Abstract

Objective: The main aim of the study was to compare outcomes based on diabetic control for patients undergoing formation of a new upper limb arteriovenous fistula (AVF). Research design and methods: A prospective cohort study was performed where we obtained baseline HbA1c in 65 patients before undergoing AV fistula formation. Patients were followed up at our clinic 6 weeks after creation to assess fistula maturity.

Results: Multiple logistic regression was used to analyze the association between HbA1c status and maturity of AVF at 6 weeks after controlling for possible confounding factors such as age, sex, presence of hypertension and dyslipidaemia. Those with HbA1c less than 6.5 were 22 times likely to have maturity of AVF at 6 weeks as compared to those with HbA1c 6.5 or more (AOR=22.65, p<0.005)

Conclusion: Good diabetes control, reflected by an HbA1c of less than 6.5, is associated with a very high possibility of AVF maturity at 6 weeks post creation.
underwent a brachiocephalic creation by the same vascular surgeon using the same technique (prolene 6/0 continuous sutures for the anastomosis). Patients were discharged the same day after the procedure and seen in the clinic after 6 weeks. A duplex scan was performed to assess fistula maturity. Any complications arising from AVF creation were treated as per standard medical procedure. Maturation of fistula (primary end-point) is measured using the “rule of 6s” that describes parameters associated with maturity of a newly created AV fistula as set forth by the Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines for dialysis access [5]. The rule of 6s states that 6 weeks after the AV fistula has been placed, the fistula is more likely to be usable if: the external diameter is greater than 0.6 cm, the fistula is no more than 0.6 cm deep from the skin surface, and blood flow rate is greater than 600 mL/minute, All data that was collected was tabulated and computerized in MS Excel and was analyzed using SPSS version 23.0. Patients were divided into 2 groups. One with HbA1c of >6.5 and the other with HbA1c of <6.5. Comparison between outcomes of AVF (Successfully matured at 6 weeks) was analyzed using multiple logistic regression, adjusting dyslipidemia, hypertension, age, sex and ethnicity.

Results

A total of 65 patients we recruited in this study. The demographic and descriptive data of the patients enrolled in this study are as shown on Table 1 above. The mean age of the study population was 54.7 (SD=12.6) years. Almost 59% of them were males and rest were females. Majority of the patients were Malay (72%) they had dyslipidaemia or hypertension (81% and 72% respectively). 73% of all Brachiocephalic fistulas created matured in 6 weeks. About 7% had delayed maturity, meaning fistula matured eventually but not in 6 weeks. A small percentage had surgical site infection and cellulitis.

Multiple logistic regression was used to analyse the association between Hba1c status and maturity of AVF at 6 weeks after controlling for possible confounding factors. Those with Hba1c less than 6.5 were 22 times more likely to have maturity of AVF at 6 weeks as compared to those with Hba1c 6.5 or more (AOR=22.65, 95% CI = 2.56-200.34). Hypertension has been excluded from the data analysis due to significant interaction with dyslipidaemia (Table 2).

The association between Hba1c and complications were determined using Fisher’s exact test. There was no significant association between Hba1c status and delayed maturity (p=0.388). There is also no association between surgical site infection and cellulitis between the two cohorts (p =1.00 for both) as shown in (Table 3).

Discussion

Angiopathy is a known complication of long-standing diabetes. Many patients in Malaysia with end stage renal disease have a background of diabetes. Performing a vascular access surgery or any vascular surgery in a diabetic patient often yield unsatisfactory results. Historically, diabetic patients who undergo AVFs fared worse than their non-diabetic counterparts, and this may have been misconceived as a reason to exclude diabetic patients from receiving a potential AVF and to offer them alternative forms of vascular access [6]. When it comes to previous published literature, there has been conflicting results. Mortaz at el, in a paper published in Urology Journal in 2013, conducted a retrospective study comparing factors influencing fistula outcome and noted no difference in the patency rate during the first 2 years [7]. Gordon et al, in 2016, also retrospectively studied the outcome (primary failure rate and time taken to mature) between diabetics and non-diabetics and it showed no significant difference [6]. On the contrary, studies by Sesso (1995 in Brazil), Tuka (2012) and Miller (1999) all shows the fistulas either matures later, has less patency rates and has higher risk of primary failure [8-10]. All these studies are retrospective.

<table>
<thead>
<tr>
<th>Complication</th>
<th>HbA1c &lt;6.5</th>
<th>HbA1c &gt;6.5</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed maturity</td>
<td>No</td>
<td>26 (96.3)</td>
<td>33 (86.8)</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>1 (3.7)</td>
<td>5(13.2)</td>
</tr>
<tr>
<td>SSI</td>
<td>No</td>
<td>27 (100.0)</td>
<td>37 (97.4)</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>0 (0.0)</td>
<td>1 (2.6)</td>
</tr>
<tr>
<td>Cellulitis</td>
<td>No</td>
<td>26 (96.3)</td>
<td>37 (97.4)</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>1 (3.7)</td>
<td>1 (2.6)</td>
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</tbody>
</table>
When it comes to diabetes control, Wu, published remarkable results for patients with good diabetes control with HbA1c of less than 7, who underwent angioplasty of AVF compared to diabetics with an HbA1c of more than 7. His data showed the probability of good diabetes control leading to a successful angioplasty of an AV fistula of being as high as 61% as compared to only 30% in non-diabetic [11].

Based on our study, with good control of diabetes, chances of a fistula to mature is significantly better. Other factors have been attributed to predicting fistula outcome. Increasing age and female gender has been attributed to poor outcome along with diabetes mellitus [12]. In our study, these confounding factors, along with dyslipidaemia and ethnicity were eliminated using statistical test and diabetes control alone was analysed.

Diabetes mellitus is known to cause atherosclerosis or varying degree in medium and small size arteries, especially when diabetes is poorly controlled. Medium and small arteries are used for upper limb arteriovenous fistula creation. It is postulated that impaired flow in these arteries, due to atherosclerosis, inhibit physiological dilation of the artery following an arteriovenous anastomosis creation, which in turn impedes venous dilation and maturation.

Complications of diabetes mellitus in vascular access surgery such as delayed maturity, surgical site infection and cellulitis were more common in the poorly controlled diabetics as compared to the other group, but it is statistically not significant. This could be attributed to our small sample size. In our study, a single experienced surgeon performed all the fistulas. This eliminates surgeon to surgeon bias in terms of experience and surgical technique.

**Conclusion**

This study was carefully planned and performed with adequate sample size which demonstrates a clear difference between fistula maturity at 6 weeks between the 2 cohorts. Patients who are diabetics should not be dissuaded from having an AVF created but the procedure should only be performed when patient's diabetes status is well controlled as it proven to be associated with better outcome.

**References**


