Doppler flow indices at the proximal and distal segment of the arteriovenous shunt

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Introduction

Patients with end stage renal failure require frequent hemodialysis. In order to achieve adequate dialysis blood flow, an arteriovenous shunt is mandatory. The disturbed hemodynamics caused by this surgical intervention, affect adversely both the venous and the arterial sides of the shunt. The irregular blood flow at the venous anastomosis and outflow have been studied extensively because they are closely related to intimal hyperplasia development, a major cause of patency loss. However, few studies have examined the disturbed anastomotic arterial blood flow. Doppler ultrasound has proven an invaluable tool for the preoperative prediction, postoperative diagnosis and management of such pathological vascular flow conditions. The purpose of this study was to analyze flow parameters using Doppler ultrasound before and after the arteriovenous shunt at the proximal and distal segment.

Methods

Arteriovenous shunt was created in 14 healthy Landrace pigs (mean weight 70±8 Kg) between the common carotid artery and the ipsilateral internal jugular vein using an expanded polytetrafluroethylene synthetic graft. On the day of surgery, the pig was sedated with intramuscular administration of ketamine (10 mg/kg), azaperone (4 mg/kg), and atropine (0.05 mg/kg). Anaesthesia was induced with intravenous administration of propofol (0.9 mg/kg). Sevoflurane 3-5 % (vaporizer setting) in oxygen was administered for maintenance of anesthesia. Before and after the reconstruction of the anastomoses, doppler flow waveforms were recorded intraoperatively with a 5.7 MHz flow probe (Vivid7, GE Medical Systems) at the proximal and distal segment of the carotid artery. The flow parameters measured were: the peak systolic velocity (PSV), minimum diastolic velocity (MDV), the time averaged maximum velocity (TAmax), the time averaged mean velocity (TAmean), the resistive index (RI=PSV-MDV/PSV) and the flow rate (FR=TAmean*carotid cross-sectional area).

Results

The results are presented in Table 1, Figures 2 & 3. Data are expressed as mean ± standard error (SE) and were analyzed by using GraftPad Prism Software. Statistical comparisons were performed using the paired Student's t-test. A p value <0.05 was considered significant.

Table 1	CAROTID		PROXIMAL CAROTID		DISTAL CAROTID	
PVS (cm/s)	221,56±14,67	BEFORE AVS	258,33 ± 18,24	AFTER AVS	153,04±17,48 † *	AFTER AVS
MDV (cm/s)	41,18±5,33		157,31±14,59 ††††		-127,36±17,78 †††† **	
TAmax (cm/s)	93,64±6,38		194,44±15,84 ††††		-37,79±16,27†††† **	
TAmean (cm/s)	46,86±2,36		102,56±10,72 †††		-23,06±9,62 †††† **	
RI	0,80±0,03		0,39±0,03 ††††		1,96±0,23 ††† **	
FR	380,52±19,92		643,47±68,29 ††		-86,76±29,62 †††† **	

Values are mean ± standard error † p<0.05, †† p<0.01, ††† p<0.001, †††† p<0.0001 vs before the anastomosis * p<0.01, ** p<0.0001 vs proximal

Conclusions

Doppler flow haemodynamics are deranged after the creation of an arteriovenous shunt with proximal flow indices increased as compared to the distal or the preoperative flow values. These differences may be due to the decrease of the peripheral resistance which causes the flow indices to increase at the proximal side and a steal phenomenon toward the graft.

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