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Interventional management of high flow hemodialysis access: Optimal balloon size for the procedure

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INTRODUCTION

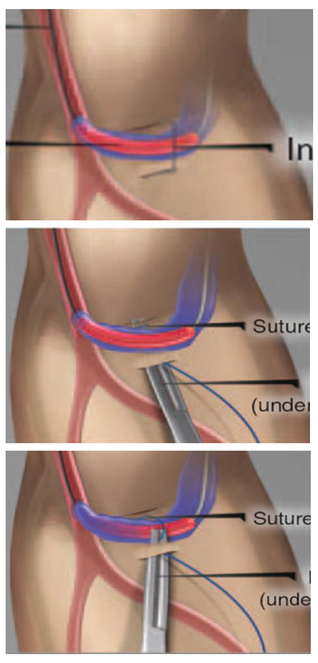
Adequate vascular access flow (Qa) is essential for effective and proper hemodialysis . High Qa is related to cardiac functional problems, resulting in high-output heart failure with cardiac overload. High Qa is also related to the Steal phenomenon, aneurysm growth, and peripheral and central venous stenosis with intimal hyperplasia. Though criteria for high flow access varies, usually high flow access indicates a flow rate in the range of 1500-4000ml/min, and it is usually thought that adequate vascular access flow rate is in the range of 500-1500ml/min.

AIM

The objective of this retrospective study was to identify the feasibility of the MILLER (minimally invasive limited ligation endoluminal-assisted revision) technique in patients with high-flow access problems and to investigate adequate balloon size.

METHODS

This retrospective study included 74 patients who had received the MILLER banding (fig 1) procedure for high Qa problems (Table 1). All study subjects underwent pre- and post-banding Qa measurements, using duplex Doppler ultrasonography. This study attempts to determine the optimal balloon size required to achieve a flow rate of<<1500mL/min. Endoluminal balloons, 3, 4, and 5mm size, were randomly used for the banding procedure. The 74 patients were placed into 1 of 3 groups, according to balloon size (Table 2). The pre- and post-banding Qa was compared between the 3 groups, using non-parametric analysis of variance, followed by post-hoc analysis. The comparisons of the continuous variables between groups of successful, and unsatisfactory flow reduction, were made by means of the Mann-Whitney U test (Table 3).



Two parallel, lateral 0.5cm incisions are made approximately 1–3cm from the AV anastomosis.

A peri-access tunnel is dissected subcutaneously using Kelly clamp blunt dissection, and a 2-0 monofilament ligature of prolene is pulled under the access.

The suture is looped over the access (under the skin) using a Kelly clamp.

Fig 1. MILLER procedure

Table 1. Demographic data of the high-flow group

Characteristics	Number of patients or years
Total patients	74
Age (years)	54.6±13.4*
Sex (males)	30
Hypertension (%)	58 (78)
Cause of end stage renal disease (%)	
Diabetes mellitus	27 (36.5)
Hypertension	11 (14.9)
Chronic glomerulonephritis	10 (13.5)
Polycystic kidney disease	5 (6.8)
preeclampsia	3 (4.1)
Unknown	18 (24.3)

Table 2. Comparison of pre-/post-banding Qa and diameter of VA among patients groups of different balloon sizes by Kruskal-Wallis test

	3mm balloon (n=18)	4mm balloon (n=33)	5mm balloon (n=21)	*P* Valu
Pre-banding Qa (mL/min)	3225.94±2515.51	3476.81±2684.74	3815.14±1851.55	.197
Post-banding Qa (mL/min)	1300.83±707.24	1712.68±1233.00	2361.33±1422.51	**.019**
Pre-banding diameter of VA (mm)	13.47±5.50	15.09±6.31	17.19±6.29	.110
Post-banding diameter of VA (mm)	3.24±0.63	4.46±1.27	5.04±1.44	**<.001**

Table 3. Comparison of pre-banding Qa and diameter of VA between groups of successful and unsatisfactory flow reduction.

	Successful flow reduction	Unsatisfactory flow reduction	*P* Value*
Pre-banding Qa (mL/min)			
3mm (11/ 7)**	2354.27±1113.60	3448.50±1918.50	.149
4mm (17/16)	2495.35±1233.81	3648.20±1902.92	**.022**
5mm (5/ 16)	2267.40±781.68	4298.81±1833.04	**.015**
Pre-banding diameter of VA (mm)			
3mm	12.43±5.66	15.12±5.22	.328
4mm	14.53±6.29	15.69±6.50	.615
5mm	16.52±4.76	17.40±6.82	.791

RESULTS

The technical success rate was 97% (72/74). The mean values of the pre- and post-banding Qa in all patients were 3474.14 ± 2373.45 mL/min and 1780.54 ± 1230.24, respectively. The ratios of decreasing flow, less than 1500mL/min, in the 3, 4, and 5mm balloon groups were 61.1%, 51.5%, and 23.8%, respectively. The mean post-banding Qa values of patients who used 3, 4 and 5mm balloon were 1300.83 ± 707.24 mL/min, 1712.68 ± 1233 mL/min, and 2361.33 ± 1422.51 mL/min, respectively (Table 2). A statistically significant difference was demonstrated between groups using the 3mm and 5mm balloons in post-banding Qa (P=0.004). In the case of the 4 and 5mm balloon groups, the pre-banding Qa was higher in patients showing unsatisfactory flow reduction, compared to the patients showing satisfactory flow reduction (P=0.012, =015) (Table 3 (fig 2).

CONCLUSIONS

Banding adjustment with 3mm balloons may be reasonable in MILLER banding of patients with high-flow vascular access problems. These results will be helpful for optimizing the procedure for flow reduction of the AVF.

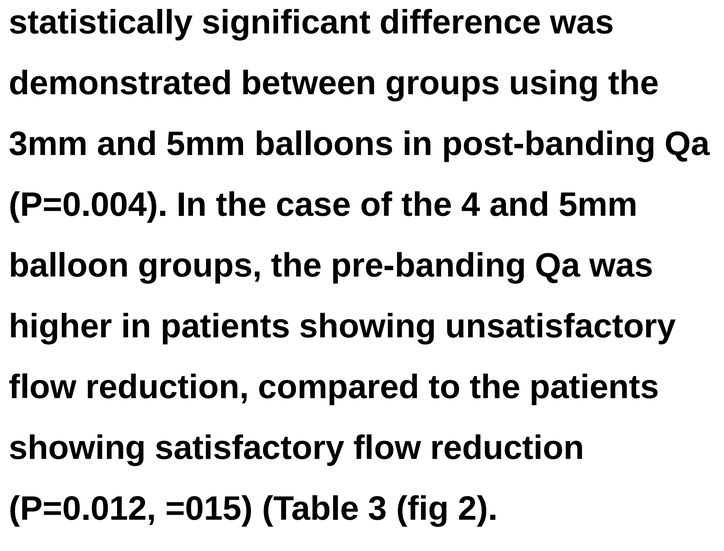


Figure 2. A 66-year-old man with problem of high flow vascular access.
A shows pre-banding fistulography with catheter at brachial artery.
B. Photograph for two bandings **C** shows successful banding after MILLER banding procedure with the reduction of vascular access diameter (arrows).

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