

噪音和警报对重症监护病房的影响及干预研究进展

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摘 要

噪音问题一直是伴随重症监护病房发展的一大问题, 而其中相当一部分是机器发出的警报, 目前ICU的噪音水平普遍高于WHO建议的水平, 并对患者和医护人员产生了不良影响, 众多研究致力于探索新方法以减少ICU的噪音水平和对患者以及医护人员的影响, 本文就目前对ICU噪音的现状、对患者和医护人员的影响以及对其的干预措施的研究进展进行综述。

关键词

噪音, 警报, 重症监护病房

Research Progress on the Impact and Intervention of Noise and Alarms on Intensive Care Units

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Abstract

The issue of noise has always been a major issue accompanying the development of intensive care

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units, and a considerable part of it is caused by machine alarms. Currently, the noise level in ICUs is generally higher than the recommended level by WHO, and has had adverse effects on patients and medical staff. Numerous studies are dedicated to exploring new methods to reduce the noise level in ICUs and its impact on patients and medical staff. This article reviews the current status of ICU noise, its impact on patients and medical staff, and the research progress of intervention measures.

Keywords

Noise, Alarm, Intensive Care Units

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1. 引言

重症监护病房(Intensive Care Unit, ICU)至今已成立约 70 年, 处理危重疾病和损伤、临时支持并在某些情况下取代多器官系统功能是 ICU 的核心能力之一。因此 ICU 的医疗干预及监护措施比普通病房更多, 侵入性更强[1]。由于监测患者病情变化及治疗的需要, 24 小时生命体征监护、机械通气、输液泵、连续肾脏替代治疗及其他设备等产生了大量的警报声, 同时护理活动、对话、电话、开关门等也产生了部分噪音[2]。声光刺激不可避免, 世界卫生组织建议医院的声压级应不超过 35 dB, 美国儿科学会建议 NICU 声压级上限为 45 dB, 并限制短暂的响亮声音。本文就噪音和警报对 ICU 患者及医护人员影响及干预的研究进展进行综述。

2. ICU 噪音的现状

ICU 作为医院的最高级生命支持部分, 高级的生命体征监测及其他有创、无创监测、各种器官功能支持及替代疗法是挽救生命的强力武器, 但监护仪及各种机器产生的警报、闪烁灯光和噪音也远高于医院其他部分。Drew BJ 等人[3]开展了为期 31 天的多中心研究, 记录了 461 名在 ICU 接受治疗的患者的监测数据, 结果出现惊人的 2,558,760 次警报, 平均声音警报负担为 187 个/床/天。NICU 的各时段最大声级均超过 80 dB [4]。Darbyshire JL 等人[5]在 5 个英国 ICU 使用麦克风检测 2 周的声音水平, 结果提示任何时间患者附近的平均声音水平均未降至 50 dBA 以下, 相当于一家热闹的餐厅, 远高于 WHO 建议的 35 dB, 唯一能达到 WHO 标准的房间是关闭所有监测设备的封闭侧室。除了警报以外, 交谈、操作和移动设备、使用电话以及开关门和容器等也产生了部分背景噪音。其另一项研究[6]在所在的 ICU 一个四张病床的单间安装了 16 个麦克风组成的阵列, 连续监测约 1 年环境声音的具体位置、声压水平和加权响度值(响度值是对声音的主观感知), 描绘的噪音热图显示大多数高水平的噪音来自极其有限的区域, 除了护士站和医护人员经常交流的区域外, 许多响亮的声音来自位于患者耳朵附近的监护仪和呼吸机, 尤其是机器发出的警报声, 其频率范围(2.5~3.15 kHz)类似于人类的尖叫和婴儿的哭声。虽然这可能是吸引医护人员注意力的理想选择, 但远非患者休息和感到舒适的理想选择。

3. 噪音和警报对患者的影响

噪音在日常生活中已对健康人群产生认知、决策和情绪影响[7], 道路交通噪音与抑郁情绪正相关[8],

并可能与心血管和代谢系统疾病有关[9]。ICU 患者处在危重状态中更是易受到影响, Boyacioglu 等人[10]构建了 ICU 噪音环境模型, 测量 5 组暴露于不同时间噪音模型的大鼠氧化应激水平标志物, 结果发现随着暴露于噪音的持续时间增加, 血清、脑组织、脾脏中的超氧化物歧化酶(SOD)活性显著降低(血清 $P = 0.005$, 脑组织 $P = 0.001$, 脾脏 $P = 0.027$)、丙二醛(MDA)水平显著升高(血清 $P = 0.003$, 脑组织 $P = 0.001$, 脾脏 $P = 0.001$), 血浆总蛋白显著降低($P = 0.049$), 提示随着暴露于 ICU 噪音的时间增加, 大鼠的氧化应激水平也在增加。睡眠障碍是 ICU 患者住院期间及出院后长期的并发症之一, 疼痛、镇静、约束、机械通气、光照、焦虑等多种因素导致了 ICU 患者昼夜节律被打断并出现睡眠障碍[11], 多达一半的睡眠发生在白天, 不稳定的 N1 和 N2 期睡眠比例更大, 出现频繁的觉醒。噪音也是影响 ICU 患者睡眠的一大因素, Saylan 等人的研究[12]纳入了 130 个 ICU 患者, 评估噪音水平和疼痛、焦虑水平、睡眠质量的关系, 结果提示噪音水平与 SAI (状态焦虑评分)、RCSQ (Richards-Campbell 睡眠质量评分)显著相关。Elbaz M 等人[13]使用多导睡眠图设备收集了 11 个接受机械通气的患者的 24 小时睡眠图, 并对监测的声音进行定性和定位, 结果提示声音水平与清醒、觉醒显著相关, 所有的声源都对睡眠阶段的过渡和唤醒有显著影响, 其中呼吸机警报的影响最大。Weatherhead JR 等人进行了长达 83 周的研究[14], 在 PICU 病房中监测声级, 并使用康奈尔儿童谵妄评分(CAPD)对患儿进行谵妄筛查, 结果提示每周夜间噪声水平和 CAPD 评分中位数成中度相关性($r = 0.6, P < 0.001$), 提示 PICU 存在显著的噪声污染, 噪音污染可能是谵妄发展的危险因素。

4. 噪音和警报对医护人员的影响以及警报疲劳

虽然处理警报是医疗护理工作的一个重要部分, 并且理论上它们是为了保障患者安全而设计的, 可如今的护理人员比以往任何时候都更需要将注意力分散在照顾患者和处理医疗设备之间, 大多数 ICU 护士都被同时发出的不同种类和设备的警报所淹没, 且其中大多数警报缺乏临床相关性, 被认为是假警报或对临床评估和护理没有帮助[15] [16]。过多的警报造成的感官负担可能会导致对警报的反应延迟或完全忽略警报[17], 产生“狼来了”效应, 出现警报疲劳(Alarm Fatigue), 造成 ICU 护士的感觉超负荷, 影响身心健康以及提供护理的能力, 甚至对患者的生命安全造成影响[18]。许多监测设备会产生不同优先级的警报, Wung SF 等人的研究[19]发现监护仪、输液泵和呼吸机对 ICU 护士的感觉超负荷影响最大, ICU 护士将他们的沮丧归因于警报, 即使是较新的设备, 也被认为“非常复杂, 不便于使用”。McCullagh 等人对 3818 位护士参与的问卷调查的分析[20]提示暴露在高噪音水平下的护士更有可能报告疾病(高血压、心脏病、抑郁、焦虑)、更高的倦怠分数、更高的工作压力等, 且高噪音水平与较低的职业生活质量显著相关。Bi J [21]等人基于计划行为理论进行研究, 对实验组护士进行了为期 12 周的报警管理培训课程, 结果提示实验组护士警报疲劳评分显著低于对照组, 且记录的调整后的警报总数明显低于对照组。Asadi N 等人[22]的研究同样提示 COVID-19 流行期间接受过呼吸机培训和警报设置培训的护士警报疲劳明显低于其他护士, 2 项研究均建议将警报管理实践培训纳入 ICU 护士课程。

5. 噪音的干预和警报改进

如何减少噪声及警报对患者和医护人员的危害是目前临床亟需解决的问题和研究热点之一。Guisasola 等人[23]评估了视觉噪音预警系统在实施前后对外科重症监护室(SICU)噪音水平的影响, 在 SICU 安装了视觉噪音警报系统(SoundEar II), 通过颜色改变来提醒工作人员保持安静, 结果显示使用 SoundEar II 系统期间, 患者比其他阶段接受的催眠药物更少, 平均声压级较基线水平下降约 1.35 dBA。设立“安静时间”也是降低噪音的方法之一, 根据对患者的调查, 最烦人的噪音是医护人员在早上换班时的谈话, Danielle G 等人[24]在神经外科 ICU (NSCU)通过向 NSCU 团队及其他辅助职能部门所有成员

提供关于噪音的有害影响、安静时间好处的教育的小册子, 约定从凌晨 3 点到 5 点、下午 3 点到 5 点为安静时间, 在安静时间中, 护士站的灯会关闭、病房所有工作人员均被强烈建议低声说话并互相监督, 调暗灯光是提醒医护人员保持安静的有效的视觉提示, 结果提示安静时间的噪音水平比基线平均水平降低约 10~15 dB, 但仍然没有达到 WHO 建议的水平。Zhang SW 等人[25]对所在 NICU 医护人员进行了关于安静时间的半结构化访谈, NICU 的医护人员普遍表示有必要在 NICU 设置安静时间, 可以减少早产儿的能量消耗, 保护神经发育, 以及改善预后, 同时一部分医护人员认为设置安静时间在可以一定程度上缓解临床工作的压力, 让他们有一个明确的休息和放松的时间, 安静的环境使用更加柔和的声音说话改善了医护人员的情绪, 但护理人员的缺乏、婴儿病情的严重性等都会使安静时间难以实施。但 Crawford KJ 等人的研究[26]发现供暖、通风和空调系统导致了高基线噪音, 而高流量呼吸机(>10 L/min)进一步产生了额外的高噪音, 其认为工程控制(如通气改进、在患者和设备之间放置隔板等)可能比行为干预更加有效。Jung S 等人的研究[27]发现呼吸机、血液透析机等大量医疗设备连续使用产生了大量低频噪音, 通过加装吸音板及使用橡胶轮、更换噪音吸收软管、将医疗设备从墙上取下等措施也可以降低噪音。减少患者对噪音和警报的主观感觉也是简便有效的方法之一, 多项研究评估了 ICU 患者使用耳塞和眼罩来减少噪音和光照对患者的刺激, 结果提示使用耳塞和眼罩可有效改善 ICU 患者的睡眠质量[28]、降低谵妄评分[29]、增加 N3 期睡眠时长[30]等等, Warjri E 等人[31]使用耳机给 ICU 患者播放白噪音也同样提高了睡眠质量, Le Guen M 等人在麻醉后监护室(PACU)使用耳塞和眼罩不仅保持了睡眠质量, 还减少了吗啡的使用量[32]。Gallacher S 等人[33]建立了 ICU 环境的主动降噪耳机模型, 结果提示主动降噪耳机更加优于耳塞, 但并没有进一步研究主动降噪耳机的实际应用效果。

6. 总结与展望

噪音和警报仍然是 ICU 十分显著的问题, 对医护人员及患者均造成了不良的影响, 随着 ICU 技术的进步和规模的扩大, 噪音水平不断提高, WHO 建议的 35 dB 标准几乎无法实现, 且 ICU 医护人员对噪音的理论认识水平仍较低[34]。虽然警报管理实践培训降低了警报疲劳, 但并没有彻底解决这个问题。视觉噪音反馈系统、设置安静时间等虽然起到了降低噪音水平的结果, 但相比于目前的绝对高噪音水平仍十分有限, 且长期持续性仍需评估[35]。目前大部分 ICU 的医疗设备警报仍是单设备模式, 每个医疗设备独立生成警报, 未来的进一步研究方向可能会集中于 ICU 患者对噪音和警报的主观感受、改变监护仪及其他机器发出警报的声源位置、降低基线噪音水平、整合多设备警报以提高警报质量并减少警报数量[36]等方面。值得注意的是, 噪音和警报的干预此时对于患者和医护人员来说已经出现了分水岭, 随着主动降噪技术的发展, ICU 患者主观感受到的声压级可能在可见的未来会降低到 35 dB 以下, 但医护人员必须及时获知监护仪和其他机器发出的报警, 如何在让警报发挥理论的用途和减少对医护人员的危害之间取得平衡, 仍然是需要进一步研究的一大难题。

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