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斜角肌间臂丛阻滞影响心率变异性的危险因素分析*

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摘要 目的:本研究旨在探讨斜角肌间臂丛阻滞影响心率变异性的危险因素及 Logistic 回归分析。**方法:**选取 2021 年 5 月至 2022 年 3 月于我院接受肩关节开放手术治疗的患者 60 例作为研究对象,按照麻醉方式不同随机分为实验组和对照组 2 组,其中实验组患者给与超声引导下斜角肌间臂丛神经阻滞,对照组患者进行单纯斜角肌间臂丛神经阻滞,统计患者的一般临床资料,对比分析阻滞前后心率变异指标、SpO₂、心率和平均动脉压水平;同时研究危险因素与心率变异性之间的关系。**结果:**斜角肌间臂丛阻滞影响心率变异性的单因素分析显示,危险因素与性别、平均年龄、BMI、总胆固醇、甘油三酯、高密度脂蛋白、低密度脂蛋白、合并慢性病(糖尿病、高血压)、吸烟史和饮酒史无关($P>0.05$),镇痛维持时间较短、运动恢复时间较长、阻断节数较少的斜角肌间臂丛阻滞患者更易表现出心率变异性($P<0.05$)。阻滞后,实验组 LF、HF、LF/HF、RMSSD、SDNN 和 PNN50 %显著低于对照组($P<0.05$),而阻滞后 SpO₂、心率和平均动脉压比较无差异($P>0.05$)。影响心率变异性危险因素的多因素为镇痛维持时间($OR=6.224, P=0.001<0.05$)、运动恢复时间($OR=9.556, P=0.002<0.05$)、阻断节数($OR=7.591, P=0.001<0.05$)。**结论:**斜角肌间臂丛阻滞出现心率变异性与镇痛维持时间、运动恢复时间、阻断节数有关。

关键词:斜角肌间臂丛阻滞;心率变异性;危险因素

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Risk Factors of Interscalenus Brachial Plexus Block Affecting Heart Rate Variability*

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ABSTRACT Objective: The purpose of this study was to investigate the risk factors and Logistic regression analysis of interscalenus brachial plexus block affecting heart rate variability. **Methods:** Selection in May 2021 to March 2022 in our hospital in patients with shoulder joint open surgical treatment of 60 cases as the research object, according to the different anesthesia were randomly divided into experimental group and control group in two groups, one group patients give between scalene muscle under the guidance of ultrasound brachial plexus block, between the control group patients with pure scalenus brachial plexus block. General clinical data of the patients were collected, and heart rate variation index, SpO₂, heart rate and mean arterial pressure level before and after block were compared and analyzed. The relationship between risk factors and heart rate variability was also studied. **Results:** Univariate analysis of interbrachial plexus block affecting heart rate variability showed that risk factors were not related with sex, mean age, BMI, total cholesterol, triglycerides, HDL, LDL, chronic diseases (diabetes, hypertension), smoking and alcohol history ($P>0.05$), and interanginal brachial plexus block with shorter analgesic maintenance, longer exercise recovery and fewer blocks were more likely to show heart rate variability ($P<0.05$). After the block, LF, HF, LF / HF, RMSSD, SDNN and PNN50% were significantly lower than those in the control group ($P<0.05$), however, there was no difference in SpO₂, heart rate, and mean arterial pressure after the block ($P>0.05$). The multiple factors affecting the risk factors of HEART rate variability were maintenance time of analgesia ($OR=6.224, P=0.001<0.05$), exercise recovery time ($OR=9.556, P=0.002<0.05$), number of blocks ($OR=7.591, P=0.001<0.05$). **Conclusion:** The heart rate variability in brachial plexus block was related to the maintenance time of analgesia, the recovery time of exercise and the number of blocks.

Key words: Interscalenus brachial plexus block; Heart rate variability; Risk factors

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前言

斜角肌间臂丛阻滞常被选择作为肩关节手术的主要麻醉方法,但该技术存在一定不足如:心血管不稳定,如心动过缓和/或低血压,可在高达 29 % 的坐位手术患者中发现^[1-3]。由于经常观察到星状神经节阻滞与斜角肌间臂丛阻滞一起出现,因此有人提出该阻滞与心动过缓和/或低血压有关。心率变异性(Heart rate variability, HRV)是心脏自主状态的一种简单的、无创的心电图定量指标^[4-6]。HRV 表现出自相似(分形)动力学的成分。HRV 复杂性的降低等于心率波动分形分量的增加,并已被用于预测心脏死亡率和发病率。在实施 HRV 的报告中,右侧或左侧星状神经节阻滞已被证明对心脏自主状态有不同的影响^[7-9]。尽管许多研究者怀疑斜角肌间臂丛阻滞期间心血管不稳定与复杂的星状神经节阻滞有关,但直到目前为止还无关于斜角肌间臂丛阻滞期间自主神经外流的可用数据。本研究选取了 60 例接受肩关节开放手术治疗的患者进行斜角肌间臂丛阻滞治疗,探究斜角肌间臂丛阻滞影响心率变异性的危险因素。

1 资料和方法

1.1 一般资料

选取 2021 年 5 月至 2022 年 3 月于我院接受肩关节开放手术治疗的患者 60 例作为本研究的手术组,其中男性患者 36 例,女性患者 24 例,平均年龄为(44.58±4.90)岁。

纳入标准:臂丛阻滞次数小于 2 次者;体重指数小于 30 kg/cm²者;凝血功能正常者。

排除标准:存在凝血功能缺陷的;已知对局麻药过敏、待手术肢体神经功能障碍以及局部炎症的;患有冠状动脉疾病、心律失常、充血性心力衰竭、糖尿病、甲状腺激素异常、肾功能不全以及电解质异常的;自主神经功能障碍。所有纳入研究的患者及其家属均已签署知情同意书。

1.2 方法

1.2.1 研究分组 将纳入研究的 60 例患者按照麻醉方式不同随机分为实验组和对照组 2 组,每组 30 例患者。其中实验组患者给与超声引导下斜角肌间臂丛神经阻滞,对照组患者进行单纯斜角肌间臂丛神经阻滞。

1.2.2 斜角肌间臂丛阻滞 手术前麻醉评估和外周静脉通路的建立由负责的麻醉师在术前完成,同时指派一名麻醉师测量患者的心率变异性(Heart Rate Variability, HRV),麻醉和手术由同一团队在标准化条件下进行。进入手术室后,开始标准监测心电图、无创血压、脉搏血氧和双频谱,并在外周静脉进行静脉输注,用与患者手臂周长相匹配的袖带测量对侧手臂的血压。术前行斜角间臂丛阻滞,患者取仰卧位,床头抬高 30°,头部稍偏离手术侧;阻滞放置时,患者静脉给予咪达唑仑 0-2 mg 和/或芬太尼 0-100 mg,由麻醉师酌情决定。使用无菌技术,6-13 mhz 线性探头传感器用于识别臂丛的 C5-C6-C7 神经根,用 27 g 针注射 2-3 mL 浓度为 2 % 的利多卡因麻醉皮肤。使用长度 5 cm,22 号绝缘针从后到前的,平面内的针插入方法进行实时超声引导斜角间神经阻滞,在臂丛内组,针向前向后穿过中斜角肌,穿过 C5-C6 神经根之间的臂丛鞘。在这个过程中告知患者,若在放置过程中有任何感觉异常,则需要麻醉师改变针头的方向,在感觉异常消失之前不要恢复局部麻醉。放置阻

滞后,每隔 1 min 进行感觉和运动检查,直到感觉检查减少或患者离开术前区域进入手术室^[10,11]。

1.3 观察指标

1.3.1 患者一般临床资料分析 统计分析实验组和对照组性别、平均年龄、BMI、总胆固醇、甘油三酯、高密度脂蛋白、低密度脂蛋白、合并慢性病(糖尿病、高血压)、吸烟史和饮酒史。

1.3.2 阻滞前后心率变异性指标水平 采用席勒心血管 AT-60 心电图仪和内置软件检测患者阻滞前后心率变异性指标包括低频(Low frequency, LF)、高频(High Frequency, HF)、LF/HF、相邻 RR 间期差值的均方根(RMSSD)、全部窦性心搏 RR 间期的标准差(SDNN)和超过 50 ms 的个数占总窦性心搏数的百分率(PNN50 %)^[12]。

1.3.3 阻滞前后 SpO₂、心率和平均动脉压水平 采用席勒心血管 AT-60 心电图仪和内置软件检测患者阻滞前后血氧饱和度(SpO₂)、心率(Heart rate, HR)和平均动脉压(Mean arterial pressure, MAP)水平^[13]。

1.4 统计学方法

使用 SPSS-20 进行分析。数据的正态性通过 Kolmogorov-Smirnov 检验进行评估,使用 χ^2 检验或 Fisher 精确检验。最初通过双变量分析研究了危险因素与心率变异性之间的关系,并将显示显著性水平 $P<0.05$ 的变量纳入多因素 Logistic 回归模型,进行线性 and 逻辑回归分析以估计针对混杂因素调整的结果,计算结局的调整后的赔率(OR)和 95 % 的置信区间(95%CI)。

2 结果

2.1 影响心率变异性的单因素分析

斜角肌间臂丛阻滞影响心率变异性的单因素分析显示,危险因素与性别、平均年龄、BMI、总胆固醇、甘油三酯、高密度脂蛋白、低密度脂蛋白、合并慢性病(糖尿病、高血压)、吸烟史和饮酒史无关($P>0.05$),镇痛维持时间较短、运动恢复时间较长、阻断节数较少的斜角肌间臂丛阻滞患者更易表现出心率变异性($P<0.05$)。(表 1)。

2.2 阻滞前后心率变异性指标水平

两组患者阻滞前各心率变异性指标(LF、HF、LF/HF、RMSSD、SDNN 和 PNN50 %)比较,差异无统计学意义($P>0.05$);在阻滞后,实验组 LF、HF、LF/HF、RMSSD、SDNN 和 PNN50 % 显著低于对照组($P<0.05$)。(表 2)。

2.3 阻滞前后 SpO₂、心率和平均动脉压

两组患者阻滞前后 SpO₂、心率和平均动脉压比较,差异均无统计学意义($P>0.05$)。(表 3)。

2.4 影响心率变异性的危险因素的多因素 Logistic 回归分析

影响心率变异性危险因素单因素 Logistic 回归分析以“未出现心率变异性=0,出现心率变异性=1”为应变量,以镇痛维持时间、运动恢复时间和阻断节数为自变量,分析因素赋值表见表 4。(表 4)。

影响心率变异性危险因素的多因素 Logistic 回归分析结果显示,最终进入主效应模型的因素即影响心率变异性危险因素的多因素为镇痛维持时间($OR=6.224, P=0.001<0.05$)、运动恢复时间($OR=9.556, P=0.002<0.05$)、阻断节数($OR=7.591, P=0.001<0.05$)。(表 5)。

表 1 影响心率变异性的单因素分析

Table 1 Univariate analysis affecting heart rate variability

Variable		Experimental group (n=60)	Matched group (n=60)
Gender	Male	36(60.00)	32(53.33)
	Female	24(40.00)	28(46.67)
Average age		44.58± 4.90	43.79± 5.56
BMI(kg/m ²)		23.17± 2.63	22.90± 3.34
Total cholesterol(mmol/L)		5.35± 0.25	5.29± 0.86
Glycerin trilaurate(mmol/L)		1.83± 0.19	1.86± 0.23
High density lipoprotein(mmol/L)		1.15± 0.20	1.16± 0.31
Low densith lipoprotein(mmol/L)		2.87± 0.35	2.90± 0.25
Consolidation of chronic diseases	Diabetes	7(11.67)	5(8.33)
	Hypertension	3(5.00)	2(3.33)
History of smoking		23(38.33)	21(35.00)
History of drinking		15(25.00)	13(21.67)
Analgesia maintenance time(min)		480.83± 90.34*	596.78± 84.53
Exercise recovery time(min)		515.74± 72.42*	613.25± 90.04
Block number(n)		4.76± 0.74*	5.36± 0.28

Note: Compared with matched group, * $P<0.05$, the same below.

表 2 阻滞前后心率变异性指标水平

Table 2 Level of heart rate variability index before and after the block

Indexs	Time	Experimental group(n=60)	Matched group(n=60)
LF	Before block	977.58± 133.10	965.58± 109.30
	After the block	361.84± 22.37*	752.17± 115.67
HF	Before block	451.71± 27.47	463.23± 30.34
	After the block	240.88± 51.37*	398.94± 70.12
LF/HF	Before block	1.94± 0.23	1.83± 0.32
	After the block	0.79± 0.14*	1.04± 0.12
RMSSD	Before block	40.54± 4.23	42.19± 3.23
	After the block	33.39± 4.11*	37.23± 2.01
SDNN	Before block	64.12± 3.09	66.53± 1.32
	After the block	43.52± 4.43*	55.20± 6.16
PNN50 %	Before block	10.12± 1.25	10.02± 1.34
	After the block	4.11± 0.31*	7.89± 0.65

表 3 阻滞前后 SpO₂、心率和平均动脉压Table 3 SpO₂, heart rate, and mean arterial pressure before and after the block

Indexs	Time	Experimental group(n=60)	Matched group(n=60)
SpO ₂ (%)	Before block	97.20± 10.16	98.34± 14.24
	After the block	95.02± 12.34	97.25± 12.13
Heart rate (Secondary/min)	Before block	73.89± 8.65	71.74± 9.22
	After the block	72.81± 6.03	71.43± 7.03
Mean arterial blood pressure (mmHg)	Before block	92.84± 4.54	91.44± 6.13
	After the block	91.43± 0.23	91.42± 0.21

表 4 分析因素赋值表

Table 4 Analytical factor assignment table

Variable	Voluatio
Analgesia maintenance time(min)	Length =0, Short =1
Exercise recovery time(min)	Length =0, Short =1
Block number(n)	Length =0, Short =1

表 5 影响心率变异性危险因素的多因素 Logistic 回归分析

Table 5 Multivariate Logistic regression analysis of the factors influencing risk factors for heart rate variability

Variable	S.E.	Wald	OR	OR 95%CI	P
Analgesia maintenance time(min)	1.243	3.908	6.224	1.391-6.690	0.001
Exercise recovery time(min)	1.672	3.672	9.556	3.093-7.370	0.002
Block number(n)	1.214	3.895	7.591	2.223-6.754	0.001

3 讨论

斜角肌间臂丛阻滞麻醉时上肢手术中常见麻醉方式,但是其在手术中极大可能会引发作者机体出现心动过缓和/或低血压,大多情况下,这些症状似乎是短暂的、孤立的,但也有部分发生了严重的心脏系统疾病,包括心搏骤停等,但其潜在机制尚不清楚^[14-16]。据报道,斜角肌间臂丛阻滞期间心血管不稳定的发生是心率变异性的一种形式,其潜在机制是心脏抑制机械受体的激活^[17-19]。

本研究结果发现,阻滞前,实验组 LF、HF、LF/HF、RMSSD、SDNN 和 PNN50 %显著低于对照组,而阻滞前 SpO₂、心率和平均动脉压比较,差异均无统计学意义。同样的,有研究表明^[20,21],斜角肌间臂丛阻滞对向心脏的自主外流有不同的影响取决于手术时的麻醉方式,其中麻醉效果较差易导致 HRV 低频分量下降,表明阻断后交感神经影响减弱,而麻醉效果好的阻滞则未产生这种影响^[22,23]。且以上研究表明麻醉效果好的斜角肌间臂丛阻滞前副交感神经系统的活动也增加了,在时域分析中反映为 PNN50 的统计学增加,而在频域分析中,高频分量增加未达到统计学意义。此外,还有研究同样证实^[24,25],斜角肌间臂丛阻滞可能通过阻滞延伸到同侧星状神经节,改变了向中央循环系统的自主外流,这种影响取决于麻醉方式;通过单因素回归分析可知,镇痛维持时间较短、运动恢复时间较长、阻断节数较少的斜角肌间臂丛阻滞患者更易表现出心率变异性($P<0.05$)。影响心率变异性危险因素的多因素为镇痛维持时间($OR=6.224, P=0.001<0.05$)、运动恢复时间($OR=9.556, P=0.002<0.05$)、阻断节数($OR=7.591, P=0.001<0.05$)。根据本研究中纳入的患者,在实验组中,镇痛维持的时间显著长于对照组,并且实验组的 LF 值表现出显著降低,表明该组患者的交感神经的正常活动受到抑制,且 SDNN 和 PNN50 %值也出现明显减小,提示迷走神经活动性也受到抑制,然而两组患者的 LF/HF 值均呈现出降低的趋势,则说明在阻滞前交感神经和迷走神经之间的平衡性是降低的,并且阻滞后的迷走神经活动占主要优势^[26]。此外,在阻断节数方面,阻滞节数越少,那么阻滞维持的时间也就越小,这与 Wilczek 等学者^[27]的研究结果是一致的,即符合 HRV 的变异规律。而对于患有高血压、糖尿病或者心脏

病的患者来讲,在阻滞方面需要给予重视,其原因为对于上述病人,导致其出现 HRV 的因素可能并非镇痛维持时间、运动恢复时间和阻断节数,其他因素也会导致患者的心肌活动不稳定性,进一步增加 HRV 发生的概率^[28]。

结合本研究的研究结果,因在本研究中所纳入的患者数量较少,导致部分危险因素与预期以及其他文献的报道存在差异,且部分患者由于自身经济等因素的限制未能及时就诊导致了病情的延误,在治疗后无法按时随访,对治疗效果造成了一定程度的影响。患者自身不良的生活方式例如吸烟、酗酒和熬夜等也极有可能影响心率变异性的发生程度。虽然在本研究中吸烟和酗酒对 HRV 的影响不存在显著性,但有研究学者则发现 HRV 的发生率与吸烟存在显著的正相关关系,但目前并没有研究表明吸烟是斜角肌间臂丛阻滞影响心率变异性的危险因素^[29,30]。因此,对于 HRV 的预防和治疗,不仅需要进行药物干预,同时还需干预患者的日常生活习惯。

综上所述,斜角肌间臂丛阻滞出现心率变异性与镇痛维持时间、运动恢复时间、阻断节数有关。虽然斜角肌间臂丛阻滞具有一定疗效,但对于表现为术后 HRV 的患者是不能忽视的,临床在治疗过程中需进一步观察并明确 HRV 患者的临床症状,并结合其他手段做进一步诊断,为患者选择合适的治疗方案。因此,进一步加深对斜角肌间臂丛阻滞出现心率变异性患者深入认识,增强阻滞手术的针对性和有效性,提高阻滞手术的临床应用价值。

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