STUDY OF ELECTROPHYSIOLOGICAL ABNORMALITIES IN UPPER EXTREMITIES AFTER A-V FISTULA CREATION IN END STAGE RENAL DISEASE PATIENTS

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Introduction

Chronic kidney disease (CKD) is characterized by the gradual decline of renal function, initially presenting with no symptoms and progressing to manifestations such as lower limb edema, exhaustion, nausea, and vomiting. CKD is caused by various factors including hypertension, diabetes mellitus, genetic disorders, and autoimmune diseases. Diagnosis involves measuring estimated glomerular filtration rate (GFR), urinary albumin levels, and sometimes ultrasound or kidney biopsy. Differentiating between CKD and acute kidney injury (AKI) is crucial as AKI is reversible while CKD is irreversible. End-stage renal disease (ESRD) necessitates chronic hemodialysis, often requiring vascular access (VA) creation. Treatment options for ESRD include central dialysis catheters (CDCs), arteriovenous fistulae (AVFs), and arteriovenous grafts (AVGs). Complications of VA include infection, stenosis, thrombosis, and nerve-related issues such as ischemic monomelic neuropathy (IMN) and nerve compression. Early detection and intervention are crucial for minimizing complications and optimizing patient outcomes. Nerve conduction tests post-AVF creation can aid in identifying potential nerve-related complications, allowing for timely management.

Aim of the work

The aim of this work was to evaluate the electrophysiologic changes of peripheral nerves of the upper extremity after creation of AV access in ESRD patients.

Subjects and Methods

The study involved 50 end-stage renal disease (ESRD) patients in Alexandria Main University Hospitals requiring upper limb arteriovenous fistula (AVF). Patients meeting inclusion criteria and not exhibiting exclusion criteria, such as limb suitability and absence of certain complications, were consented for participation. History taking encompassed personal, medical, and surgical aspects including cardiovascular and respiratory conditions. Clinical examination involved assessing upper limb pulsations and signs of venous hypertension. laboratory investigations and imaging were conducted preoperatively and six months post-AV access creation. Nerve testing was performed on the median, ulnar, and radial nerves preoperatively and postoperatively to assess sensory and motor capacities. Statistical analysis using IBM SPSS software included descriptive statistics and tests like the paired t-test and Wilcoxon signed ranks test to compare data between periods. Normality of distribution was verified using the Shapiro-Wilk test, with significance set at 5%.

Results

Table 1: Comparison between pre- and post-AVF creation among cases according to motor parameters (n = 50)

Motor	Pre	Post	Test of sig.	p
Amplitude (Median n.)				
Min. – Max.	2.97 – 20.50	3.80 – 19.50	Z= 0.417	0.677
Mean ± SD.	8.70 ± 4.31	8.67 ± 4.09		
Median (IQR)	8.71 (4.90 – 10.82)	8.50 (5.39 – 10.15)		
Amplitude (Ulnar n.)				
Min. – Max.	1.52 – 12.70	2.24 – 10.30	t= 2.394*	0.025*
Mean ± SD.	6.72 ± 2.54	5.89 ± 1.92		
Median (IQR)	6.54 (4.75 – 8.20)	6.22 (4.71 – 7.15)		
Amplitude (Radial n.)				
Min. – Max.	2.60 – 12.0	1.20 – 13.80	Z= 1.009	0.313
Mean ± SD.	5.24 ± 2.63	4.87 ± 2.76		
Median (IQR)	4.60 (3.17 – 5.50)	4.80 (3.29 – 5.90)		

Table 2: Relation between diabetes and change of motor parameters (n = 50)

Change of motor (post – pre)	Diabetes		U	p
	Non diabetic (n = 32)	Diabetic (n = 18)		
Amplitude (Median n.)				
Min. – Max.	-12.68 – 8.08	-6.89 – 1.73	62.000	0.571
Mean ± SD.	0.25 ± 5.82	-0.52 ± 2.76		
Median (IQR)	0.64 (-3.06 – 4.24)	0.64 (-0.43 – 1.01)		
Amplitude (Ulnar n.)				
Min. – Max.	-6.00 – 3.02	-2.45 – 0.72	67.000	0.777
Mean ± SD.	-0.93 ± 2.09	-0.68 ± 0.98		
Median (IQR)	-0.97 (-1.80 – 0.47)	-0.38 (-1.39 – 0.19)		
Amplitude (Radial n.)				
Min. – Max.	-2.10 – 3.10	-3.61 – 0.81	23.500 *	0.006*
Mean ± SD.	0.38 ± 1.43	-1.70 ± 1.47		
Median (IQR)	0.36 (-0.81 – 1.50)	-1.33 (-3.12 – -0.80)		

In this study, 50 patients with end-stage renal disease (ESRD) were evaluated, with the majority being male (76%). The mean age was 51.24 ± 13.61 SD. Some of the patients were diabetic (36%), hypertensive (80%), and cardiac patients (4%). The types of AV access created varied, with 52% BC shunts, 32% BB shunts, and 16% distal AVF. Sensory and motor parameters of the median, radial, and ulnar nerves including amplitude, latency and conduction velocity were tested showing insignificant changes post-AVF creation, except for a significant increase in sensory median nerve amplitude (p = 0.041). and a significant decrease in motor ulnar nerve amplitude postoperatively (p = 0.025), though without clinical symptoms. Diabetic and non-diabetic groups did not show significant differences in sensory parameters, but there is a significant decrease in motor radial nerve amplitude in diabetics post-AVF creation(P = 0.006), other motor nerve parameters displayed no significant differences between diabetic and non-diabetic groups. Regardless of the type of arteriovenous fistula (AVF) created, there are no statistically significant differences in sensory nerve parameters in the upper limb. Conversely, the impact of different AVF types on motor nerves postoperatively compared to preoperative status is obvious. The analysis reveals a statistically significant difference in motor ulnar nerve conduction velocity (CV) among the three shunt types (p = 0.036). Specifically, the brachio-basilic (BB) group exhibits the greatest impact, with the lowest mean and widest standard deviation (Mean ± SD -9.16 ± 16.0). Additionally, a significant difference is observed when comparing BB and brachio-cephalic (BC) groups (p = 0.012). Notably, distal AVF shows the least effect on motor nerves across various shunt types, evident by the smallest standard deviation in mean values of different motor nerve parameters.

Conclusion

Significant changes of sensory median nerve and motor ulnar nerve conduction parameters were observed indicating potential neurological impact of AVF. DM had no significant effect on either sensory or motor conduction parameters except motor radial nerve amplitude. No significant difference of either sensory or motor conduction parameters in different types of UL AVF when compared to each other except a significant ulnar nerve motor change (decrease). BB AVF had the impression of being most influencing regarding NCS parameters. Hence, further studies are required to verify this point. All study patients had no clinical reflection of the NCS changes observed. However, long term observation study and longer follow up of patients with NCS changes are required to clear this point in the far future.