ORIGINAL ARTICLE

# CLINICAL UTILITY OF $CAVeA_2T_2$ SCORE FOR ASSESSING THE SURVIVAL OF BRACHIOCEPHALIC ARTERIOVENOUS FISTULA

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**Background:** There are not many error proof clinical scores to assess the native dialysis access. CAVeA2T2 score is a recent tool in use. Objective of the study is to assess the clinical utility of $CAVeA_2T_2$ scoring system in predicting the survival rate of brachiocephalic arteriovenous fistula (BC-AVF). **Methods**: All consecutive patients fulfilling the inclusion criteria for BC-AVF from January 2016 to January 2018 were included. According to their $CAVeA_2T_2$ score they were divided into two groups (Group A: < 2 and Group B: ≥2). Cumulative primary and secondary patency survival of BC-AVF for both groups were measured. **Results:** A total of 112 BC-AVFs were analysed. Mean age was 42±SD 14 years (M: F =5:1). Mean $CAVeA_2T_2$ score was 1.45±1.8. In terms of primary patency, there was no statistically significant difference between two groups ($p$=0.074, $p$ = 0.229 and $p$=0.357 at 6 weeks, 6 months and 12 months respectively). However, the difference was significant in terms of secondary patency ($p$=0.002, $p$=0.036 and $p$=0.032 at 6 weeks, 6 months and 12 months respectively). On comparing the cumulative survival between two groups; a significantly low primary patency rate survival (Log Rank $x^2$ = 12.9, $p$-value = 0.001) and secondary patency rate survival (Log Rank $x^2$ = 7.6, $p$-value = 0.001) of BC-AVF was found in Group B. **Conclusion:** We found $CAVeA_2T_2$ score an easily applicable and useful tool to assess the patency and survival of BC-AVF. Patients have a poor patency and significantly low survival rate when their $CAVeA_2T_2$ score was ≥2.

**Keywords:** Fistula survival; Patency rate; Score; Arteriovenous fistula

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## INTRODUCTION

Successful AVF is a benchmark in reducing the long-term morbidity and mortality and improving the survival rate. However, studies have shown that a significant number of AVFs have failed within the first few months, some as early as 24 hours.[1] In clinical practice, patients requiring an AVF often have several other underlying co-morbidities such as diabetes mellitus, peripheral artery disease, hypertension; which also promote failure to mature of an AVF.[2] Many studies postulated that 20-50% of AVFs do not get mature at all for haemodialysis (HD).[3–5]

RC-AVF is considered as a gold standard initial site, since it provides a long vein for better cannulation and is also associated with less complication rate.[6] However patients with multiple co-morbidities often have poor veins and atherosclerotic distal arteries in forearm leading to their high failure rate.[7,8] The arterial and venous diameter at the elbow is satisfactory hence creation of an AVF at elbow provides better long term patency and survival of fistula, especially when the distal options have already been exhausted.[9]

In recent years, various scoring systems have been devised to predict the patency of an AVF. Recently, $CAVeA_2T_2$ score has been devised and found useful in predicting the survival of radio cephalic AVF (RC-AVF).[10] Considering the fact that a large number of patients need an AVF at a more proximal site, there is a need to devise a scoring system to predict the patency of such AVFs. However, there is scarce evidence of such predicting scores for more proximal AVFs such as at elbow. The present study was designed to see whether $CAVeA_2T_2$ scoring system which was originally designed for RC-AVF, is useful in predicting the patency of BC-AVF at elbow.

## MATERIAL AND METHODS

This cross-sectional study was conducted at Combined Military Hospital and Midcity Hospital, Lahore, Pakistan from January 2016 to January 2018. The ethical approval of the study was obtained from the institutional ethical board review committee (Ref: 416 ERC/CMHLMC) and principles of declaration of Helsinki were followed.

The study group included all consecutive patients operated by a single surgeon, requiring a brachiocephalic AVF for HD access in cubital fossa. Their demographic data and co morbid risk factors were recorded. Patients fit for an AVF at distal site, requiring prosthetic access, deemed unfit for surgery and refused consent for inclusion in the study; were excluded. Furthermore, patients who had previous surgery in cubital fossa or who were lost to a minimum follow up of 12 months were also excluded. All patients underwent a Duplex scan (with 10MHz Linear probe LOGIQ BOOK; GE Medical Systems U.S.A, Inc).

Patency and diameter of cephalic vein and diameter of brachial artery in cubital fossa were recorded. The patency of the subclavian vein was also noted. Patients with stenosis of subclavian vein were excluded from the study.

Standard surgical technique was followed for creation of BC-AVF at elbow. This included curvilinear skin crease incision after infiltration of 50% diluted 10ml Lignocaine, cephalic vein was dissected and divided at distal most part in the operative field, 2500 units of un-fractioned heparin were given intravenously, linear arteriotomy was performed followed by end to side anastomosis with Polypropylene 6/0. Post-operative palpable thrill was recorded. All patients were discharged same day with written instructions for fistula care. Patients were followed up weekly for 6 weeks, then monthly for 6 months and then at 12 months. $CAVeA_2T_2$ score (Table-1) was calculated for all patients. Primary and secondary patency was recorded at 6 weeks, 6 months and 12 months.

Statistical analysis was done using SPSS-20 Inc, Chicago, Illinois, USA. Quantitative variables like age were expressed as Mean±Standard Deviation (SD). Qualitative variables like gender and co morbid factors were expressed as Frequency and Percentage. According to the $CAVeA_2T_2$ score, the patients were divided into two groups (Group A: <2 and Group B: ≥2). Comparison between two groups was done using Chi-Square Test. Kaplan-Meier curves were drawn to assess cumulative primary and secondary patency survival of BC-AVF for both groups. The comparison between survival curves of two groups was done by log rank test ($x^2$). A *p*-value of ≤0.05 was considered statistically significant.

## RESULTS

During the study period, a total of 112 BC-AVF were created. However, after applying the exclusion criteria, a total of 90 patients were included in this study. There were 67.8% (n=61) patients who had failed AVF at a distal site and BC-AVF was planned while 32.2% (n=29) had BC-AVF planned primarily due to poor distal veins. There were 83.3% (n=75) males and 16.7% (n=15) females with a male to female ratio of 5:1, and mean age of 42±14 years. The most prevalent atherosclerotic risk factor was diabetes mellitus in 88.9% (n=80) followed by hypertension in 66.7% (n=60) cases [Table-2]. Around 1/3 [67%, (n=60)] patients had 2 or more risk factors for atherosclerosis. There were 31.1% (n=28) patients who had BC-AVF created before the start of HD while 68.9% (n=62) patients were already on weekly HD. In these 62 cases, 80.6% (n=50) patients had a non-tunnelled double lumen catheter while 19.3% (n=12) had tunnelled catheter for HD. In terms of secondary intervention, 25.5% (n=23) needed further procedures to salvage the AVF. 16/23 needed open exploration while remaining 7/23 were dealt with by endovascular interventions. According to the $CAVeA_2T_2$ score; 40% (n=36) scored 0, 24.4% (n=22) scored 1, 15.5% (n=14) scored 2, 16.6% (n=15) scored 3, 3.3% (n=3) scored 4. Mean score 1.45±1.8. The two groups were compared to study the patency rates of RC-AVF. The cumulative primary patency was 88.8%, 72.2% and 60% at 6 weeks, 6 months and 12 months respectively. These patients were divided into two groups: 64.4% (n=58) had a score of less than 2 (Group A) while 35.6% (n=32) scored >=2 (Group B). When compared, there was no statistically significant difference between two groups at follow up visits [Table-3]. The cumulative secondary patency was 86.6%, 65.5% and 55.1% at 6 weeks, 6 months and 12 months respectively. There was significant difference between two groups at subsequent visits (P = 0.002 at 6 weeks, $p$ = 0.036 at 6 months and $p$ = 0.032 at 12 months).

On comparing the cumulative survival between two groups using Kaplan-Meier curve; a significantly low primary patency rate survival (Log Rank $x^2$ = 12.9, $p$ value = 0.001) (Figure-1) and secondary patency rate survival (Log Rank $x^2$ = 7.6, *p*-value = 0.001) (Figure-2) of BC-AVF was found in Group B ($CAVeA_2T_2$ score of ≥ 2) patients.

**Table-1: $CAVeA_2T_2$ Score (Maximum Score = 7)**

| Variable | Score |
|---|---|
| Age > 73 years | 1 |
| Central venous access ipsilateral side | 1 |
| Vein diameter <2.2mm | 1 |
| Absent post-operative thrill | 2 |
| History of lower limb angioplasty | 2 |

**Table-2: Baseline Characteristics and Co morbid conditions**

| Total BC-AVF (n) | 90 |
|---|---|
| Age in years (Mean ± SD) | 42±14 |
| Gender Male (%[n]) | 83.3 (75) |
| Gender Female (%[n]) | 16.7 (15) |
| Diabetes Mellitus (%[n]) | 88.9 (80) |
| Hypertension (%[n]) | 66.7 (60) |
| Smoking (%[n]) | 44.4 (40) |
| Hyperlipidaemia (%[n]) | 34.4 (31) |
| Peripheral Vascular disease (%[n]) | 35.5 (32) |
| Ischemic Heart Disease (%[n]) | 30 (27) |

**Table-3: Primary and Secondary Patency rates of $CAVeT_2A_2$ Score [expressed as Percentage (%) and Number (n)]**

| Follow up | Primary Patency | | | Secondary Patency | | |
|---|---|---|---|---|---|---|
| | Score <2 | Score ≥2 | *p*-value | Score <2 | Score ≥2 | *p*-value |
| 6 weeks | 100% (58) | 68.7% (22) | 0.074 | 94.8% (55) | 71.8% (23) | 0.002 |
| 6 months | 82.7% (48) | 53.1% (17) | 0.229 | 75.8% (44) | 46.8% (15) | 0.036 |
| 12 months | 70.6% (41) | 40.6% (13) | 0.357 | 62.0% (36) | 31.2% (10) | 0.032 |

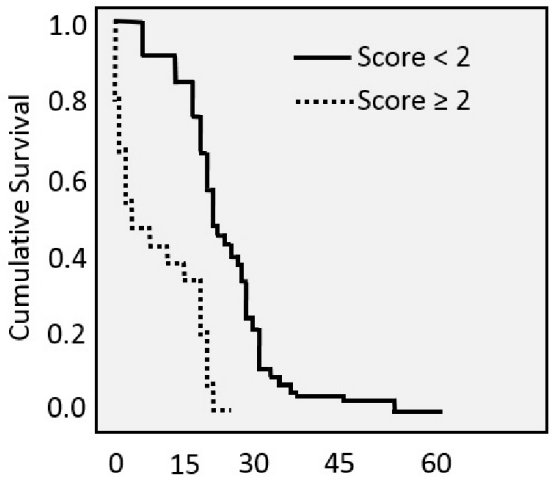


**Figure-1: Primary patency survival curve for BC-AVF according to $CAVeA_2T_2$ score**

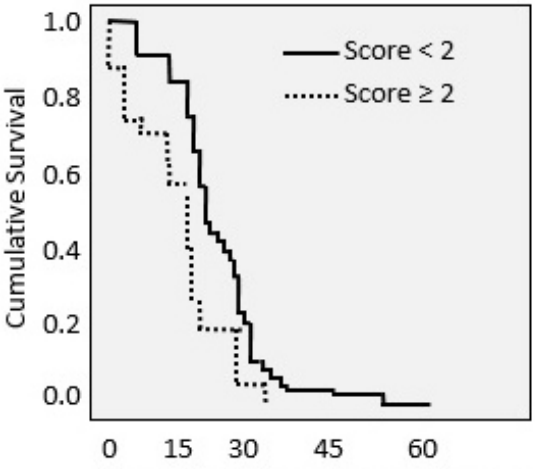


**Figure-2: Secondary patency survival curve for BC-AVF according to $CAVeA_2T_2$ score**

## DISCUSSION

With the advancements in treatment modalities, patients with end stage renal disease (ESRD) are given a longer life span with regular HD. To improve the process of HD, creation of an AVF has become a necessity. Once a fistula is created, maintaining patency and preventing complications is the number one priority. There are numerous patient and surgeon related factors which may affect the patency and long-term survival of AVF. Many studies have identified the impact of patient related modifiable factors such as diabetes, hypertension, peripheral vascular disease and non-modifiable factors such as advancing age and gender; on long term survival of AVF.[2,11–13]

Vessel size and compliance may further play a part in fistula maturation hence preoperative mapping with a Doppler scan is becoming an integral part of evaluation.[14] Despite numerous thorough preoperative evaluations one can never be sure of complete success. Thus, it is very important to maintain constant check-ups on patients especially the high-risk ones. It was noted that patients who had ESRD along with uncontrolled diabetes mellitus and previous catheterization for HD purpose, had a higher risk of failure as compared to those patients who have managed their diabetes relatively well and were on low dose heparin.[15]

Keeping in view all these factors, it is imperative to identify patients who are at high risk of failure of AVF. Devising clinical scores to segregate the cohort of high-risk patients is something being tried for few decades but no single scoring system is yet validated for this purpose, although various prognostic scores have been devised in past to assess the survival of AVFs. Lok *et al* proposed a scoring system consisting of four parameters.[16] This was externally validated in 445 patients and concluded that the score was simple and easily reproducible. In their study, all AVFs created in distal forearm and cubital fossa were included. However, they cautioned that the clinical utility of these risk factors requires further clinical evaluation. Another score used in the past is Index of Co-existent Diseases. This Score is complex and include 19 disease classes along with 11 categories of physical impairment with a score of 0 to 3 in each category. Vernaglione *et al* used this score to assess the survival of AVFs at wrist.[17] His study results were not externally validated and he postulated a poor survival rate in patients with score >1.

Bosanquet *et al* assessed the impact of numerous variables on the survival of AVFs in distal forearm.[18] They found statistically significant effect of 5 variables on the survival rates and proposed $CAVeA_2T_2$ score consisting of these 5 variables. They proposed that a score of ≥2 was associated with a significantly poor survival rate. However, they admitted that the study was not externally validated and more pooled data is needed in multicentre settings. This scoring system was further analysed in another study by Martinez *et al*.[10] They assessed the primary, assisted primary and secondary patency survivals. They reached a conclusion that the patency rates were significantly lower in those patients who had a score of ≥2. Further stratification in three categories (0–1, 2 and 3+) retained the significance in primary and secondary survival rates however not much difference was found in terms of assisted primary patency. They proposed that distal forearm fistula should not be the access of choice in patients with a score of ≥2. In our study, we have assessed the impact of this score on the primary and secondary

survival. We found similar results as proposed by Martinez *et al*[10] and Bosanquet *at al*[18]. However, in our study we used this $CAVeA_2T_2$ scoring system for more proximal AVF access rather than distal forearm fistula, as was originally designed in previous studies. Our results indicate that patients with a high score should be given more time for the fistula to mature especially in those cases where an attempt to create a distal AVF has already failed. Similar proposals were given by Martinez *et al* also.[10]

We accept the limitation of our study such as small sample size and short follow up of only 12 months. Furthermore, absence of external validation of this study should be kept in mind when interpreting the results. We propose larger multi centre studies with higher sample size and stratification of the score based on the fistula site. That may help in understanding the effect of this scoring system on various types of fistula in term of their site such as distal forearm or cubital fossa. External validation of prospective studies is recommended for more validated results.

## CONCLUSION

In this study we found $CAVeA_2T_2$ scoring system as an easy to apply and clinically useful tool to assess the patency and survival of BC-AVF. Patients have a poor patency and significantly low survival rate when their $CAVeA_2T_2$ score was $\geq 2$. Further multicentre studies to assess the external validity of this scoring system are recommended.

## AUTHORS' CONTRIBUTION

RU: Study conception. RU, HM, MM, AS, MWA: Data collection. RU, HM: Analysis. RU, HM, MM, MWA, AS: Investigation. RU, HM: Writing, accountability for all aspects of the work. RU, HM, MM, MWA, AS: Critical review, revision, final approval of the article.

## REFERENCES


1. Woo K, Ulloa J, Allon M, Carsten CG, Chemla ES, Henry ML, *et al*. Establishing patient-specific criteria for selecting the optimal upper extremity vascular access procedure. J Vasc Surg 2017;65(4):1089–103.
2. Masengu A, Maxwell AP, Hanko JB. Investigating clinical predictors of arteriovenous fistula functional patency in a European cohort. Clin Kidney J 2016;9(1):142–7.
3. Lee HS, Song YR, Kim JK, Joo N, Kim C, Kim HJ, *et al*. Outcomes of vascular access in hemodialysis patients: Analysis based on the Korean National Health Insurance Database from 2008 to 2016. Kidney Res Clin Pract 2019;38(3):391–8.
4. Rayner HC, Pisoni RL, Gillespie BW, Gillespie BW, Goodkin DA, Akiba T, *et al*. Creation, cannulation and survival of arteriovenous fistulae: data from the Dialysis Outcomes and Practice Patterns Study. Kidney Int 2003;63(1):323–30.
5. Copeland TP, Hye RJ, Lawrence PF, Woo K. Association of Race and Ethnicity with Vascular Access Type Selection and Outcomes. Ann Vasc Surg 2020;62:142–7.
6. Al-Balas A, Lee T, Young CJ, Allon M. Choice of a second vascular access in hemodialysis patients whose initial arteriovenous fistula failed to mature. J Vasc Surg 2018;68(6):1858–64.
7. Monroy-Cuadros M, Yilmaz S, Salazar-Banuelos A, Doig C. Risk factors associated with patency loss of hemodialysis vascular access within 6 months. Clin J Am Soc Nephrol 2010;5(10):1787–92.
8. Huang YT, Chang YM, Chen IL, Yang CL, Leu SC, Su HL, *et al*. Heart rate variability during hemodialysis is an indicator for long-term vascular access survival in uremic patients. PLoS One 2017;12(3):e0172212.
9. Vascular Access 2006 Work Group. Clinical practice guidelines for vascular access. Am J Kidney Dis 2006;48(Suppl 1):S176–247.
10. Martinez LI, Esteve V, Yeste M, Artigas V, Llogostera S. Clinical Utility of a New Predicting Score for Radiocephalic Arteriovenous Fistula Survival. Ann Vasc Surg 2017;41:56–61.
11. Smith GE, Gohil R, Chetter IC. Factors affecting the patency of arteriovenous fistulas for dialysis access. J Vasc Surg 2012;55(3):849–55.
12. Ma L, Zhao S. Risk factors for mortality in patients undergoing hemodialysis: A systematic review and meta-analysis. Int J Cardiol 2017;238:151–8.
13. Lee KG, Chong TT, Goh N, Achudan S, Tan YL, Tan RY, *et al*. Outcomes of arteriovenous fistula creation, effect of preoperative vein mapping and predictors of fistula success in incident haemodialysis patients: A single-centre experience. Nephrology (Carlton) 2017;22(5):382–7.
14. Hossain S, Sharma A, Dubois L, DeRose G, Duncan A, Power AH. Preoperative point-of-care ultrasound and its impact on arteriovenous fistula maturation outcomes. J Vasc Surg 2018;68(4):1157–65.
15. Jamil M, Usman R. Predictive parameters for successful functional maturation of native arteriovenous fistula. J Ayub Med Coll Abbottabad 2015;27(4):821–4.
16. Lok CE, Allon M, Moist L, Oliver MJ, Shah H, Zimmerman D. Risk equation determining unsuccessful cannulation events and failure to maturation in arteriovenous fistulas (REDUCE FTM I). J Am Soc Nephrol 2006;17(11):3204–12.
17. Vernaglione L, Mele G, Cristofano C, Distratis C, Perrone F, Frascina M, *et al*. Comorbid conditions and gender impact the primary survival of distal radiocephalic arteriovenous fistula inpatients on long-term hemodialysis. J Nephrol 2005;18(3):276–81.
18. Bosanquet DC, Rubasingham J, Imam M, Woolgar JD, Davies CG. Predicting outcomes in native AV forearm radio-cephalic fistulae; the CAVeA2T2 scoring system. J Vasc Access 2015;16(1):19–25.



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