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【临床研究】

维持性血液透析与持续不卧床腹膜透析对终末期肾病患者钙磷代谢及氧化应激的影响比较

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摘要: **目的** 探讨维持性血液透析与持续不卧床腹膜透析对终末期肾病患者钙磷代谢及氧化应激反应的影响。
方法 选择 2019 年 1 月至 2021 年 10 月南阳市中心医院肾内科收治的 120 例行透析治疗的终末期肾病患者为研究对象,按照随机数字表法将患者分为对照组和观察组,每组 60 例。对照组患者采用维持性血液透析治疗,观察组患者采用持续不卧床腹膜透析治疗,2 组患者均连续治疗 3 个月。透析治疗前及连续透析治疗 3 个月后,使用全自动生物化学分析仪检测 2 组患者的血清钙、磷水平,采用硫代巴比妥酸法检测 2 组患者血清中丙二醛(MDA)水平,采用黄嘌呤氧化酶法检测 2 组患者血清中超氧化物歧化酶(SOD)水平,采用比色法检测 2 组患者血清中髓过氧化物酶(MPO)水平。比较 2 组患者连续透析治疗 3 个月后血清钙、磷达标率及透析治疗期间消化道出血、动静脉内瘘闭塞、感染、低蛋白血症及心功能异常等并发症发生情况。**结果** 透析治疗前,2 组患者血清钙、磷及 MDA、SOD、MPO 水平比较差异均无统计学意义($P>0.05$)。透析治疗 3 个月后,2 组患者的血清钙水平及对照组患者的血清磷水平与透析治疗前比较差异无统计学意义($P>0.05$),观察组患者的血清磷水平显著低于透析治疗前($P<0.05$)。透析治疗 3 个月后,2 组患者的血清钙水平比较差异无统计学意义($P>0.05$),观察组患者的血清磷水平显著低于对照组($P<0.05$)。对照组患者血清钙达标 35 例(58.33%),血清磷达标 16 例(26.67%);观察组患者血清钙达标 38 例(63.33%),血清磷达标 31 例(51.67%);2 组患者血清钙达标率比较差异无统计学意义($\chi^2=0.315, P>0.05$),观察组患者血清磷达标率显著高于对照组($\chi^2=7.869, P<0.05$)。透析治疗 3 个月后,2 组患者血清中 MDA、MPO 水平显著高于透析治疗前($P<0.05$),SOD 水平显著低于透析治疗前($P<0.05$)。透析治疗 3 个月后,观察组患者血清中 MDA、MPO 水平显著低于对照组($P<0.05$),SOD 水平显著高于对照组($P<0.05$)。透析治疗期间,对照组患者发生消化道出血 4 例(6.67%),动静脉内瘘闭塞 3 例(5.00%),感染 2 例(3.33%),低蛋白血症 4 例(6.67%),心功能异常 5 例(8.33%),并发症发生率为 30.00%(18/60);观察组患者发生消化道出血 2 例(3.33%),动静脉内瘘闭塞 1 例(1.67%),感染 1 例(1.67%),低蛋白血症 1 例(1.67%),心功能异常 2 例(3.33%),并发症发生率为 11.67%(7/60);观察组患者并发症发生率显著低于对照组($\chi^2=6.114, P<0.05$)。**结论** 维持性血液透析和持续不卧床腹膜透析对终末期肾病患者血清钙代谢的影响无显著差异,而持续不卧床腹膜透析对终末期肾病患者血清磷的控制效果更好,诱发患者机体的氧化应激反应相对更轻微,安全性更高。

关键词: 终末期肾病;血液透析;腹膜透析;钙磷代谢;氧化应激

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Comparison of the effect of maintenance hemodialysis and continuous ambulatory peritoneal dialysis on calcium and phosphorus metabolism and oxidative stress in patients with end-stage renal disease

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Abstract: **Objective** To investigate the effect of maintenance hemodialysis and continuous ambulatory peritoneal dialysis on calcium and phosphorus metabolism and oxidative stress in patients with end-stage renal disease. **Methods** A total of 120 patients with end-stage renal disease who received dialysis treatment in the Department of Nephrology of Nanyang Central Hospital from January 2019 to October 2021 were selected as the research objects, and the patients were divided into the control group and the observation group according to the random number table method, with 60 cases in each group. The patients in the control group were treated with maintenance hemodialysis, and patients in the observation group were treated with continuous ambulatory peritoneal dialysis, the patients in the both groups were treated for 3 months. Before dialysis treatment and after

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3 months of continuous dialysis treatment,the serum calcium and phosphorus levels of the patients in the two groups were detected by the automatic biochemical analyzer,the serum malondialdehyde (MDA) level was detected by the thiobarbituric acid method,the serum superoxide dismutase (SOD) level was detected by the xanthine oxidase method,the serum myeloperoxidase (MPO) level was detected by the colorimetric method. The rate of serum calcium and phosphorus reaching the standard before dialysis treatment and after 3 months of continuous dialysis treatment between the two groups were compared,the complications such as hemorrhage of digestive tract,arteriovenous fistula occlusion,infection,hypoalbuminemia and abnormal cardiac function during dialysis treatment were compared between the two groups. **Results** There was no significant difference in serum calcium,phosphorus,MDA,SOD and MPO levels of patients between the two groups before dialysis treatment ($P>0.05$). After 3 months of dialysis treatment,there was no significant difference in the serum calcium level of patients between the two groups ($P>0.05$). There was no significant difference in serum phosphorus level of patients before dialysis treatment and after 3 months of dialysis treatment in the control group($P>0.05$). The serum phosphorus level of patients in the observation group after 3 months of dialysis treatment was significantly lower than that before dialysis treatment ($P<0.05$). There was no significant difference in serum calcium level of patients between the two groups after 3 months of dialysis treatment ($P>0.05$). After 3 months of dialysis treatment,the serum phosphorus level of patients in the observation group was significantly lower than that in the control group ($P<0.05$). In the control group,35 cases (58.33%) reached the standard of the serum calcium,and 16 cases (26.67%) reached the standard of the serum phosphorus;in the observation group,38 cases (63.33%) reached the standard of serum calcium,and 31 cases (51.67%) reached the standard of the serum phosphorus;there was no significant difference in the rate of reaching the standard of serum calcium between the two groups ($\chi^2=0.315,P>0.05$);the serum phosphorus compliance rate in the observation group was significantly higher than that in the control group($\chi^2=7.869,P<0.05$). After 3 months of dialysis treatment,the serum MDA and MPO levels of patients were significantly higher than those before dialysis treatment in the two groups ($P<0.05$),and the SOD level of patients was significantly lower than that before dialysis treatment($P<0.05$). After 3 months of dialysis treatment,the serum MDA and MPO levels of patients in the observation group were significantly lower than those in the control group($P<0.05$),and the serum SOD level of patients was significantly higher than that in the control group($P<0.05$). During dialysis treatment,hemorrhage of digestive tract occurred in 4 cases (6.67%),arteriovenous fistula occlusion in 3 cases (5.00%),infection in 2 cases (3.33%),hypoalbuminemia in 4 cases (6.67%),abnormal cardiac function in 5 cases (8.33%),and the incidence of complication was 30.00% (18/60) in the control group;in the observation group,hemorrhage of digestive tract occurred in 2 cases (3.33%),arteriovenous fistula occlusion in 1 case (1.67%),infection in 1 case (1.67%),hypoproteinemia in 1 case (1.67%),cardiac dysfunction in 2 cases(3.33%),and the incidence of complications was 11.67% (7/60);the incidence of complications in the observation group was significantly lower than that in the control group ($\chi^2=6.114,P<0.05$). **Conclusion** The effect of maintenance hemodialysis on the serum calcium metabolism of patients with end-stage renal disease has no significant difference compared with that of continuous ambulatory peritoneal dialysis,but continuous ambulatory peritoneal dialysis has better control for serum phosphorus in patients with end-stage renal disease,and the oxidative stress reaction of patients caused by continuous ambulatory peritoneal dialysis is relatively mild,it has higher security.

Key words: end-stage renal disease;hemodialysis;peritoneal dialysis;calcium and phosphorus metabolism;oxidative stress

终末期肾病是指各种类型慢性肾脏疾病的终末阶段,肾脏替代治疗如血液透析和腹膜透析等血液净化技术是治疗该类疾病的主要措施,这 2 种透析方法均可有效清除机体代谢产生的毒素,但长期透析治疗可引起机体钙磷代谢紊乱,进而导致骨质疏松、血管和软组织钙化、心血管疾病等严重并发症,不但降低患者的生活质量,甚至可危及患者生命^[1]。终末期肾病患者机体已存在一定程度的微炎症状态和氧化应激反应,而体内代谢毒素的存在不仅可加重机体炎症反应,还可作为氧化应激产物进一步加剧机体氧化应激反应^[2-3]。血液透析和腹膜透析对血液净化的机制及所用设备不同,对机体钙磷代谢紊乱的控制情况及对应激反应的影响程度

也不完全一致。基于此,本研究以南阳市中心医院肾内科收治的 120 例进行透析治疗的终末期肾病患者为研究对象,观察并比较维持性血液透析和持续不卧床腹膜透析对其钙磷代谢及氧化应激反应的影响,现报道如下。

1 资料与方法

1.1 一般资料 选择 2019 年 1 月至 2021 年 10 月南阳市中心医院肾内科收治的 120 例行透析治疗的终末期肾病患者为研究对象。病例纳入标准:(1)符合《肾脏病诊疗指南》^[4]中相关肾脏疾病诊断标准,且已发展至终末期;(2)肾小球滤过率 $<1.5\text{ mL}\cdot\text{min}^{-1}$;(3)舒张压控制在 80~105 mm Hg

(1 mm Hg = 0.133 kPa), 收缩压控制在 100 ~ 160 mm Hg; (4) 年龄 > 40 岁; (5) 接受透析治疗至少 3 个月。排除标准: (1) 收缩压 < 80 mm Hg 者; (2) 有严重出血或出血倾向者; (3) 入组前 1 个月内有消化道出血病史者; (4) 合并严重感染者; (5) 患有血液传播的传染病者; (6) 恶性肿瘤患者; (7) 严重心、肺功能不全者; (8) 身体综合情况差, 不能耐受透析治疗者; (9) 接受血液透析联合腹膜透析者。按照随机数字表法将患者分为对照组和观察组, 每组 60 例。观察组: 男 32 例, 女 28 例; 年龄 48 ~ 77 (65.60 ± 5.22) 岁; 基础疾病: 糖尿病肾病 21 例, 慢性肾小球肾炎 17 例, 高血压肾硬化 11 例, 梗阻性肾病 6 例, 多囊肾 3 例, 其他 2 例。对照组: 男 29 例, 女 31 例; 年龄 46 ~ 78 (66.11 ± 5.86) 岁; 基础疾病: 糖尿病肾病 18 例, 慢性肾小球肾炎 19 例, 高血压肾硬化 10 例, 梗阻性肾病 6 例, 多囊肾 4 例, 其他 3 例。2 组患者的性别、年龄、基础疾病构成比等比较差异无统计学意义 ($P > 0.05$), 具有可比性。本研究通过南阳市中心医院医学伦理委员会批准, 所有患者签订知情同意书。

1.2 透析治疗方法 对照组患者采用维持性血液透析治疗, 使用 4008S 费森尤斯医疗血液透析机、F_x80 高流量透析器 (德国费森尤斯公司), 设置参数: 膜面积 1.8 ITI, 血流量 250 ~ 280 mL · min⁻¹, 透析液使用碳酸氢盐, 透析液流量为 500 mL · min⁻¹, 钙离子浓度为 1.5 mmol · L⁻¹, 每次 4 h, 每周 3 次。观察组患者采用持续不卧床腹膜透析治疗, 手工换液, 使用含 15 g · L⁻¹ 葡萄糖的乳酸盐腹膜透析液, 腹透液中钙离子浓度为 1.77 mmol · L⁻¹, 交换腹透液的量为 8 000 mL · d⁻¹, 每日更换透析液 4 次。2 组患者均接受连续透析治疗 3 个月。

1.3 观察指标 (1) 钙磷代谢情况: 透析治疗前及连续透析治疗 3 个月后, 分别抽取 2 组患者静脉血 5 mL, 3 000 r · min⁻¹ 离心 10 min (离心半径 6 cm), 分离血清, 使用 502 型全自动生物化学分析仪 (成都斯玛特科技有限公司) 检测血清钙、磷水平, 依据《中国慢性肾脏病矿物质和骨异常诊治指南概要 (2019 年版)》^[5] 规定, 血清钙 2.10 ~ 2.50 mmol · L⁻¹、血清磷 0.87 ~ 1.45 mmol · L⁻¹ 为达标标准, 计算治疗 3 个月后血清钙、血清磷达标患者所占比例。(2) 应激指标水平: 透析治疗前及连续透析治疗 3 个月后, 分别抽取 2 组患者静脉血 5 mL, 3 000 r · min⁻¹ 离心 10 min (离心半径 6 cm), 分离血清, 使用 HT-5856 可见分光光度计 [奥谱天成 (厦门) 科技有限公司], 采用硫代巴比妥酸法检

测血清丙二醛 (malondialdehyde, MDA) 水平, 采用黄嘌呤氧化酶法检测血清超氧化物歧化酶 (superoxide dismutase, SOD) 水平, 采用比色法检测血清髓过氧化物酶 (myeloperoxidase, MPO) 水平, 试剂盒均购自上海研启生物科技有限公司, 严格按照试剂盒说明书进行操作。(3) 并发症: 观察 2 组患者透析治疗期间消化道出血、动静脉内瘘闭塞、感染、低蛋白血症及心功能异常等并发症发生情况。

1.4 统计学处理 应用 SPSS 20.0 软件进行统计学分析。计量资料以均数 ± 标注差 ($\bar{x} \pm s$) 表示, 组间比较采用 t 检验; 计数资料以例数和百分率表示, 组间比较采用 χ^2 检验; $P < 0.05$ 为差异有统计学意义。

2 结果

2.1 2 组患者透析治疗前后血清钙、磷水平比较 结果见表 1。透析治疗前, 2 组患者血清钙、磷水平比较差异均无统计学意义 ($P > 0.05$)。透析治疗 3 个月后, 2 组患者的血清钙水平及对照组患者的血清磷水平与透析治疗前比较差异均无统计学意义 ($P > 0.05$); 观察组患者的血清磷水平显著低于治疗前, 差异有统计学意义 ($P < 0.05$)。透析治疗 3 个月后, 2 组患者的血清钙水平比较差异无统计学意义 ($P > 0.05$); 观察组患者的血清磷水平显著低于对照组, 差异有统计学意义 ($P < 0.05$)。对照组患者血清钙达标 35 例 (58.33%), 血清磷达标 16 例 (26.67%); 观察组患者血清钙达标 38 例 (63.33%), 血清磷达标 31 例 (51.67%); 2 组患者血清钙达标率比较差异无统计学意义 ($\chi^2 = 0.315$, $P > 0.05$); 观察组患者血清磷达标率显著高于对照组, 差异有统计学意义 ($\chi^2 = 7.869$, $P < 0.05$)。

表 1 2 组患者透析治疗前后血清钙、磷水平比较
Tab.1 Comparison of serum calcium and phosphorus levels of patients between the two groups before and after dialysis

($\bar{x} \pm s$)			
组别	<i>n</i>	血清钙/(mmol · L ⁻¹)	血清磷/(mmol · L ⁻¹)
对照组	60		
透析治疗前		2.17 ± 0.40	2.10 ± 0.36
透析治疗 3 个月后		2.20 ± 0.38	2.03 ± 0.43
观察组	60		
透析治疗前		2.20 ± 0.42	2.14 ± 0.33
透析治疗 3 个月后		2.29 ± 0.35	1.57 ± 0.30 ^{ab}

注: 与透析治疗前比较^a $P < 0.05$; 与对照组比较^b $P < 0.05$ 。

2.2 2 组患者透析治疗前后血清中 MDA、SOD、MPO 水平比较 结果见表 2。透析治疗前, 2 组患者血清中 MDA、SOD、MPO 水平比较差异均无统计学意义 ($P > 0.05$)。透析治疗 3 个月后, 2 组患者血清中 MDA、MPO 水平显著高于透析治疗前, SOD 水

平显著低于透析治疗前,差异有统计学意义($P < 0.05$)。透析治疗 3 个月后,观察组患者血清中 MDA、MPO 水平显著低于对照组,SOD 水平显著高于对照组,差异有统计学意义($P < 0.05$)。

表 2 2 组患者透析治疗前后血清中 MDA、SOD、MPO 水平比较

Tab. 2 Comparison of serum MDA, SOD and MPO levels of patients between the two groups before and after dialysis

($\bar{x} \pm s$)				
组别	<i>n</i>	MDA/($\mu\text{mol} \cdot \text{L}^{-1}$)	SOD/($\times 10^3 \text{ U} \cdot \text{L}^{-1}$)	MPO/($\text{U} \cdot \text{L}^{-1}$)
对照组	60			
透析治疗前		10.74 \pm 1.93	103.30 \pm 9.94	18.89 \pm 2.20
透析治疗 3 个月后		14.40 \pm 2.26 ^a	84.40 \pm 8.77 ^a	24.77 \pm 3.69 ^a
观察组	60			
透析治疗前		11.03 \pm 1.75	104.06 \pm 10.08	19.25 \pm 2.36
透析治疗 3 个月后		12.74 \pm 1.66 ^{ab}	91.18 \pm 9.53 ^{ab}	22.28 \pm 3.02 ^{ab}

注:与透析治疗前比较^a $P < 0.05$;与对照组比较^b $P < 0.05$ 。

2.3 2 组患者透析治疗期间并发症发生情况比较

透析治疗期间,对照组患者发生消化道出血 4 例(6.67%),动静脉内瘘闭塞 3 例(5.00%),感染 2 例(3.33%),低蛋白血症 4 例(6.67%),心功能异常 5 例(8.33%),并发症发生率为 30.00%(18/60);观察组患者发生消化道出血 2 例(3.33%),动静脉内瘘闭塞 1 例(1.67%),感染 1 例(1.67%),低蛋白血症 1 例(1.67%),心功能异常 2 例(3.33%),并发症发生率为 11.67%(7/60);观察组患者并发症发生率显著低于对照组,差异有统计学意义($\chi^2 = 6.114, P < 0.05$)。

3 讨论

血液净化技术主要是通过清除患者体内的炎症介质、病原体及各种毒素等有害物质,调节水、电解质酸碱平衡,改善机体免疫功能,进而达到降低病死率的目的,在终末期肾病及感染性疾病中均有广泛应用。钙磷代谢紊乱是血液净化治疗的常见并发症,其可导致患者发生骨质疏松、血管和软组织钙化、心血管疾病等严重并发症。长期高磷血症是血管和软组织转移性钙化及心脏瓣膜钙化的始动因素,严重者可危及患者生命^[6]。临床研究发现,由于不同血液净化技术的机制及所用设备不同,其对机体钙磷代谢紊乱的控制情况也有较大差别^[7]。虽然近年血液净化技术得到不断完善和提高,但钙磷代谢紊乱的发生率并未明显下降,研究不同血液透析技术对钙磷代谢的影响,有助于临床选择合适的透析技术,以降低钙磷代谢紊乱发生率。基于此,本研究探讨了维持性血液透析和持续不卧床腹膜透析 2 种透析方法对终末期肾病患者钙磷代谢及氧化

应激的影响,以期临床透析方式的选择提供参考。

本研究结果显示,透析治疗 3 个月后,2 组患者的血清钙水平及其达标率比较差异无统计学意义,但观察组患者血清磷水平显著低于对照组,血清磷达标率显著高于对照组;该结果提示,维持性血液透析和持续不卧床腹膜透析这 2 种透析方法对终末期肾病患者钙代谢的影响无显著差异;而相较于维持性血液透析,持续不卧床腹膜透析对终末期肾病患者血清磷控制效果更好,这与卢光娅等^[8]的研究结果一致。分析其原因,可能有以下几种^[9-10]:(1)持续不卧床腹膜透析可以将患者代谢产生的磷物质通过半透膜扩散到膜外透析液中,从而降低患者的血清磷水平;(2)持续不卧床腹膜透析患者在腹膜透析液的刺激下食欲下降,蛋白质摄入减少,所以磷的摄入量也相对减少,而相比之下维持性血液透析患者食欲变化则不明显;(3)维持性血液透析仅能清除细胞外未与蛋白质结合的无机磷,且长期进行维持性血液透析的患者经常需要服用骨化三醇等药物以控制异常升高的甲状旁腺激素,使磷的摄入量增加,所以血清磷相对处于较高的水平。

正常生理情况下,机体的氧化能力与抗氧化能力处于动态平衡状态,以维持机体内环境稳定;当机体受到外界干扰或其他有害的刺激时,反映机体氧化能力的因子如 MDA、MPO 等高活性分子大量产生,并进入机体血液循环,而抗氧化物质 SOD 生成减少,以致机体的氧化能力超过抗氧化能力,从而诱发机体的氧化应激反应,损伤组织细胞^[11-13]。此外,终末期肾病患者本身存在一定的炎症反应,加之透析过程中透析膜的生物不相容性、炎症递质或毒素清除不充分、大量非生理性透析液对局部微环境等因素的影响,进一步刺激机体分泌大量炎症反应因子如白细胞介素类及 C 反应蛋白等,从而增强机体的促氧化作用,进一步加剧机体的氧化应激反应^[14]。本研究结果显示,与透析治疗前比较,透析治疗 3 个月后 2 组患者的血清 MDA、MPO 水平显著增加,SOD 水平显著降低;且观察组患者的 MDA、MPO 水平显著低于对照组,SOD 水平显著高于对照组;提示终末期肾病患者经过 3 个月的透析治疗,患者机体均产生了不同程度的氧化应激反应;但与维持性血液透析相比,持续不卧床腹膜透析诱发机体的氧化应激反应更轻微,这与 ROUMELIOTIS 等^[15]和刘伯英等^[16]的研究结果相一致。另外,本研究结果显示,透析治疗期间观察组患者的并发症发生率低于对照组,提示持续不卧床腹膜透析的安全性优于维持性血液透析,考虑其原因可能为血液透析需

要建立体外循环,所以并发症发生风险更高。

综上所述,维持性血液透析和持续不卧床腹膜透析对终末期肾病患者血清钙代谢的影响无显著差异,而腹膜透析对终末期肾病患者的血清磷控制效果更好,诱发患者机体的氧化应激反应相对更轻微,安全性更高。但本研究样本量有限,后期仍需进行多中心大样本的研究以进一步探讨二者的效果差异。

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