

## The Diagnostic Power of Physical Examination on Surgical Planning for Dialysis Access in Sari Imam Hospital Patients from 2013 to 2014

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### Abstract

**Introduction:** It is routine to do physical examination to determine the most suitable place for AV access for haemodialysis. Duplex ultrasonography is a high sensitive modality for the evaluation of vessels and can determine vascular diameter. This study was aimed to evaluate the diagnostic power of physical examination for AV access surgical planning in comparison with Duplex ultrasonography (as the gold standard diagnostic tool).

**Methods:** Physical examination and duplex ultrasonography were done and results were recorded. 117 patients were included on the study. With 95% confidence interval data were analyzed by SPSS 16.0 and sensitivity and specificity of physical examination were calculated.

**Results:** Out of 117 patients, in 60 patients (51.3%), include 33 males and 27 females, physical examination results consistent with Duplex ultrasonography (true positive), with 64.22%, 65% and 86.96% sensitivity, specificity, and positive predictive value, respectively. AVF failure was significantly more observed in snuffbox (forearm) AVF surgery site.

**Conclusion:** Preoperative physical examination can be used initially for patients to evaluate a suitable site for AVF surgery. For better AVF outcome, it's suggested to perform duplex ultrasonography study in patients with insufficient clinical findings, 60 years and older, BMI 25-30, diabetes, and hypertension.

**Keywords:** AVF access; Physical examination; Duplex ultrasonography

### Introduction

Providing a proper vascular access for long term hemodialysis in chronic kidney disease patients remains controversial. Physical examination is routine to determine the most suitable AV access for hemodialysis in all these patients [1,2]. Duplex ultrasonography is a safe, noninvasive and high sensitive modality for the evaluation of vessels. It can determine vascular diameter and give an accurate quantitative data about blood flow [3-7]. Preoperative duplex ultrasonography is a gold standard study of veins and arteries to AVFs planning in order that it can result in changes in AVF surgical management, with an increased number of AVFs placed and an improved likelihood of selecting the most functional vessels preoperatively [8-12].

This study was aimed to evaluate the diagnostic power of physical examination for surgical planning in AVF access surgery in comparison with duplex ultrasonography.

### Methods

In this diagnostic study, we have used Duplex ultrasonography as the gold standard diagnostic technique to assess vasculature for planning of dialysis access procedures. Patients with chronic kidney disease who had been candidates for AVF surgery and starting hemodialysis were referred to vascular surgery clinic, Imam Khomeini hospital, Sari, and enrolled in study. This included new cases and those who had nonfunctional AVF. The study approved by ethic committee of Imam Khomeini Hospital. After explanation of study plan and its purposes, verbal consent was taken. Data about all patients included careful history and physical examination for vascular access planning in operating room recorded in patient's data sheet. Physical examination included evaluation of extremities appearance (signs of

the presence of scar tissue), assessment and recording of arterial pulses (in a warm environment), length of the vessels and veins bulging and compressibility. Patients assessed by Duplex ultrasonography prior to arteriovenous fistula construction for hemodialysis access with the portable M-Turbo ultrasound system (SN: 03KHZ5 made in USA). Age, sex, BMI, history of diabetes mellitus, cardiovascular diseases and previous surgeries reviewed and recorded. Follow-up visits were done in a week and a month after AVF surgery in vascular surgery clinic, monitoring of the newly placed AV Fistula and palpating for thrill. We used KDOQI Rule of 6's to evaluate the maturity of a recently-placed AVF. Fistulas are more likely to be useable when they meet the Rule of 6s characteristics 6 weeks after surgery, flow greater than 600 mL/min, diameter at least 6 mm, no more than 6 mm deep, and discernible margins. Dialysis session was performed as an assessment after surgery. According to a pilot study was conducted on 21 patients (50% sensitivity, 20% specificity), 117 sample size was calculated, with 95% confidence interval and 15% error ratio. Patients were divided into four groups depending upon the physical examination and Duplex ultrasonography findings. Patients with consistent Duplex ultrasound

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and physical examination plan were considered True Positive. If functional vessels were found on physical examination but did not match with Duplex ultrasonography, results considered False Positive. Unreliable physical examination with proper location identified with ultrasonography was considered False Negative. If neither physical examination nor ultrasonography revealed any significant results, results considered True Negative. 2x2 table was used to calculate sensitivity and specificity of physical examination, with 95% confidence interval. SPSS 16.0 windows version was used to analyzing data. P value < 0.05 was considered statistical significant.

## Results

117 patients were included in this study. 111 patients (95%) were right hand dominant and 6 patients (5%) were left hand dominant. 84 patients (72%) had vascular access, 76 of them had temporary dialysis catheter (Perm catheter or Shaldone) and 8 patients had a history of vascular access surgery (Table 1).

During follow up visits, one week after surgery, 110 patients (94%) (54 males and 56 females) had proper pulse and thrill. 7 patients (6%) had hemodialysis access failure; include 2 males and 5 females.

One month after surgery, 107 patients (91.4%) (52 males and 55 females) had good pulse and thrill and 10 patients (9.6%) had hemodialysis access failure (4 males and 6 females).

As primary outcome (a hemodialysis session after vascular access maturation), 107 patients (91.4%) include 52 males and 55 females had their first session.

In order to determine surgical plan by physical examination, right and left upper extremity were selected in 14 patients (12%) and 103 patients (88%), respectively. To determine surgical plan by Duplex ultrasound, right and left upper extremity were selected in 18 patients (15.5%) and 99 patients (84.5%), respectively (Table 2).

Out of 117 patients, 60 (51.3%) patients had true positive physical examination (33 males and 27 females) whereas 9 patients (7.7%) had false positive physical examination (6 males and 3 females). 32 patients (27.3%) had false negative physical examination (9 males and 23 females) while 16 patients (13.7%) had true negative physical examination (8 males and 8 females) (Table 3).

In surgical planning by both physical examination and duplex ultrasound, Snuffbox had the most failures.

Male	56 (48%)
Female	61 (52%)
Age 10-20	2 (1.7%)
20-40	15 (12.8%)
40-60	39 (33.3%)
>60	61 (52.0%)
BMI <18.5	4 (3.4%)
18.5-24.9	43 (37.0%)
25-29.9	60 (51.0%)
30-34.9	9 (7.7%)
35-39.9	1 (0.9%)
≥40	0 (0.0%)
DM	61 (52.1%)
CHF	8 (6.8%)
HTN	76 (65.0%)
DLP	14 (12.0%)

Table 1: Patients' characteristics.

By Ultrasonography No. (%)	By Physical Examination No. (%)	Location	Surgery Plan No. (%)
17 (14.5%)	20 (17.0%)	Snuff box	17 (14.5%)
4 (3.5%)	2 (1.7%)	Radiocephalic	4 (3.5%)
00 (0.0%)	0 (0.0%)	Ulnarbasilic	0 (0.0%)
25 (21.5%)	49 (42.0%)	Brachio mediancubital	21 (18.0%)
45 (38.5%)	0 (0.0%)	Brachiocephalic	50 (43.0%)
2266 (22.0%)	46 (39.0%)	Unknown	BVT: 10 (9.5%)
			AVG: 15 (13.0%)

Table 2: Surgery location determined by Physical examination versus Duplex ultrasonography.

	%	CI95%
Sensitivity	65.22%	74.16-55.05%
Specificity	64%	79.75-44.52%
Positive predictive value	86.96%	92.98-77.03%
Negative predictive value	33.33	47.46-21.68%
Accuracy	64.96%	73.00-55.96%
Positive Likelihood ratio	1.81%	3.12-1.05%
Negative Likelihood ratio	0.54%	0.82-0.36%

Table 3: sensitivity and specificity of physical examination for AVF surgery site determination.

Physical examination was not very helpful in surgical planning; more commonly in patients aged 60 or over, patients with history of hypertension and BMI range 25-30.

Duplex ultrasound changed surgery planning mostly in patients with history of Diabetes and hypertension. Congestive heart failure and hyperlipidemia had no significant effect on planning or failure (Table 4).

## Discussion

In this study we evaluated the diagnostic power of physical examination for AVF surgical planning. In data analysis the most suitable site evaluated by both clinical evaluation and Duplex ultrasound was left upper extremity (antecubital). 60 patients (51.3%), 33 males and 27 females, have had consistent physical examination and Duplex ultrasound plan (true positive). Sensitivity and specificity of physical examination for determine AVF surgical plan were 65.22% and 64%, respectively. The positive predictive value was 86.96%. Patients aged 60 and over, BMI range 25-30 and with Hypertension had more insufficient clinical findings. For this group of patients Duplex ultrasound is required before surgery to improve AVF outcomes. AVF failure rate was not significantly differ based on whether physical examination or duplex ultrasound study.

Smith et al. [13] reported routine preoperative ultrasound vessel imaging do not significantly reduce early failure rates and if clinical evaluation detects anatomy suitable for AVF formation duplex imaging may not be needed. Malvor et al. [14,15] showed AV fistula failure has become more common as more patients are older, have diabetes and/or vascular disease, so suggested physical examination and ultrasound assessment before surgery in these patients. Although Persic et al. [4] followed 129 patients aged 75 ± 6 (65-93) years, and found native AVF can be constructed in the majority of elderly patients, with no significant differences in terms of sex or diabetic status. In a same way, in our study, surgical plan changing and AVF failure was not statistically differ in patients with diabetes, hypertension, congestive heart disease and hyperlipidemia. William et al. [16] observed a higher likelihood of primary fistula failure in women, older patients, and forearm fistulas.

	1 week AVF failure	P value	1 month AVF failure	P value
Male	2 (1.7%)	0.25	4 (3.4%)	0.42
Female	5 (4.3%)		6 (5.1%)	
Age 10-20	0	0.36	0	0.33
20-40	2 (1.7%)		2 (1.7%)	
40-60	3 (2.6%)		5 (4.3%)	
>60	2 (1.7%)		3 (2.6%)	
BMI <18.5	0 (0.0%)	0.45	0	0.78
18.5-24.9	1 (0.9%)		3 (2.6%)	
25-29.9	6 (5.1%)		7 (6.0%)	
≥30	0 (0.0%)		0	
DM Positive	4 (3.4%)	0.54	7 (6.0%)	0.19
Negative	3 (1.6%)		3 (2.6%)	
CHF Positive	0 (0.0%)	0.45	0	0.47
Negative	7 (6.0%)		10 (8.5%)	
HTN Positive	4 (3.4%)	0.47	5 (4.3%)	0.24
Negative	3 (2.6%)		5 (4.3%)	
DLP Positive	1 (0.9%)	0.6	1 (0.9)	0.65
Negative	6 (5.1%)		9 (7.7%)	
Plan based on P/E				
Snuffbox	3 (2.6%)		5 (4.3%)	
RC	0 (0.0%)		0 (0.0%)	
BMC	3 (2.6%)	0.24	4 (3.43%)	0.023
unknown	1 (0.9%)		1 (0.9%)	
Plan based on DUS				
Snuffbox	3 (2.6%)		4 (3.4%)	
RC	0 (0.0%)	0.17	1 (0.9%)	0.04
BMC	2 (1.7%)		3 (2.6%)	
BC	2 (1.7%)		2 (1.7%)	
Surgery plan				
Snuffbox	3 (2.6%)		4 (3.4%)	
RC	0 (0.0%)		1 (0.9%)	0.06
BMC	1 (0.9%)	0.19	2 (1.7%)	
BC	3 (2.6%)		3 (2.6%)	
BVT	0 (0.0%)		0 (0.0%)	

**Table 4:** AVF failure 1 week and 1 month after surgery based on patient and plan characteristics.

These discrepancies suggest that functional properties of the vessels may contribute to fistula failure to mature even when the diameters are adequate. Martin et al. [5] reported physical examination should be used initially for all patients to evaluate a suitable site for AVF surgery. Patients who are likely to benefit from preoperative ultrasound evaluation are those with obesity, absent pulses, older age, diabetes, and cardiovascular disease. In our study AVF failure was more observed in females, age range 60-70, BMI range 25-30 and snuffbox site (forearm) surgery, but there was no statistically difference but for snuffbox site. Furthermore 91.5% of patients had first session of hemodialysis. In addition, it's worth to mention vascular access care and catheter insertion techniques in hemodialysis ward have significant effects on AVF failure.

## Conclusion

Preoperative physical examination can be used initially for patients to evaluate a suitable site for AVF surgery. Patients with insufficient clinical findings aged 60 and over and had BMI range 25-30, diabetes and hypertension. For this group of patients duplex ultrasound is suggested before surgery to improve AVF outcomes. Surgical plan changing and AVF failure mostly observed in patients with diabetes and hypertension, but it was not statistically significant. Patients with snuffbox (forearm) as surgery site had the most failure during first week and first month follow up visits.

## Recommendation

- Preparing proper and warm environment for physical examination and vascular assessment.
- Educating patients how to take care of vascular access.
- Enough time to Physical examination to determine the most suitable AV access.
- Using preoperative duplex ultrasound evaluation for those with ages older than 60 and BMI range 25-30.
- Using preoperative duplex ultrasound evaluation for those with diabetes and hypertension.

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