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彩色多普勒超声对尿毒症血液透析患者动静脉内瘘的术前及术后监测效果分析*

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摘要 目的: 探讨与分析彩色多普勒超声对尿毒症血液透析患者动静脉内瘘的术前及术后监测效果。**方法:** 选择2017年2月至2019年5月在本院诊治的尿毒症血液透析并行自体动静脉内瘘的患者90例,在术前1-3d与术后3个月进行超声监测,记录超声特征。记录患者术后内瘘失功、并发症发生情况并进行相关性分析。**结果:** 所有患者都顺利完成自体动静脉内瘘;术后3个月患者自体动静脉内瘘在超声上表现为"u"或"v"形管状结构,表现为高速低阻动静脉瘘血流频谱,瘘口处彩色血流均显示为五彩镶嵌紊乱血流。术后3个月患者的头静脉与桡动脉内径、血流量都高于术前($P<0.05$)。90例患者术后3个月发生血栓形成2例、狭窄1例和静脉瘤样扩张4例,并发症发生率为7.8%。同时发生8例动静脉内瘘失功,发生率为8.9%;Pearson相关分析法显示术后动静脉内瘘失功、并发症发生情况与头静脉、桡动脉内径与血流量存在显著相关性($P<0.05$)。**结论:** 彩色多普勒超声应用于尿毒症血液透析患者及动静脉内瘘患者可监测内瘘血流动力学、血管形态学变化,能够客观评价内瘘失功与并发症发生情况。

关键词: 彩色多普勒超声;尿毒症;血液透析;动静脉内瘘;并发症

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Analysis of Preoperative and Postoperative Monitoring Effects of Color Doppler Ultrasound on Arteriovenous Fistula in Uremia Hemodialysis Patients*

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ABSTRACT Objective: To investigate and analysis the effect of preoperative and postoperative monitoring of color Doppler ultrasound on arteriovenous fistula in uremia hemodialysis patients. **Methods:** 90 caees of patients with uremia hemodialysis and autologous arteriovenous fistula selected for treatment in our hospital from February 2017 to May 2019 were selected. Ultrasound monitoring were performed preoperative 1-3 d and postoperative 3 months, recorded the ultrasound feature. The postoperative internal fistula failure and complications were recorded and the correlation analysis were performed. **Results:** All patients were successfully completed autologous arteriovenous fistula; At the 3 months after operation, the autologous arteriovenous fistula were showed "u" and "v" tubular structure on ultrasound, and were showed high-speed and low-blocking arteriovenous fistula blood flow. In the frequency spectrum, the colored blood flow at the fistula is shown as multicolored mosaic disordered blood flow. The internal diameter and blood flow of the cephalic vein and radial artery were higher than those before surgery at 3 months after operation ($P<0.05$). There were 3 patients were thrombosis at the 3 months after operation in the 90 patients, and were 1 patient of stenosis, and 4 patients of venous tumor-like dilation that the complication rates were 7.8 %. And there were 8 cases of arteriovenous fistula failure at the same time, the incidence rates were 8.9 %. Pearson correlation analysis showed that arteriovenous fistula failure and complications after operation were significantly correlated with the internal diameter of the cephalic vein, radial artery, and blood flow ($P<0.05$). **Conclusion:** Color Doppler ultrasound can be used to monitor the hemodynamics and vascular morphology of internal fistula in patients with arteriovenous fistula in patients with uremia and hemodialysis. It can objectively evaluate the failure and complications of internal fistula.

Key words: Color Doppler ultrasound; Uremia; Hemodialysis; Arteriovenous fistula; Complications

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前言

尿毒症已经成为全球性公共健康问题,具有较高的发病率与死亡率;其在临床上很难根治,且伴有肾功能的持续性下降^[1-3]。血液透析为尿毒症的主要治疗方法,可显著提高患者的生活质量和生存期^[4]。自体动静脉内瘘(native arteriovenous fistula, AVF)是维持性血液透析治疗患者的长期血管通路,具有血管通路通畅、成熟稳定等优势^[5,6]。但是由于各种因素的影响,比如患者血容量不足、内瘘穿刺不当等可导致内瘘失功,可导致机体耗尽自身血管^[7,8]。合理的内瘘修复能够节约血管,保证在短时间内血管通路重新通畅,保障透析患者的顺利治疗,在评价内瘘状态具有重要价值^[9,10]。当前超声在各种疾病中的诊断应用越来越多,其中彩色多普勒超声在小血管的应用方面日益普及,可无创评估内瘘血管状态^[11,12]。本文具体探讨与分析彩色多普勒超声对尿毒症血液透析患者动静脉内瘘的术前及术后监测效果,希望提高自体动静脉内瘘的手术成功率,减少术后并发症的出现。现总结报告如下。

1 资料与方法

1.1 研究对象

选择2017年2月至2019年5月在本院诊治的尿毒症血液透析并行自体动静脉内瘘的患者90例,纳入标准:符合尿毒症的诊断标准;年龄33~90岁;患者签署了知情同意书;透析时间 ≥ 3 个月;都采用自体动静脉内瘘、头静脉与桡动脉端侧吻合方式;临床资料均有效且完整;本院伦理委员会批准了此次研究。排除标准:治疗、诊断配合度差者;临床资料不完整者;术前检查发现术侧上肢桡动脉、头静脉狭窄或闭塞者。

其中男46例,女44例;年龄最小38岁,最大90岁,平均年龄 73.12 ± 5.19 岁;透析时间6个月~8年,平均 3.14 ± 0.24 年;透析次数1~3次/周,平均 2.13 ± 0.29 次/周;原发疾病:慢性肾病50例,高血压肾病20例,多囊肾12例,其他8例。

1.2 手术方法

所有患者都由同一组医生进行手术操作,头静脉与桡动脉间采用端-侧吻合。

1.3 超声方法

使用PHILIPS IE33彩色多普勒超声诊断仪,配有L12-5型高频线阵探头,探头频率5~12 MHz。患者在超声时尽量选取坐位,手臂平展伸直置于检查床上,可将枕头垫于患者手臂之上。

术前监测(术前1~3 d):使用超声探查头静脉、桡动脉的最小内径,记录内膜是否光滑,明确有无狭窄或闭塞。记录自体动静脉内瘘的分支静脉情况,测量血流量,取平均值。

术后监测(术后3个月):采用超声记录吻合口至头静脉全程走行,明确管腔内狭窄情况,记录血流量与血管内径。

内瘘失功标准(术后3个月判断):内瘘血流量 <150 mL/min,不能满足透析需要;内瘘未能触及震颤,未能闻及血管杂音。瘘口狭窄标准:头静脉内径 <2.5 mm,瘘口内径 <2.7 mm,狭窄处血管腔内血流变细,桡动脉狭窄处内径小于相邻管腔的50%。

1.4 统计方法

应用SPSS 19.00,计量数据以 $(\bar{x} \pm s)$ 表示,计数数据以%表示,对比采用配对t检验与 χ^2 检验,相关性分析采用Pearson相关分析法,影响因素分析采用多因素Logistic回归分析, $P < 0.05$ 有统计学意义。

2 结果

2.1 超声特征

术前发现3例患者头静脉内径较细,2例患者桡动脉粥样硬化与斑块较多,不过所有患者都顺利完成自体动静脉内瘘。术后3个月患者自体动静脉内瘘在超声上表现为"u"或"v"形管状结构,表现为高速低阻动静脉瘘血流频谱,瘘口处彩色血流均显示为五彩镶嵌紊乱血流。

2.2 血管内径变化对比

术后3个月患者的头静脉与桡动脉内径都高于术前,对比差异有统计学意义($P < 0.05$)。见表1。

表1 尿毒症血液透析患者动静脉内瘘手术前后血管内径变化对比(mm, $\bar{x} \pm s$)

Table 1 Comparison of changes in blood vessel diameter before and after arteriovenous fistula surgery in uremia hemodialysis patients (mm, $\bar{x} \pm s$)

Groups	n	Cephalic vein	Radial artery
Preoperative	90	2.33 ± 0.12	2.25 ± 0.21
3 months after operation	90	$4.73 \pm 0.19^*$	$5.15 \pm 0.17^*$

Note: Compared to the preoperative, $*P < 0.05$.

2.3 血管血流量对比

术后3个月患者的头静脉与桡动脉血流量都高于术前

($P < 0.05$)。见表2。

表2 尿毒症血液透析患者动静脉内瘘手术前后血管血流量对比(mL/min, $\bar{x} \pm s$)

Table 2 Comparison of vascular blood flow before and after arteriovenous fistula surgery in uremia hemodialysis patients (mL/min, $\bar{x} \pm s$)

Groups	n	Cephalic vein	Radial artery
Preoperative	90	821.84 ± 178.29	38.98 ± 2.11
3 months after operation	90	$1278.09 \pm 200.77^*$	$1113.98 \pm 187.76^*$

2.4 并发症情况

术后3个月,90例患者发生血栓形成2例、狭窄1例和静

脉瘤样扩张4例,并发症发生率为7.8%。同时发生8例动静脉内瘘失功,发生率为8.9%。

2.5 相关性分析

在 90 例患者中, Pearson 相关分析法显示术后动静脉内瘘

失功、并发症发生情况与头静脉、桡动脉内径与血流量存在显著相关性($P<0.05$)。见表 3。

表 3 尿毒症血液透析患者动静脉内瘘失功、并发症与超声特征的相关性($n=90$)

Table 3 Correlation between arteriovenous fistula failure, complications and ultrasound characteristics in uremia hemodialysis patients ($n=90$)

Index	Bore size		Blood flow	
	Cephalic vein	Radial artery	Cephalic vein	Radial artery
Loss of power-r	0.566	0.642	0.588	0.613
<i>P</i>	0.003	0.001	0.002	0.001
Complication-r	0.599	0.632	0.611	0.642
<i>P</i>	0.002	0.001	0.001	0.000

3 讨论

血液透析是尿毒症患者最主要的治疗方法之一,能有效改善患者的临床症状,但透析的成功需要良好性与通畅性的动静脉内瘘^[13]。并且动静脉内瘘需要一个成熟的过程,需要静脉血管内径增粗与动脉化,血流量增加,便于穿刺,需要满足透析需要^[14]。同时自体动静脉内瘘也是一种非生理性的高顺应性、低阻力的血流动力学血管环境,可顺利进行透析,管壁适度均匀增厚,最终内瘘成熟^[15]。不过多数尿毒症患者合并有各种基础疾病,自身血管条件差,加之在内瘘的使用与穿刺不当,导致出现并发症,使得动静脉瘘完全失去功能^[16,17]。

当前导致内瘘失功的直接原因有内瘘血栓形成、内瘘血管狭窄等^[18]。血管造影是监测动静脉内瘘血栓及狭窄的金标准,但该方法为有侵入性操作,使用时易引发穿刺部位血肿、造影剂外渗等^[19,20]。彩色多普勒超声具有重复性强、操作简便、无创等优点,能够良好显示头静脉、桡动脉管腔、管壁情况,也能够显示上述部位的流速、血流充盈程度^[21,22]。本研究显示术后 3 个月患者的头静脉与桡动脉内径、血流量都高于术前。当前也有研究对动静脉内瘘术后内径及血流量的彩色多普勒超声观察中发现,在内瘘建立后 1 个月之内血流量增加显著,术前患者的平均桡动脉流量约为 30 mL/min,术后 1 个月可上升 860 mL/min^[23]。并且当前彩色多普勒超声可通过测量平均血管数个心动周期内的时间空间平均流速从而获得血流量参数,有效防止内瘘失功,延长内瘘使用时间,并且测量结果更准确、更稳定,利于早期发现无临床症状,从而持续改善患者的预后^[24,25]。

血液透析为尿毒症患者临床治疗中应用较为普遍且有效的方式,自体动静脉内瘘为目前血透首选的血管通路,其通畅性直接关系血液透析能否顺利进行。自体动静脉内瘘是人为的把头静脉与桡动脉吻合,形成一个血管短路,桡动脉血液分流至头静脉,由于动脉血压高于静脉血,导致机体血流重新分布^[26]。不过因内瘘使用或造瘘操作不当及穿刺导致血管壁损伤、渗血,会引发相关动静脉内瘘并发症。因此自体动静脉内瘘是一个病理性的结构,在临床上的应用存在一定的并发症,包括血栓、血管狭窄、血肿、静脉瘤样扩张等^[27]。本研究显示 90 例患者术后 3 个月发生血栓形成 2 例、狭窄 1 例和静脉瘤样扩张 4 例,并发症发生率为 7.8%。同时发生 8 例动静脉内瘘失功,发生率为 8.9%; Pearson 相关分析法显示术后动静脉内瘘失功、并发症发生情况与头静脉、桡动脉内径与血流量存在显著相关

性。其中血栓在超声上主要表现为管腔内径显著增宽,血栓无回声,彩色多普勒检查显示管腔内无显著血流信号。狭窄常见于瘘口及近瘘口处的静脉血管,尤其是反复穿刺部位,在超声上主要表现为管腔内部血流束显著变细,局部存在花彩样血流。静脉瘤样扩张主要与吻合口成角、扭转及高凝状态有关,在超声上可表现为头静脉血流动脉化压力增高^[28]。在应用中,常规清除小分子溶质要求血流量要在 200-300 mL/min 范围内^[29]。严格把握内瘘的使用时机,规范地使用和维护内瘘指征^[30]。本研究也存在一定的不足,纳入的样本数量不足,且术后观察时间点比较少,研究指标比较少,将在后续研究中深入探讨。

综上,彩色多普勒超声应用于尿毒症血液透析患者动静脉内瘘患者可监测内瘘血流动力学、血管形态学变化,能够客观评价内瘘失功与并发症发生情况。

参考文献(References)

- [1] Benard V, Pichette M, Lafrance JP, et al. Impact of Arteriovenous fistula creation on estimated glomerular filtration rate decline in Predialysis patients[J]. BMC Nephrol, 2019, 20(1): e420
- [2] Derbel B, Koubaa MA, Miri R, et al. Conservative aneurysmorrhaphy for hemodialysis arteriovenous fistula [J]. J Med Vasc, 2019, 44(6): 380-386
- [3] Hamadah AM, Gharaibeh K. Predialysis nephrology care and its impact on initial vascular access type in hemodialysis patients in Jordan[J]. Saudi J Kidney Dis Transpl, 2019, 30(5): 1103-1110
- [4] Jeong S, Kwon H, Chang JW, et al. Comparison of outcomes between type 2 diabetic and non-diabetic incident hemodialysis patients with functioning arteriovenous fistulas[J]. Medicine (Baltimore), 2019, 98(48): e18216
- [5] Jeong S, Kwon H, Chang JW, et al. Effects of patient age on patency of chronic hemodialysis vascular access [J]. BMC Nephrol, 2019, 20(1): e422
- [6] Kumar JS, Sajeev Kumar KS, Arun Thomas ET, et al. Prediction model for successful radiocephalic arteriovenous fistula creation in patients with diabetic nephropathy [J]. Saudi J Kidney Dis Transpl, 2019, 30(5): 1058-1064
- [7] Odajima S, Inoue T, Hamana T, et al. Skin ulcer due to hemodialysis access-induced distal ischemia treated with arteriovenous fistula banding and endovascular therapy [J]. J Cardiol Cases, 2019, 20(5): 155-157
- [8] Palumbo VD, Fazzotta S, Damiano G, et al. Loup-assisted technique to

- create arterio-venous fistulas in elderly. A single centre experience[J]. Clin Ter, 2019, 170(6): e454-e459
- [9] Rao NN, McDonald P, Worthley MI, et al. Response by Rao et al to Letter Regarding Article, "Effects of Arteriovenous Fistula Ligation on Cardiac Structure and Function in Kidney Transplant Recipients" [J]. Circulation, 2019, 140(21): e806-e807
- [10] Takashima T, Nakashima Y, Suenaga A, et al. Radial artery-first dorsal metacarpal vein arteriovenous fistula in the first interdigital space of the dorsal hand for hemodialysis[J]. J Vasc Access, 2019, 11(29): 4477-4479
- [11] Germano AS, Gomes AP, Martins R, et al. Upper limb vascular mapping with Doppler ultrasound: Technique precision evaluated in healthy volunteers[J]. Ultrasound, 2019, 27(4): 225-232
- [12] Gioppo A, Acerbi F, Farago G. Detection and treatment of a spinal dural arteriovenous fistula supplied by a radiculomedullary artery: case illustration[J]. J Neurosurg Spine, 2019: 1-2.[Epub ahead of print]
- [13] Minarchick L, Simoni E, Ferranti K. Successful endovascular embolization of large symptomatic congenital renal arteriovenous fistula in an octogenarian [J]. J Vasc Surg Cases Innov Tech, 2019, 5(4): 419-422
- [14] Mukendi AM, Rauf A, Doherty S, et al. Renal arteriovenous malformation: An unusual pathology [J]. SA J Radiol, 2019, 23(1): e1704
- [15] Raherinantenaina F, Avotsihoarana TH, Rabemanorintsoa F, et al. Management of carotid-jugular fistula: Case report and review of the literature[J]. J Med Vasc, 2019, 44(6): 426-431
- [16] Asari A IA, Damasceno D CF, De Almeida NA, et al. Ulcers of the fingers and dorsum of the left hand caused by venous hypertension after construction of a brachiocephalic arteriovenous fistula: case report[J]. J Vasc Bras, 2019, 18: e20190008
- [17] Beaubien-Souligny W, Kontar L, Blum D, et al. Meta-Analysis of Randomized Controlled Trials Using Tool-Assisted Target Weight Adjustments in Chronic Dialysis Patients[J]. Kidney Int Rep, 2019, 4(10): 1426-1434
- [18] Cai YS, Xiao H, Zhang S, et al. Carbapenem-resistant Klebsiella pneumoniae infection causing rupture of graft artery in solid organ recipients: Case report and review of literature [J]. Medicine (Baltimore), 2019, 98(45): e17878
- [19] Goloborodko SA. The Transposition of the Median Nerve for the Treatment of Carpal Tunnel Syndrome [J]. J Hand Surg Asian Pac Vol, 2019, 24(4): 498-499
- [20] Hashimoto M, Ohkuma K, Akita H, et al. Usefulness of contrast-enhanced ultrasonography for diagnosis of renal cell carcinoma in dialysis patients: Comparison with computed tomography [J]. Medicine (Baltimore), 2019, 98(47): e18053
- [21] Hu Z, Han E, Chen W, et al. Feasibility and safety of ultrasound-guided percutaneous microwave ablation for tertiary hyperparathyroidism[J]. Int J Hyperthermia, 2019, 36(1): 1129-1136
- [22] Lin N, Fang YC, Song JC, et al. Total parathyroidectomy plus multi-point subcutaneous transplantation in the forearm may be a reliable surgical approach for patients with end-stage renal disease: A case report[J]. Medicine (Baltimore), 2019, 98(47): e17649
- [23] Ong J SL, Manickavasagar R, Misur P, et al. Migration of a Retained Guidewire Puncturing Multiple Organs in a Remote Australian Dialysis Patient[J]. J Vasc Interv Radiol, 2019, 30(12): 2041-2043
- [24] Sprenger-Mahr H, Zitt E, Kronbichler A, et al. A hemodialysis patient with bone disease after pregnancy: a case report [J]. BMC Nephrol, 2019, 20(1): e425
- [25] Yao CA, Lin CH. Treatment with the herbal formulation Eefooton slows the progression of chronic kidney disease: A case report [J]. Medicine (Baltimore), 2019, 98(43): e17573
- [26] Shinoda Y, Watanabe T, Minamisaka T, et al. Inferior Vena Cava Occlusion and Ilio-Iliac Arteriovenous Fistula Caused by Tumor Invasion: A Case Report[J]. Ann Vasc Dis, 2019, 12(3): 388-391
- [27] Xu L, Han F. Neurosyphilis complicated with pial arteriovenous fistula: A rare case report [J]. Medicine (Baltimore), 2019, 98(45): e17770
- [28] Asari A IA, Damasceno D CF, De Almeida NA, et al. Ulcers of the fingers and dorsum of the left hand caused by venous hypertension after construction of a brachiocephalic arteriovenous fistula: case report[J]. J Vasc Bras, 2019, 18(11): e20190008
- [29] Carroll JE, Colley ES, Thomas SD, et al. Tracking geometric and hemodynamic alterations of an arteriovenous fistula through patient-specific modelling[J]. Comput Methods Programs Biomed, 2019, 186(9): e105203
- [30] Diogenes P CN, Da Silva A NA, Guzen FP, et al. Evaluation of upper limb superficial venous percussion as a sign of anatomical location and venous permeability. A comparative study of superficial venous percussion to ultrasound findings on non-renal patients and on chronic kidney disease patients[J]. PLoS One, 2019, 14(11): e0224825

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- [25] Ramesh KSV, Swetha P, Mohan Kumar P, et al. Estimation of superoxide dismutase levels in saliva and gingival crevicular fluid among smokers and non-smokers in periodontitis patients - An Observational Study[J]. Niger Med J, 2019, 60(3): 133-137
- [26] 阿布拉江·米吉提, 买买提·依斯热依力, 艾克拜尔·艾力, 等. 丙二醛在胃食管反流病食管黏膜炎症发生中的表达及作用机制 [J]. 中国医师杂志, 2019, 21(7): 997-1001, 1006
- [27] Bryniarski P, Kasprczyk S, Rajwa P, et al. The comparison of oxidative stress effect in classic and tubeless percutaneous nephrolithotomy[J]. Int Urol Nephrol, 2018, 50(12): 2145-2152
- [28] Alsmadi J, Fan J, Zhu W, et al. The Influence of Super-Mini Percutaneous Nephrolithotomy on Renal Pelvic Pressure In Vivo[J]. J Endourol, 2018, 32(9): 819-823
- [29] Said SH, Al Kadum Hassan MA, Ali RH, et al. Percutaneous nephrolithotomy; alarming variables for postoperative bleeding. Arab J Urol, 2017, 15(1): 24-29
- [30] Del Santo K, Audouin M, Ouzaid I, et al. Evaluation of the operating results and costs associated with the implementation of a flexible ureteroscopy activity within a university hospital center [J]. Prog Urol, 2017, 27(6): 375-380