complications.

According to vascular access, 50% of the total number started HD treatment with a temporary catheter, 44.4% with AVF,

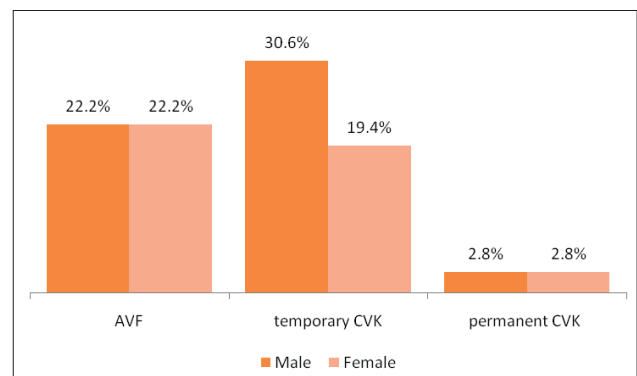


Figure 2. Gender representation of the first vascular access

while the smallest number of patients started dialysis treatment with permanent central venous catheter. Most patients with temporary catheter were male (30.6%), while an equal gender representation is recorded with AVF (Figure 2). From all dialysis patients who started hemodialysis in Konjic, 73% of cases had a temporary vascular access and afterwards the fistula has been created, only 27% started with a functional AV fistula. Also, patients who had a permanent catheter as the first vascular access in this Center are also the oldest with an average age of 59.5 years.

The most patients (72.2%) continued dialysis through fistulas (after the first vascular access) with the same location constructed on the forearm; 16.7% over the temporary and 11.1% over the permanent central venous catheter, where by all patients the catheter had to be replaced at least once due to their usually complication—infection (83.3%). Replacing temporary with a permanent catheter is done in 17% of patients but just one patient had to replace the permanent catheter due to infection.

In our Center the most common location of placing a temporary catheter was the subclavian vein (83.3%). The same location with the same percentage of representation was used for placing a permanent catheter. None of these outpatient yet placed a temporary or a permanent catheter in femoral vein, also nobody had an AV graft constructed. Recanalization of the fistula has been done in 11% of patients due to its thrombosis, while 23.1% had to re-construct the fistula (Table 1).

	AVF	temporary catheter	permanent catheter
representation (%)	72.2%	16.7%	11.1%
number of replacement	6 (23.1%)	6 (100%)	1 (25.0%)
number of complication	8 (30.8%)	5 (83.3%)	4 (100%)
most common complication	thrombosis (30.8%)	Infection (83.3%)	infection (100%)
v. subclavia	/	5 (83.3%)	3 (75.0%)
v. jugularis	/	1 (16.7%)	1 (25.0%)

Table 1. The representation of current vascular access, their location and complications

The average value of Kt/V in patients of Dialysis Center in Konjic is 1,2 (range 0.63 – 1.92). The value of this parameter in patients with AV fistula is 1,3, in patients with a temporary central vein catheter is 0.90, while Kt/V of 1.1 was recorded in patients with a permanent catheter.

During the four year period 27% of patients with AVF was died. The number of deaths cases with a temporary catheter is 50%, while the percentage is much higher in patients with a permanent catheter—75%.

Results of statistical analysis showed no statistical significance between the vascular access and adequacy/quality of dialysis presented through Kt/V ($p = 0.57$). Also, there is no statistical significance between the type of vascular access and outcomes of dialysis treatment ($p = 0.077$).

5. DISCUSSION

From 2010-2014 hemodialysis treatment was performed in 40 patients in Dialysis Center in Konjic, of which 36 were on chronic hemodialysis treatment, and only 5 patients were on acute dialysis. More than half is still undergoing chronic dialysis, and only one sixth of the patients switched to the treatment of peritoneal dialysis. From these results it is seen that the most

common modality of treatment ESRD is hemodialysis while in this period there were no patients who performed kidney transplantation. Similar data are recorded in the Renal Registry of Bosnia and Herzegovina (from 2010 to 2013) where the most common treatment modality is also HD, while transplantation is recorded but in a small number (11).

Most of our dialysis patients were males with the most common age of 62 years. Similar results are presented in Renal Registry of Bosnia and Herzegovina indicating the dominance of male patients, while the most common age group is a group from 45 to 64 years. We hadn't patients younger than 19 years, while in other dialysis center in Bosnia and Herzegovina was noticed an increase of younger patients on hemodialysis treatment (11).

Half of the patients started HD treatment with temporary catheter independent of the institution in which they started HD. Recently published study of Erikson et al. showed that much more likely to control the renal status by nephrologists are associated with adequate preparation and construction of arterio-venous fistula or graft as a first and permanent vascular access (12). The most common vascular access in Konjic Center is AVF, while the permanent catheter rarely used (especially in patients older than 60 with a poor quality of blood vessels). Similar findings were present in the Renal Registry of Bosnia and Herzegovina where it is noticed that the majority of patients are dialyzed through fistulas but with a increase of catheter access from year to year. The most common location of the fistula is the forearm. The most common location of the catheter for dialysis in our Center is in the subclavian vein, significantly less jugular vein, without any implantation into the femoral vein. According to this study, the AV fistula had a significantly lower number of complications (thrombosis), while wearing a central venous catheter was in 90% of cases associated with infection. Similar results showed the study of Banjeree et al., which confirmed that the dialysis through a central venous catheter associated with more frequent and stronger inflammation in comparison with fistula and it is possible that their higher mortality rate induced by infections (13). Also, study of Cornelis et al. showed a lower rate of any form of complication of AVF according to other vascular access (14). Results Macedonian authors also suggest that hemodialysis patients have a high number of central venous catheters as vascular access for hemodialysis and significantly higher mortality compared to patients with other vascular access (15). Similar results who are also observed in some other studies (16, 17). Proper care of the catheter, the introduction of algorithms and protocols of treatment should occupy an essential place in each hemodialysis center as a way of prevention and solution of emerging complications (17).

The study of Karkar et al. showed a significant increase in fistula creation, reduction of catheter implantation, and at the same time reducing of thrombosis and infection, which were associated with the increase value of Kt/V, increase in serum hemoglobin and other parameters (18). The results of our study showed that the vascular access does not affect the quality and outcome of dialysis treatment, which could be explained by a small number of patients in this Center in a period of four years.

6. CONCLUSION

In the Dialysis center in Konjic in a last four year the most dialysis patients were male and belonged to the older population. Although the AVF is more frequently vascular access for hemo-

dialysis, we had frequent implantation of a permanent catheter in elderly patients due to the lower quality of their blood vessels.

The infection is a very common catheter complication. We confirmed fewer complications in patients with AV fistula, which are mainly presented by thrombosis and which were resolved by fistula recanalization in three cases, and in the rest of patients with construction of a new AV fistula. Despite the higher mortality rate in patients with catheters, probably due to frequent infection, the type of vascular access does not affect the outcome of the dialysis treatment.

CONFLICT OF INTEREST: NONE DECLARED.

REFERENCES

1. National kidney foundation. K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification, and stratification. *Am J Kidney Dis.* 2002; 39: S1.
2. Resić H, Mešić E, Kukavica N, Alečković M. Klinički aspekti hemodijalize. IKD "University Press - Magistrat izdanja", Sarajevo, 2013: 14-26.
3. Galešić K, Matovinović MS. Hronična bubrežna insuficijencija. U: Božidar Vrhovac I. suradnici. *Interna medicina.* 3 izd. Zagreb, Naknada Ljevak, 2003; 1134.
4. Swartz RD, Messana JM, Boyer CJ. Successful use of cuffed central venous hemodialysis catheters inserted percutaneously. *J Am Soc Nephrol.* 1994; 1(4): 1719-1725.
5. Riella MC, Roy-Chaudhury P. Vascular access in hemodialysis: strengthening the Achilles' heel. *Nat Rev Nephrol.* 2013; 9(6): 348-357.
6. Saad TF. Bacteremia associated with tunneled, cuffed hemodialysis catheters. *Am J Kidney Dis.* 1999; 34(1): 1114-1124.
7. NKF-K/DOQI Clinical practice guidelines for vascular access. *Am J Kidney Dis.* 1997; 30(3): 157-158.
8. Lew SQ, Nguyen BN, Ing TS. Hemodialysis vascular access construction in the upper extremity: a review. *J Vasc Access.* 2014; 4(0): 10.
9. Frank T, Padberg Jr, Keith D, Calligaro, Anton N. Complications of arteriovenous hemodialysis access: Recognition and management. *J Vasc Surg.* 2008; 48(5): S55-S80.
10. Mehmedović N, Mešić E. Hemodijaliza. Tuzla: Off-set. 2006; 69-71.
11. Resić H, Prnjavorac B. Nadomještanje bubrežne funkcije u Bosni i Hercegovini - Godišnji izvještaji Renalnog registra BiH. [Online]. Sarajevo, 2010-2013. Dostupno na: <http://www.undt.ba/download/Godisnji%20izvjestaji/2010.pdf>[03.01.2015]
12. Erickson KF, Mell M, Winkelmayer WC, Chertow GM, Bhattacharya J. Provider Visits and Early Vascular Access Placement in Maintenance Hemodialysis. *J Am Soc Nephrol.* 2014; 4(1):10-12.
13. Banerjee T, Kim SJ, Astor B, Shafi T, Coresh J, Powe NR. Vascular access type, inflammatory markers, and mortality in incident hemodialysis patients: The choices for Healthy Outcomes in Caring for End-Stage Renal Disease Study. *Am J Kidney Dis.* 2014; 64(6): 954-961.
14. Cornelis T, Usvyat LA, Tordoir JH, Wang Y, Wong M, Leunissen KM, Van der Sande FM, Kotanko P, Kooman JP. Vascular access vulnerability in intensive hemodialysis: a significant Achilles' heel? *Blood Purif.* 2014; 37(3): 222-228.
15. Stojceva-Taneva O, Selim G. Vascular access in hemodialysis patients- registry data. *Hippokratia.* 2014; 18(3): 209-211.
16. Shahidi SH, Soheilipour M. Comparison of vascular access use in hemodialysis patients in Isfahan in 2003 and 2013. *Indian J Nephrol.* 2015; 25(1): 16-20.
17. Resić H, Ajanović S, Kukavica N, Corić A, Masnić F, Bećiragić A. Tunneled catheter infections in patients on hemodialysis—one center experience. *Acta Med Croatica.* 2012; 66(2): 17-21.
18. Karkar A, Chaballout A, Ibrahim MH, Abdelrahman M, Al Shubaili M. Improving arteriovenous fistula rate: Effect on hemodialysis quality. *Hemodial Int.* 2014; 18(2): 516-521.