ARTERIOVENOUS ACCESS IN CHILDREN

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ABSTRACT

Objective: To evaluate arteriovenous access (AVA) in children for patency and to compare our results with other studies.

Study Design: Cross sectional descriptive study.

Place and Duration of Study: Combined Military Hospital Rawalpindi and Combined Military Hospital Lahore, from 1st August 2005 to 15th June 2011.

Patients and Methods: Total 35 AVA patients were included in the study. Record was made of age, weight, gender, physical examination of vein, findings of duplex venous mapping, plan of AVA and procedure performed. Twenty nine cases (82.8 %) were already undergoing hemodialysis. Thirty (85.7%) cases were operated under general anesthesia and only 5 (14.2%) under local anesthesia. All end-to-side fistulae were made. Meticulous microsurgical technique was used. Patients were examined on 1st, 2nd and 10th postoperative days, and then every month for at least 12 months. Primary failure, complications and revision procedures were recorded. SPSS version 19.00 was used for statistical analysis. Primary and secondary patencies were calculated. Kaplan – Meier curve was used to express both primary and secondary patency.

Results: Out of 35 AVA, 20 (57.1%) radiocephalic (RCAVA), 11(31.4%) brachiocephalic (BCAVA) and 4 (11.4%) brachiobasilic (BBAVA) were made. Three (8.5%) AVA thrombosed within 48 hours. Thrombectomy was done in all but only one (2.8%) was saved. Six (17.1%) presented with failure within next 6 months (4 RCAVA and 2 BCAVA).Only 1 (2.8%) RCAVA was saved. One RCAVA, BCAVA and BBAVA each presented with failure between 6 and 12 months. Again 1 RCAVA was saved. Primary failure occurred in 4 (11.4 %) patients. Primary patency rate at 6 months and 12 months was 74.2% and 65.7% respectively while secondary patency rate was 80% and 74.2% at 6 and 12 months respectively.

Conclusion: Primary and secondary patency rates of AVA in children in our study were comparable to most of the similar studies.

Keywords: Arteriovenous fistula, Arteriovenous graft, Central venous catheter, Hemodialysis, Vascular access.

INTRODUCTION

A functioning AV access is vital for a patient on chronic hemodialysis. A significant proportion of these patients are children[1]. Although first AV access report was published in 1966[2], first AV access in children was reported in 1970[3]. Initial reports showed patency rates quite inferior to adult population with 50% immediate failure[3] but just after 3 years.

Broyer et al. reported acceptable results in 54% of distal AVFs in children less than 20 kg[4]. With the development of microsurgical techniques, operating loupes and microscope, better results were achieved. In 1981 Bourquelot et al. reported the first distal AVA using microsurgical technique in children weighing less than 10 kg[5]. In many centers of world, fistula first policy is still not followed for pediatric group. Most of these patients have Central Venous Catheter (CVC) placement for hemodialysis even in the developed part of the world[6,7]. These centrally placed catheters not only lead to both local and systemic infections, these ultimately cause central venous stenosis, further precluding the chance of fistula success[1,8,9]. Even in USA, CVC are used as primary access in 89% of children under the age of 13 years and 64% of children 13 to 19 years of

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age[1]. In our country, due to the deficiency of vascular surgeons, AV access is mostly made by surgeons who do not have formal microvascular surgery training. This causes more AV access failure rates. When these cases are referred to us, first or even second ideal site for AV access has already been exhausted. In this paper we will present our experience of AV access in pediatric patients and compare with previous studies. Peculiar problems faced during creation of AV access in these patients in our setup are also highlighted.

PATIENTS AND METHOD

This descriptive study was conducted at CMH Rawalpindi and CMH Lahore from August 2005 to June 2011. Chidren, upto the age of 12 years who underwent AVA procedure, were included in the study. Total 35 cases were selected by simple random sampling technique. Patients who reported with complications or for revision of AVA already constructed were excluded from the study. All new AVA which were created on any of the 35 cases selected for study after the failure of initial AVA, were not included in the study. All those who died during the study period or had follow up less than 52 weeks were also not included in the study. AVA was planned after clinically evaluating and selecting the vein or after Duplex venous mapping in which suitable vein for AVA was not clinically obvious. All procedures were done by a single vascular surgeon. Local anesthesia was used in only 5 (14.2%) children between the age of 11 and 12 years while GA was given to 30(85.7%) cases. In 26 (74.2%) cases nondominant side was chosen for AVA while in 9(25.7%) cases dominant side was used. Inflatable tourniquet was not used in any case. Operating loupes (×3 magnification) and microsurgical instruments were used in all cases. All end-to-side (end of vein to the side of artery) fistulae were fashioned. In 4 (11.4%) cases injection papaverine was used locally to reverse arterial spasm. Anastomosis was done using 7/0 or 8/0 proline swaged on double

Table-1: Time of AVA failure, complications, procedure done and results.

Type of AVA	Time of failure	Complication	Procedure done	Result
RCAVA	Within 48 hrs	Thrombosis	Thrombectomy	Saved
RCAVA	Within 48 hrs	Thrombosis	Thrombectomy	Not saved
RCAVA	Within 48 hrs	Thrombosis	Thrombectomy	Not saved
RCAVA	12 week	Thrombosis(latepresentation	AVA at new site	Not saved
RCAVA	15 week	Thrombosis(late presentation)	AVA at new site	Not saved
BCAVA	19 week	Thrombosis(late presentation)	AVA at new site	Not saved
RCAVA	23 week	Thrombosis(late presentation)	AVA at new site	Not saved
BCAVA	24 week	Thrombosis(late presentation)	AVA at new site	Not saved
RCAVA	24 week	Stenosis	Resection and anastomosis	Saved
RCAVA	30 week	Stenosis	Resection and anastomosis	Saved
BCAVA	33 week	Thrombosis(late presentation)	AVA at new site	Not saved
BBAVA	50 week	Thrombosis in aneurysm between 2 stenosis	Two stage BBAVA on contralateral side.	Not saved

Primary failure occurred in 4(11.4 %) patients. Nine AVA failed within 6 months while 3 AVA failed between 6months and 1 year. Primary patency rate at 6 months and 12 months was 74.2% and 65.7% respectively while secondary patency rate was 80% and 74.2% at 6 and 12 months respectively.

needle using microsurgical technique. Thrill was checked peroperativey before concluding the procedure. Drain was not placed in any procedure. Record was made of age, weight, gender, physical examination of vein, finding of duplex venous mapping, plan of AVA and type of AVA made on a predesigned proforma. Frequency and percentages were computed for studied variables. Patients were examined on 1st, 2nd and 10th postoperative days, and then every month for at least 12 months. Parent or attendants were briefed about the supervised exercises. Active exercises of hand (for distal AVA) and forearm (for proximal AVA) were started at 7th postoperative day. Intermittent proximal venous tourniquet was used during exercise from 2nd postoperative week to hasten the maturity. Maturation time was between 6 to 10 weeks.

Primary patency (intervention-free access survival) was defined as the interval from time of access placement to any intervention designed to maintain or reestablish patency or to access thrombosis or the time of measurement of patency. Secondary patency (access survival until abandonment) was defined as the interval from time of access placement to access abandonment or time of measurement of patency, including intervening manipulations (surgical or endovascular interventions) designed to reestablish the functionality of thrombosed access.

A functional AVF is an access that is able to deliver a flow rate of 350 to 400 ml/min without recirculation for the total duration of dialysis. A nonfunctional AVF is an access that is not being successfully used for hemodialysis, regardless of whether it is patent. Inadequate maturation was defined as insufficient access flow to maintain dialysis or the inability to cannulate an AVF, if required, at 6 wk after surgery.

Primary failure was defined as an AVF that did not develop to maintain dialysis or thrombosed before the first successful cannulation for hemodialysis treatment, regardless of eventual AVF abandonment. This definition includes (*1*) inadequate maturation, (*2*) early thrombosis, (*3*) failure of first cannulation, and (*4*) other complications such as ischemia or infection. All these definitions are in accordance with the recommendations of Committee on Reporting Standards of the Society for Vascular Surgery and the American Association for Vascular Surgery[10].

All statistical analysis was performed with SPSS version 19.00. Results were expressed as numbers, percentages, means and standard deviation. Kaplan – Meier curve was used to express both primary and secondary patency.

RESULTS

Thirty five cases of AVA created in pediatric group from August 2005 to July 2011 were included in the study. Age ranged from 2 years to 12 years (mean age : 8.26 years ,S.D 2.73).Five (14.2%) patients were upto the age of 5 years, 22(62.8%) were between 5 and 10 years while 8 (22.8%) were between 10 and 12 years. Weight ranged from 10 Kg to 33 Kg (mean 19.6 Kg, SD: 5.9). There were 22(62.8%) males and

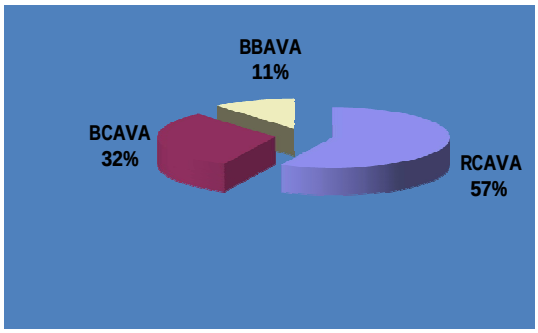

Figure-1: Type of AVA.

13(37.1%) females. In 25(71.4%) cases AVA was planned after clinically evaluating and selecting the vein. Duplex scan venous mapping was done only in 10(28.5%) cases in which suitable vein for AVA was not clinically obvious. Twenty nine (82.8%) patients already had CVC and were undergoing hemodialysis. Types of AVA made are shown in Figure-1. Time of AVA failure, complications, procedure done and results are shown in table-1.

DISCUSSION

AV access creation in pediatric patients is a challenge for a surgeon. Smaller diameter of

vessels and pronounced arterial spasm make the job difficult[11]. These issues demand microvascular techniques. Extreme dedication and tremendous skills are required to produce satisfactory results especially in low weight children.

Total number of patients included in our study is less as compared to some other similar studies[12]. The reasons for this were: (1) we did not include those AVAs in our study which were made on the same patient after the initially selected access failed (2) most of these patients did not turn up for follow up (3) due to the posting of surgeon as well as of child's father many cases could not be followed up (4) our hospitals are mainly treating only entitled patients and only limited number of general population.

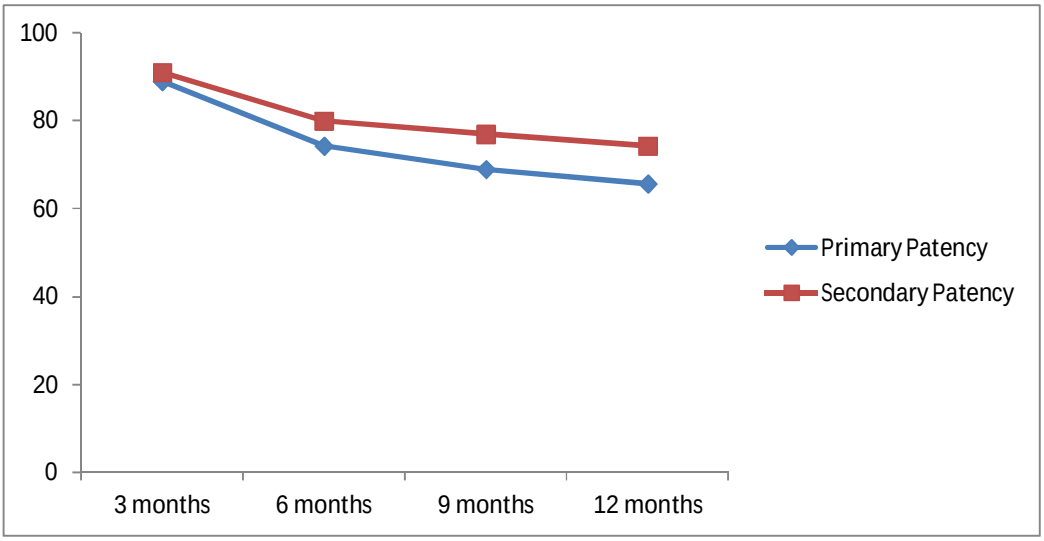

Figure-2: Shows Kaplan–Meier curve expressing primary and secondary patency.

Lumsden et al in their study performed 61 AVA procedures in 24 chidren in about 7 years[13]. But there were only 15 AV fistulae. Rest were either expanded polytetrafluoroethylene (ePTFE) bridge grafts (37) or bovine arteriovenous bridge grafts (9).The ratio of using bridge graft was quite high in this study. Owing to high incidence of thrombosis and infection, we did not use any such graft in our study. The upper limit of age in our study was 12 year which was much less as compared to other studies[13,14]. It was intentionally limited to lesser age as we believed that vessel size in late teens did not represent the vessel caliber of children below 12 years and did not offer the same challenge. This was another factor which decreased our sample size. Lower average weight was due to three factors: (1) most (n=27) of our patients were less than10 years (2) most were from poor socioeconomic group (3) all were Asians. AVA salvage could be done in only 3 (8.5%) cases. This is relatively less number as compared to other studies[12,13]. This was due to the fact that most of failed AVAs reached us more than 7 days after thrombosis. By that time thrombus was firm and adherent to vessel wall. Secondly, we did not have endovascular facility to rectify failing and stenosed fistulas. Another reason could be that if the followup interval should have been less than 1 month, more AVAs could have been saved.

We selected most of our patients on clinical examination. Duplex venous mapping was done in only 10 (28.5%) cases in which veins were not clinically obvious. We followed this protocol because in all cases in which vein was selected clinically did not have history of CVC insertion on ipsilateral side. Twenty nine patients(82.8%) already had CVC for HD in our study. It shows that in our setup we are far

from fistula first policy. de Souza RA and Oliveira EA have shown that patients with a CVC had a 34 times higher risk of infection than patients with an AVF[15].

Bourquelot was the first one who suggested the use of preventive hemostasis with an inflatable tourniquet for microsurgical distal arteriovenous fistulas for hemodialysis[16]. In a study of 434 microsurgical accesses in 380 children with 78% distal autologous AVF, he had 85 % patency at 2 years. It was revealed that the percentage of graft for AVA and failure to mature has significanty droped after using microsurgery[17].

Bagolan et al have stressed the use of microsurgical technique and use of upper-arm exsanguination and ischemia[12]. Many microsurgeons now use complete exsanguination of limb and inflatable tourniquet for AVA in children to prevent arterial spasm. We used microsurgical technique but tourniquets were not used. Although we did not have many early thromboses, yet we believe that had we measured the operating time, it could have been decreased. Also papaverine could have been avoided.

Our primary patency rates are close to those repoted by Sheth and Brandt14, despite the fact that the average weight and age was significantly less in our study.

The study conducted by Sanabia et al.18 showed RCAVA in 70% patients as compared to 57 % in our study. This was most likely due to less concern for saving cephalic vein by persons initially managing these cases in our hospitals. This results in fewer patients having useable cephalic vein. Their early failure rate was 10% which was close to 8.5% in our cases. The cumulative patency rates in radiocephalic fistulas were 79% at 1 year while in our study the overall cumulative patency rate at 1 year was 74.2% but for RCAVA it was 75%.

CONCLUSION

Satisfactory results were seen in AVA performed for pediatric patients. Both primary and secondary patency rates in our study were comparable to most of the international studies. Significant number of patients were referred to us for AVA after hemodialysis was already from CVC .

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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