

美国促进康复和围手术期质量协会联合共识：脑电图神经监测在围手术期中的作用

American Society for Enhanced Recovery and Perioperative Quality Initiative Joint Consensus Statement on the Role of Neuromonitoring in Perioperative Outcomes: Electroencephalography

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脑电图（EEG）监测可提示麻醉期间的大脑状态，目前已被广泛使用。但脑电图导向麻醉是否会影响围手术期结局尚不清楚。第六届围手术期质量计划（POQI-6）召集了一支由麻醉学，生物医学工程，神经病学和外科手术等多学科专家组成的国际团队，以回顾当前的文献，并就麻醉期间脑电图监测的实用性提出共识。我们总共检索了 1023 篇文章，涉及麻醉期间使用 EEG 监测，并从 15 项试验中进行了荟萃分析，以确定 EEG 导向麻醉对无意识，术后谵妄，神经认知障碍和长期死亡率的发生率的影响。在评估了当前证据后，工作组建议应将 EEG 监测作为重要器官监测器的一部分，以指导麻醉管理。并且鼓励麻醉医师熟悉 EEG 的基本内容，例如原始波形，频谱图和处理后的指标。现有证据表明，EEG 导向的麻醉降低了全凭静脉麻醉期间的术中知晓，且在预防术中知晓的层面上，与潮气末麻醉气体监测效果相似。但是，没有足够的证据推荐使用 EEG 监测来预防术后谵妄，神经认知障碍或术后死亡率。

（许芳霞译 李金宝校）

Electroencephalographic (EEG) monitoring to indicate brain state during anesthesia has become widely available. It remains unclear whether EEG-guided anesthesia influences perioperative outcomes. The sixth Perioperative Quality Initiative (POQI-6) brought together an international team of multidisciplinary experts from anesthesiology, biomedical engineering, neurology, and surgery to review the current literature and to develop consensus recommendations on the utility of EEG monitoring during anesthesia. We retrieved a total of 1023 articles addressing the use of EEG monitoring during anesthesia and conducted meta-analyses from 15 trials to determine the effect of EEG-guided anesthesia on the rate of unintentional awareness, postoperative delirium, neurocognitive disorder, and long-term mortality after surgery. After considering current evidence, the working group recommends that EEG monitoring should be considered as part of the vital organ monitors to guide anesthetic management. In addition, we encourage anesthesiologists to be knowledgeable in basic EEG interpretation, such as raw waveform, spectrogram, and processed indices, when using these devices. Current evidence suggests that EEG-guided anesthesia reduces the rate of awareness during total intravenous anesthesia and has similar efficacy in preventing awareness as compared with end-tidal anesthetic gas monitoring. There is, however, insufficient evidence to

recommend the use of EEG monitoring for preventing postoperative delirium, neurocognitive disorder, or postoperative mortality.

使用超级学习机器-学习算法预测 ICU 住院期间的急性低血压发作

Prediction of an Acute Hypotensive Episode During an ICU Hospitalization With a Super Learner Machine-Learning Algorithm

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背景: 急性降血压发作 (AHE) 定义为平均动脉压 (MAP) 下降至 <65 mm Hg 持续至少 5 分钟, 是重症监护病房 (ICU) 中最严重的事件之一。与危重症患者的不良结局有关。因而预测 AHE 的发生至关重要, 以此可通过调整治疗方案来预测或缩短 AHE。

方法: 超级学习器 (SL) 算法是一种集成的机器学习算法, 经过专门训练用以提前 10 分钟预测 AHE。潜在的预测因素包括年龄, 性别, 护理类型, 严重程度评分和随时间变化的特征 (例如机械通气, 血管加压药或镇静药物) 以及生命体征: 心率, 脉搏血氧饱和度和动脉血压。该算法在重症监护医学信息集数据集 (MIMIC II) 数据库上进行了训练。内部验证基于接收器工作特性曲线下面积 (AUROC) 和 Brier 分数 (BS)。外部验证来自法国巴黎 Lariboisière 医院的对外数据库。

结果: 在纳入研究的 1151 例患者, 826 例 (72%) 患者在 ICU 期间至少有 1 次 AHE。每位患者的 1 个随机周期内, 采用 Haar 小波变换预处理的 SL 算法的 AUROC 为 0.929 (95% 置信区间 [CI], 0.899-0.958), BS 为 0.08。每位患者的所有可用时间段内, 采用 Haar 小波变换预处理的 SL 的 AUROC 为 0.890 (95% CI, 0.886-0.895), BS 为 0.11。在外部验证队列中, 每位患者 1 个随机周期内的 AUROC 为 0.884 (95% CI, 0.775-0.993), 所有可用周期为 0.889 (0.768-1), 并且 BSs <0.1。

结论: SL 算法可以很好地提前 10 分钟预测 AHE 发生。它可以对低血压风险进行有效, 健全和快速的评估, 从而为常规使用开辟了道路。

(许芳霞译 李金宝校)

BACKGROUND: Acute hypotensive episodes (AHE), defined as a drop in the mean arterial pressure (MAP) <65 mm Hg lasting at least 5 consecutive minutes, are among the most critical events in the intensive care unit (ICU). They are known to be associated with adverse outcome in critically ill patients. AHE prediction is of prime interest because it could allow for treatment adjustment to predict or shorten AHE.

METHODS: The Super Learner (SL) algorithm is an ensemble machine-learning algorithm that we specifically trained to predict an AHE 10 minutes in advance. Potential predictors included age, sex, type of care unit, severity scores, and time-evolving characteristics such as mechanical ventilation, vasopressors, or sedation medication as well as features extracted from physiological signals: heart rate, pulse oximetry, and arterial blood pressure. The algorithm was trained on the Medical Information Mart for Intensive Care dataset (MIMIC II) database. Internal validation

was based on the area under the receiver operating characteristic curve (AUROC) and the Brier score (BS). External validation was performed using an external dataset from Lariboisière hospital, Paris, France.

RESULTS: Among 1151 patients included, 826 (72%) patients had at least 1 AHE during their ICU stay. Using 1 single random period per patient, the SL algorithm with Haar wavelets transform preprocessing was associated with an AUROC of 0.929 (95% confidence interval [CI], 0.899-0.958) and a BS of 0.08. Using all available periods for each patient, SL with Haar wavelets transform preprocessing was associated with an AUROC of 0.890 (95% CI, 0.886-0.895) and a BS of 0.11. In the external validation cohort, the AUROC reached 0.884 (95% CI, 0.775-0.993) with 1 random period per patient and 0.889 (0.768-1) with all available periods and BSs <0.1.

CONCLUSIONS: The SL algorithm exhibits good performance for the prediction of an AHE 10 minutes ahead of time. It allows an efficient, robust, and rapid evaluation of the risk of hypotension that opens the way to routine use.

预测危机：机器学习模型可预测术中心动过缓伴低血压的发生

Forecasting a Crisis: Machine-Learning Models Predict Occurrence of Intraoperative Bradycardia Associated With Hypotension

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背景：预测分析系统可以通过增强对高风险临床事件的准备，识别和响应来改善围手术期护理。心动过缓是一种相当普遍且影响因素众多而难以预测的临床事件。它可能是良性的，也可能与需要积极治疗的低血压有关。我们的目的是通过术前电子病历和术中麻醉信息管理系统数据来构建模型，预测术中3个时间点的术中严重心动过缓的发生。

方法：数据来源于华盛顿大学医学中心2012年至2017年所开展的62,182例择期非心脏手术。临床事件定义为严重心动过缓（心率<50次/分钟），且在10分钟窗口期内出现低血压（平均动脉压<55 mmHg）。我们开发了模型来预测以下3个时间点至少有1次事件的存在：麻醉诱导（TP1），手术开始（TP2）和手术开始后30分钟（TP3）。预测变量基于每个时间点之前的可用数据，包括术前患者和手术数据（TP1），然后是基于术中每分钟的监护仪数据，呼吸机参数，静脉输液，输液和推注药物数据（TP2和TP3）。建立机器学习和逻辑回归模型，通过ROC曲线下的面积（AUC）评估其预测能力。

结果：TP1、TP2、TP3时刻后的临床事件分别为3498（5.6%）、2404（3.9%）、1066（1.7%）。心率是TP1之后事件的最强预测因子。TP2时刻前的临床事件、平均心率和平均脉搏率是TP2时刻之后临床事件的最强预测因子。TP2时刻前的临床事件、平均心率和平均脉搏率（及其相互作用）以及心率和血压连续15分钟下降是TP3时刻后临床事件的最强预测因子。最佳的机器学习模型AUC分别为0.81（TP1），0.87（TP2）和0.89（TP3），在95%特异性下的阳性预测值分别为0.30、0.29和0.15。

结论: 我们研发了可利用术前和术中实时数据预测不稳定的心动过缓的模型。我们的研究提示了如何利用模型来预测多个时间间隔内的临床事件, 希望未来能研发实时、术中、可帮助决策的工具。

(许芳霞译 李金宝校)

BACKGROUND: Predictive analytics systems may improve perioperative care by enhancing preparation for, recognition of, and response to high-risk clinical events. Bradycardia is a fairly common and unpredictable clinical event with many causes; it may be benign or become associated with hypotension requiring aggressive treatment. Our aim was to build models to predict the occurrence of clinically significant intraoperative bradycardia at 3 time points during an operative course by utilizing available preoperative electronic medical record and intraoperative anesthesia information management system data.

METHODS: The analyzed data include 62,182 scheduled noncardiac procedures performed at the University of Washington Medical Center between 2012 and 2017. The clinical event was defined as severe bradycardia (heart rate <50 beats per minute) followed by hypotension (mean arterial pressure <55 mm Hg) within a 10-minute window. We developed models to predict the presence of at least 1 event following 3 time points: induction of anesthesia (TP1), start of the procedure (TP2), and 30 minutes after the start of the procedure (TP3). Predictor variables were based on data available before each time point and included preoperative patient and procedure data (TP1), followed by intraoperative minute-to-minute patient monitor, ventilator, intravenous fluid, infusion, and bolus medication data (TP2 and TP3). Machine-learning and logistic regression models were developed, and their predictive abilities were evaluated using the area under the ROC curve (AUC). The contribution of the input variables to the models were evaluated.

RESULTS: The number of events was 3498 (5.6%) after TP1, 2404 (3.9%) after TP2, and 1066 (1.7%) after TP3. Heart rate was the strongest predictor for events after TP1. Occurrence of a previous event, mean heart rate, and mean pulse rates before TP2 were the strongest predictor for events after TP2. Occurrence of a previous event, mean heart rate, mean pulse rates before TP2 (and their interaction), and 15-minute slopes in heart rate and blood pressure before TP2 were the strongest predictors for events after TP3. The best performing machine-learning models including all cases produced an AUC of 0.81 (TP1), 0.87 (TP2), and 0.89 (TP3) with positive predictive values of 0.30, 0.29, and 0.15 at 95% specificity, respectively.

CONCLUSIONS: We developed models to predict unstable bradycardia leveraging preoperative and real-time intraoperative data. Our study demonstrates how predictive models may be utilized to predict clinical events across multiple time intervals, with a future goal of developing real-time, intraoperative, decision support.

新型成像通过无监督的流形学习揭示心血管波形分析的内部动态性

Novel Imaging Revealing Inner Dynamics for Cardiovascular Waveform Analysis via Unsupervised Manifold Learning

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背景: 心血管波形包含用于临床诊断的信息。通过从大量原始波形数据中学习的波形形态的细微变化,无监督流形学习有助于描绘高维结构并将其显示为新颖的3D图像。我们假设这种结构的形状传达了临床相关的内部动态信息。

方法: 为了验证该假设,我们研究了缺血性心脏病的心电图(ECG)波形和动态血管活性改变时动脉血压(ABP)波形。我们将每次心跳或脉搏建模为位于流形上的点,并使用弥撒图(DMap)建立这些脉冲之间的关系。DMap的输出结果转换为可视的3D图像。对于ECG数据集,首先我们分析了3D图像中从不稳定型心绞痛患者到健康对照的非ST段升高型的ECG波形分布,并研究了术中ST段升高型ECG波形,以显示动态ECG波形变化。对于ABP数据集,我们分析了在气管插管和使用血管扩张剂时收集的波形。为了量化动态分离,我们应用了支持向量机(SVM)分析,并报告了总精度和宏观F1评分。我们进一步进行了轨迹分析,并得出了连续跳动(或脉冲)的运动方向作为高维空间中的向量。

结果: 对于非ST段抬高型心电图,三维图像呈现由不稳定型心绞痛到健康对照的连续ECG波形构成的分层树结构(准确度=97.6%, macro-f1=96.1%)。DMap有助于量化和可视化术中1小时内ST段抬高心肌事件的发展(准确度=97.58%, 宏-F1=96.06%)。尼卡地平给药后的ABP波形分析显示个体间的差异(准确度为95.01%, macro-f1=96.9%)及其与个体内运动轨迹的共同方向。气管插管过程中ABP波形的动态变化呈环形轨迹结构,利用尼卡地平的机器学习知识可以进一步对其进行划分。

结论: DMap和生成的ECG或ABP波形的三维图像提供了临床相关的内部动态信息。可为急性冠状动脉综合症的诊断提供线索,显示心肌缺血发作的临床过程,揭示应激或血管扩张状态下的生理机制。

(许芳霞译 李金宝校)

BACKGROUND: Cardiovascular waveforms contain information for clinical diagnosis. By learning and organizing the subtle change of waveform morphology from large amounts of raw waveform data, unsupervised manifold learning helps delineate a high-dimensional structure and display it as a novel 3-dimensional (3D) image. We hypothesize that the shape of this structure conveys clinically relevant inner dynamics information.

METHODS: To validate this hypothesis, we investigate the electrocardiography (ECG) waveform for ischemic heart disease and arterial blood pressure (ABP) waveform in dynamic vasoactive episodes. We model each beat or pulse to be a point lying on a manifold-like a surface-and use the diffusion map (DMap) to establish the relationship among those pulses. The output of the DMap is converted to a 3D image for visualization. For ECG datasets, first we analyzed the non-ST-elevation ECG waveform distribution from unstable angina to healthy control in the 3D image, and we investigated intraoperative ST-elevation ECG waveforms to show the dynamic ECG waveform changes. For ABP datasets, we analyzed waveforms collected under endotracheal intubation and administration of vasodilator. To quantify the dynamic

separation, we applied the support vector machine (SVM) analysis and reported the total accuracy and macro-F1 score. We further performed the trajectory analysis and derived the moving direction of successive beats (or pulses) as vectors in the high-dimensional space.

RESULTS: For the non-ST-elevation ECG, a hierarchical tree structure comprising consecutive ECG waveforms spanning from unstable angina to healthy control is presented in the 3D image (accuracy = 97.6%, macro-F1 = 96.1%). The DMap helps quantify and visualize the evolving direction of intraoperative ST-elevation myocardial episode in a 1-hour period (accuracy = 97.58%, macro-F1 = 96.06%). The ABP waveform analysis of Nicardipine administration shows interindividual difference (accuracy = 95.01%, macro-F1 = 96.9%) and their common directions from intraindividual moving trajectories. The dynamic change of the ABP waveform during endotracheal intubation shows a loop-like trajectory structure, which can be further divided using the manifold learning knowledge obtained from Nicardipine.

CONCLUSIONS: The DMap and the generated 3D image of ECG or ABP waveforms provides clinically relevant inner dynamics information. It provides clues of acute coronary syndrome diagnosis, shows clinical course in myocardial ischemic episode, and reveals underneath physiological mechanism under stress or vasodilators.

失血性休克对静脉麻醉药物的分布及效应的影响：叙述性综述

The Influence of Hemorrhagic Shock on the Disposition and Effects of Intravenous Anesthetics: A Narrative Review

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在失血性休克的情况下，减少静脉麻醉剂的剂量是一个公认的临床教条。总体来说，从动物和人类数据中获取的有关失血性休克期间静脉麻醉剂用量的信息，证实了该临床教条，并为失血性休克背景下静脉麻醉剂的合理选择和使用提供了依据。失血性休克时的生理变化可改变静脉麻醉药的药动力学和药效学。休克生理学引起的中央室和中央间隙减小导致剂量-浓度关系改变。对于大多数药剂和辅药来说，休克导致了更高的浓度和更强的效应。值得注意的例外是依托咪酯，它在休克期间的药动力学相对不变。浓度的增加不仅导致主要效应的增加，也导致副作用的增加，特别是心血管效应。所有药物的药代动力学改变基本上都是通过液体复苏来逆转的。异丙酚在这些药物中比较特殊，除了有药代动力学变化外，它在休克期间表现出更强的药效。并且即使在液体复苏后，仍有药效变化。休克期间这些药效持续性变化的原因不太可能是内源性阿片类药物的增加，而很大可能是由于未结合的异丙酚的比例增加。休克的不同阶段也可能会影响药物的变化。随着休克生理学进展到无补偿阶段，这种变化更加迅速和明显。尽管数据不多，但人类的数据证实了动物研究的结果。在失血性休克的情况下，动物和人类的数据都为静脉麻醉剂的合理选择和使用提供了依据。依托咪酯是出血性休克患者首选诱导剂这一根深蒂固的临床教条得到了有力的证据支持。丙泊酚是严重出血患者麻醉诱导或维持的较差选择，即使是在复苏的情况下；且包括紧急创伤病例或常规有轻度或中度失血的病例。

(许芳霞译 李金宝校)

The need to reduce the dose of intravenous anesthetic in the setting of hemorrhagic shock is a well-established clinical dogma. Considered collectively, the body of information concerning the behavior of intravenous anesthetics during hemorrhagic shock, drawn from animal and human data, confirms that clinical dogma and informs the rational selection and administration of intravenous anesthetics in the setting of hemorrhagic shock. The physiologic changes during hemorrhagic shock can alter pharmacokinetics and pharmacodynamics of intravenous anesthetics. Decreased size of the central compartment and central clearance caused by shock physiology lead to an altered dose-concentration relationship. For most agents and adjuncts, shock leads to substantially higher concentrations and increased effect. The notable exception is etomidate, which has relatively unchanged pharmacokinetics during shock. Increased concentrations lead to increased primary effect as well as increased side effects, notably cardiovascular effects. Pharmacokinetic changes are essentially reversed for all agents by fluid resuscitation. Propofol is unique among agents in that, in addition to the pharmacokinetic changes, it exhibits increased potency during shock. The pharmacodynamic changes of propofol persist despite fluid resuscitation. The persistence of these pharmacodynamic changes during shock is unlikely to be due to increased endogenous opiates, but is most likely due to increased fraction of unbound propofol. The stage of shock also appears to influence the pharmacologic changes. The changes are more rapid and pronounced as shock physiology progresses to the uncompensated stage. Although scant, human data corroborate the findings of animal studies. Both the animal and human data inform the rational selection and administration of intravenous anesthetics in the setting of hemorrhagic shock. The well-entrenched clinical dogma that etomidate is a preferred induction agent in patients experiencing hemorrhagic shock is firmly supported by the evidence. Propofol is a poor choice for induction or maintenance of anesthesia in severely bleeding patients, even with resuscitation; this can include emergent trauma cases or scheduled cases that routinely have mild or moderate blood loss.

关于儿童眼科手术局麻的文献综述

Regional Anesthesia for Pediatric Ophthalmic Surgery: A Review of the Literature

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儿童眼科局部麻醉已被广泛报道，但很少使用。本文综述了支持传导麻醉在小儿眼科手术中应用的现有证据。儿童和成人在轴长、眼压和有效眼眶空间方面的关键解剖差异影响了眼科区域麻醉的实施。眼睛在出生时接近成人大小，并且在眼眶还没怎么变化时迅速完成生长。这导致局部麻醉时眼外眶容积明显减小。基于针的局部阻滞根据针与眼外肌束的关系进行（即眼内或眼外），基于套管的局部阻滞根据对腱膜深部潜在空间进行。在儿童中，由儿科麻醉师或眼科医师进行麻醉诱导，通过解剖标志物或超声检查进行阻滞。眼部传导麻醉为眼科手术提供了

一些优势，包括镇痛、致盲、阻断眼心反射、减少术后恶心和呕吐。短（16 毫米）钝的针头是首选，因为儿童的眼球与眼眶的比例是不一样的。不同长度的软管在亚肌腱阻滞中是安全的。超声技术有助于直观、实时地显示针头位置和局部麻醉剂扩散，并减少针意外放入眼肌束内。发育中的眼睛容易受到热损伤和机械损伤，因此必须使用眼睛额定的传感器。辅助性透明质酸酶可改善眼部致盲，降低局部麻醉剂量要求，提高初始阻滞成功率；同时，右美托咪定可增加局麻药的药效，延长镇痛时间，但不增加不良事件。在新生儿和婴儿，视网膜母细胞瘤手术，以及后葡萄肿和眼眶炎中，眼肌束内阻滞是一种相对禁忌症。对于儿科眼科手术，综合征患儿的阻滞位置，以及与每种技术的潜在不良反应，均需要特殊考虑。以上是基于我们在繁忙的学术眼科三级转诊中心的经验所提供的建议。

（许芳霞译 李金宝校）

Ophthalmic pediatric regional anesthesia has been widely described, but infrequently used. This review summarizes the available evidence supporting the use of conduction anesthesia in pediatric ophthalmic surgery. Key anatomic differences in axial length, intraocular pressure, and available orbital space between young children and adults impact conduct of ophthalmic regional anesthesia. The eye is near adult size at birth and completes its growth rapidly while the orbit does not. This results in significantly diminished extraocular orbital volumes for local anesthetic deposition. Needle-based blocks are categorized by relation of the needle to the extraocular muscle cone (ie, intraconal or extraconal) and in the cannula-based block, by description of the potential space deep to the Tenon capsule. In children, blocks are placed after induction of anesthesia by a pediatric anesthesiologist or ophthalmologist, via anatomic landmarks or under ultrasonography. Ocular conduction anesthesia confers several advantages for eye surgery including analgesia, akinesia, ablation of the oculocardiac reflex, and reduction of postoperative nausea and vomiting. Short (16 mm), blunt-tip needles are preferred because of altered globe-to-orbit ratios in children. Soft-tip cannulae of varying length have been demonstrated as safe in sub-Tenon blockade. Ultrasound technology facilitates direct, real-time visualization of needle position and local anesthetic spread and reduces inadvertent intraconal needle placement. The developing eye is vulnerable to thermal and mechanical insults, so ocular-rated transducers are mandated. The adjuvant hyaluronidase improves ocular akinesia, decreases local anesthetic dosage requirements, and improves initial block success; meanwhile, dexmedetomidine increases local anesthetic potency and prolongs duration of analgesia without an increase in adverse events. Intraconal blockade is a relative contraindication in neonates and infants, retinoblastoma surgery, and in the presence of posterior staphylomas and buphthalmos. Specific considerations include pertinent pediatric ophthalmologic topics, block placement in the syndromic child, and potential adverse effects associated with each technique. Recommendations based on our experience at a busy academic ophthalmologic tertiary referral center are provided.

心脏手术患者低潮气量与其氧合轻度改善相关：队列研究

Low Tidal Volumes Are Associated With Slightly Improved Oxygenation in Patients Having Cardiac Surgery: A Cohort Analysis

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背景: 低潮气量的机械通气对非心脏手术患者似乎有好处,但对心脏手术患者是否有好处尚不清楚。

方法: 回顾性分析 2010 年 1 月至 2016 年 8 月中旬接受单腔气管插管机械通气的且需要体外循环的择期心脏手术患者。对手术期间(不包括体外循环阶段)时间加权平均潮气量(毫升/千克预测体重[PBW])。检查潮气量与术后氧合(通过动脉氧分压(PaO₂)/吸入氧浓度[PaO₂/FiO₂]测量)、氧合受损(PaO₂/FiO₂<300)和临床结局之间的关系。

结果: 在 9359 例心脏外科患者中,较大的潮气量与术后稍差的氧合相关。潮气量每增加 1 ml/kg PBW,术后 PaO₂/FiO₂ 降低约 1.05%(97.5%置信区间[CI], -1.74 至 -0.37; P_{Bon}=0.0005)。术中潮气量的增加也与氧合不良的比例增加(比值比 [OR; 97.5% CI:1.08 [1.02-1.14]每增加 1 ml/kg PBW 潮气量; P_{BON}=0.0029),插管时间延长(每增加 1 ml/kg 潮气量 5% (风险比; [98.33%CI], 0.95[0.93-0.98]每增加 1 ml/kg PBW; P_{Bon}<0.0001),死亡率增加(OR[98.33%可信区间],潮气量每增加 1 ml/kg PBW 死亡率增加 1.34[1.06-1.70], P_{Holm}=0.0144)相关。术中潮气量的增加也与术后急性呼吸衰竭相关(OR[98.33%可信区间],潮气量每增加 1 ml/kg PBW 1.16[1.03-1.32]; P_{Holm}=0.0146),但与其他肺部并发症无关。

结论: 较低的时间加权平均术中潮气量与心脏手术患者术后氧合状况的轻微改善有关。

(许芳霞译 李金宝校)

BACKGROUND: Mechanical ventilation with low tidal volumes appears to provide benefit in patients having noncardiac surgery; however, whether it is beneficial in patients having cardiac surgery is unclear.

METHODS: We retrospectively examined patients having elective cardiac surgery requiring cardiopulmonary bypass through a median sternotomy approach who received mechanical ventilation with a single lumen endotracheal tube from January 2010 to mid-August 2016. Time-weighted average tidal volume (milliliter per kilogram predicted body weight [PBW]) during the duration of surgery excluding cardiopulmonary bypass was analyzed. The association between tidal volumes and postoperative oxygenation (measured by arterial partial pressure of oxygen (PaO₂)/fraction of inspired oxygen ratio [PaO₂/FIO₂]), impaired oxygenation (PaO₂/FIO₂ <300), and clinical outcomes were examined.

RESULTS: Of 9359 cardiac surgical patients, larger tidal volumes were associated with slightly worse postoperative oxygenation. Postoperative PaO₂/FIO₂ decreased an estimated 1.05% per 1 mL/kg PBW increase in tidal volume (97.5% confidence interval [CI], -1.74 to -0.37; P_{Bon} = .0005). An increase in intraoperative tidal volumes was also associated with increased odds of impaired oxygenation (odds ratio [OR; 97.5% CI]: 1.08 [1.02-1.14] per 1 mL/kg PBW increase in tidal volume; P_{Bon} = .0029), slightly longer intubation time (5% per 1 mL/kg increase in tidal volume (hazard ratio [98.33% CI], 0.95 [0.93-0.98] per 1 mL/kg PBW; P_{Bon} < .0001), and

increased mortality (OR [98.33% CI], 1.34 [1.06-1.70] per 1 mL/kg PBW increase in tidal volume; PHolm = .0144). An increase in intraoperative tidal volumes was also associated with acute postoperative respiratory failure (OR [98.33% CI], 1.16 [1.03-1.32] per 1 mL/kg PBW increase in tidal volume; PHolm = .0146), but not other pulmonary complications.

CONCLUSIONS: Lower time-weighted average intraoperative tidal volumes were associated with a very modest improvement in postoperative oxygenation in patients having cardiac surgery.

术前预防性使用万古霉素在小儿神经外科和骨科患者的血浆和软组织浓度 **Preoperative Vancomycin Administration for Surgical Site Prophylaxis: Plasma and Soft-Tissue Concentrations in Pediatric Neurosurgical and Orthopedic Patients**

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背景: 万古霉素被用做儿科手术患者的预防性使用抗生素, 但其在血浆和组织的药代动力学尚不清楚。指南推荐在使用后 60 分钟内划皮; 但组织中的万古霉素浓度在早期可能尚未达到治疗效果。我们开展了一个研究, 检测小儿神经外科和骨科患者的血浆及皮肤组织万古霉素中的浓度, 从而明确其在术中的药代动力学。
方法: 对 0.1~18.8 岁的脊柱后融合 (n=30) 或脑室-腹腔分流术 (n=30) 患者静脉注射万古霉素 15 mg/kg (最大 1000 mg) 1 小时以上。在切口和皮肤缝合处对皮肤进行活检。在划皮时、术中 2 小时和 4 小时以及缝合时采集血样。人群药代动力学分析用于估计药代动力学参数, 并建立术中血浆和皮肤万古霉素浓度随时间变化的模型。

结果: 药代动力学分析包括 59 名受试者、130 份血浆和 107 份皮肤样本的数据。两室模型, 中央室体积 (vc) 和周边室体积 (v2) 被证明是最合适的。逐步协变量选择表明清除间隙和体表面积以及 V2 和体重有显著相关性。手术期间皮肤万古霉素浓度持续上升。模型预测皮肤和血浆万古霉素浓度平衡需要 5 小时以上。

结论: 与手术结束时的浓度相比, 术前刚应用万古霉素时的浓度相对较低。如果手术开始时需要更高的皮肤浓度, 建议延长给药和划皮之间的时间。

(许芳霞译 李金宝校)

BACKGROUND: Vancomycin is used for antibiotic prophylaxis in pediatric surgical patients without a complete understanding of plasma and soft-tissue pharmacokinetics. Guidelines recommend incision within 60 minutes after administration; however, tissue vancomycin concentrations at that early time may not be therapeutic. We conducted a study of plasma and skin concentrations in pediatric neurosurgical and orthopedic patients to characterize intraoperative vancomycin pharmacokinetics.

METHODS: Patients (0.1-18.8 years of age) undergoing posterior spinal fusion (n = 30) or ventriculoperitoneal shunt placement (n = 30) received intravenous vancomycin 15 mg/kg (maximum 1000 mg) over 1 hour. Skin was biopsied at incision and skin closure. Blood samples were collected at incision, at 2 and 4 hours

intraoperatively, and at closure. Population pharmacokinetic analysis was performed to characterize pharmacokinetic parameter estimates and to develop a model of intraoperative plasma and skin vancomycin concentrations versus time.

RESULTS: Pharmacokinetic analysis included data from 59 subjects, 130 plasma samples, and 107 skin samples. A 2-compartment model, volume of the central (V_c) and volume of the peripheral compartment (V_2), proved to have the best fit. Stepwise covariate selection yielded a significant relationship for body surface area on elimination clearance and body weight on V_2 . Skin vancomycin concentrations rose continuously during surgery. Modeling predicted that equilibration of skin and plasma vancomycin concentrations took ≥ 5 hours.

CONCLUSIONS: Skin vancomycin concentrations immediately after a preoperative dose are relatively low compared with concentrations at the end of surgery. It may be advisable to extend the time between dose and incision if higher skin concentrations are desired at the start of surgery.

一种结合 Poincaré 分析的自动化算法可以量化阿片类药物引起共济失调呼吸的严重程度

An Automated Algorithm Incorporating Poincaré Analysis Can Quantify the Severity of Opioid-Induced Ataxic Breath

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背景: 阿片类药物引起的呼吸抑制 (OIRD) 传统上是通过评估呼吸频率、动脉血氧饱和度、呼气末 CO₂ 和精神状态来识别的。尽管人们普遍认为不规则或共济失调的呼吸模式是阿片类药物作用的表现,但尚无用于评估共济失调呼吸严重程度的标准化方法。本研究旨在探讨使用机器学习演算法来量化阿片类药物引起的共济失调呼吸的严重程度。我们假设领域专家之间具有高度的一致性,机器学习算法与领域专家在评估共济失调呼吸严重程度方面同样具有很高的 consistency。

方法: 我们对 26 名健康志愿者靶控输注丙泊酚和瑞芬太尼,以模拟轻度睡眠和 OIRD。呼吸数据采集自呼吸电感容积描记 (RIP) 带和鼻内压力传感器。三名领域专家根据视觉评分模板量化了共济失调呼吸的严重程度。信度检验用于评估 3 名领域专家之间的一致性。利用多类支持向量机 (SVM) 训练识别领域专家已标记的数据子集,然后分析剩余数据量化共济失调呼吸严重程度。采用卡方检验方法评估机器学习算法与分组领域专家之间的一致性。卡方检验扩展了信度检验,在本例中,它分离了一个评分者,即机器学习算法,并将其与一组评分者进行了比较。两项统计指标的接受标准均设定为 >0.8 。对 SVM 的识别训练和测试主要使用 2 个传感器输入的呼吸参数,即呼吸电感容积和鼻内压力。**结果:** 3 名领域专家的卡方值为 0.93 (95%置信区间[CI]=0.91-0.95)。与专家相比, RIP SVM 的卡方值为 0.98 (95%置信区间[CI]=0.96-0.99), 鼻内压力 SVM 卡方值为 0.96 (95%置信区间=0.92-0.98)。

结论：我们得出结论，机器学习算法可以与领域专家小组一致的方式量化共济失调呼吸严重程度。这种方法可能与传统方法相结合，有助于识别 OIRD 患者。

（卢旭译 潘艳、薛张纲校）

Background: Opioid-induced respiratory depression (OIRD) is traditionally recognized by assessment of respiratory rate, arterial oxygen saturation, end-tidal CO₂, and mental status. Although an irregular or ataxic breathing pattern is widely recognized as a manifestation of opioid effects, there is no standardized method for assessing ataxic breathing severity. The purpose of this study was to explore using a machine-learning algorithm for quantifying the severity of opioid-induced ataxic breathing. We hypothesized that domain experts would have high interrater agreement with each other and that a machine-learning algorithm would have high interrater agreement with the domain experts for ataxic breathing severity assessment.

Methods: We administered target-controlled infusions of propofol and remifentanyl to 26 healthy volunteers to simulate light sleep and OIRD. Respiration data were collected from respiratory inductance plethysmography (RIP) bands and an intranasal pressure transducer. Three domain experts quantified the severity of ataxic breathing in accordance with a visual scoring template. The Krippendorff alpha, which reports the extent of interrater agreement among N raters, was used to assess agreement among the 3 domain experts. A multiclass support vector machine (SVM) was trained on a subset of the domain expert-labeled data and then used to quantify ataxic breathing severity on the remaining data. The Vanbelle kappa was used to assess the interrater agreement of the machine-learning algorithm with the grouped domain experts. The Vanbelle kappa expands on the Krippendorff alpha by isolating a single rater—in this case, the machine-learning algorithm—and comparing it to a group of raters. Acceptance criteria for both statistical measures were set at >0.8. The SVM was trained and tested using 2 sensor inputs for the breath marks: RIP and intranasal pressure.

Results: Krippendorff alpha was 0.93 (95% confidence interval [CI], 0.91-0.95) for the 3 domain experts. Vanbelle kappa was 0.98 (95% CI, 0.96-0.99) for the RIP SVM and 0.96 (0.92-0.98) for the intranasal pressure SVM compared to the domain experts.

Conclusions: We concluded it may be feasible for a machine-learning algorithm to quantify ataxic breathing severity in a manner consistent with a panel of domain experts. This methodology may be helpful in conjunction with traditional measures to identify patients experiencing OIRD.

围手术期贫血：围手术期护理的预防，诊断和管理

Perioperative Anemia: Prevention, Diagnosis, and Management Throughout the Spectrum of Perioperative Care

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贫血在围手术期很常见，并且与患者预后差有关。值得注意的是，贫血常常被忽略，直到血红蛋白水平下降到有输血指征的水平。不幸的是，这种简单的基于输血的方法已经转移了临床的关注点，不再关注通过直接控制潜在病因来充分预防、诊断和治疗贫血的策略。尽管已经发表了有关择期手术前纠正贫血的建议，但有关循证的贫血管理策略的设计和实施的的信息很少。此外，贫血不仅仅是术前要面对的问题。相反，必须在整个围手术期护理中积极解决患者的贫血问题。本文提供有关整个围手术期在外科手术患者中实施贫血管理策略的实用信息。包括预防、诊断和治疗贫血的循证医学建议，也包括补铁和补充促红细胞生成素（ESA）的实用性。

(吴兆艺译 潘艳、薛张纲校)

Anemia is common in the perioperative period and is associated with poor patient outcomes. Remarkably, anemia is frequently ignored until hemoglobin levels drop low enough to warrant a red blood cell transfusion. This simplified transfusion-based approach has unfortunately shifted clinical focus away from strategies to adequately prevent, diagnose, and treat anemia through direct management of the underlying cause(s). While recommendations have been published for the treatment of anemia before elective surgery, information regarding the design and implementation of evidence-based anemia management strategies is sparse. Moreover, anemia is not solely a concern of the preoperative encounter. Rather, anemia must be actively addressed throughout the perioperative spectrum of patient care. This article provides practical information regarding the implementation of anemia management strategies in surgical patients throughout the perioperative period. This includes evidence-based recommendations for the prevention, diagnosis, and treatment of anemia, including the utility of iron supplementation and erythropoiesis-stimulating agents (ESAs).

吸入艾洛前列素对慢性阻塞性肺疾病合并肺氧合不良的患者单肺通气期间肺力学和心肌功能的影响

Effects of Inhaled Iloprost on Lung Mechanics and Myocardial Function During One-Lung Ventilation in Chronic Obstructive Pulmonary Disease Patients Combined With Poor Lung Oxygenation

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背景：慢性阻塞性肺疾病（COPD）患者的通气/灌注不匹配会加剧心脏功能以及肺氧合恶化。我们假设在慢性阻塞性肺病患者单肺通气（OLV）期间吸入伊洛前列素可以改善肺功能和心肌功能，从而改善肺部氧合作用

方法：本研究共纳入 40 例中度至重度 COPD 患者，在开始单肺通气 OLV 30 分钟后表现出动脉血氧分压与吸入氧分数的比值（PaO₂ / FIO₂）<150 mm Hg。将患者随机分为 ILO 组（n = 20）或对照组（n = 20），分别吸入伊洛前列素（20μg）和生理盐水。在开始 OLV 后 30 分钟（Tx 前）和完成药物吸入后 30 分钟（Tx 后）评估 PaO₂ / FIO₂ 比，死腔，动态顺应性和具有心肌性能指数（MPI）的组织多普勒成像。使用组间线性混合模型分析重复变量。

结果: 在 Tx 前, 两组间的测量参数没有差异。在 Tx 后, 伊洛前列素组 (ILO 组) 的 PaO₂ / FIO₂ 比值 (P < .001) 和动态顺应性 (P = .023) 显著提高, 死腔通气 (P = .001) 显著降低, 与对照组相比, ILO 组的左心室 MPI (P = .003) 和右心室 MPI (P < .001) 显著降低。

结论: 在肺氧合不良的 COPD 患者的 OLV 期间, 吸入伊洛前列素可同时改善肺氧合, 肺力学和心肌功能。

(王沛译 潘艳、薛张纲校)

Background: The ventilation/perfusion mismatch in chronic obstructive pulmonary disease (COPD) patients can exacerbate cardiac function as well as pulmonary oxygenation. We hypothesized that inhaled iloprost can ameliorate pulmonary oxygenation with lung mechanics and myocardial function during one-lung ventilation (OLV) in COPD patients combined with poor lung oxygenation.

Methods: A total of 40 patients with moderate to severe COPD, who exhibited the ratio of partial pressure of arterial oxygen to the fraction of inspired oxygen (PaO₂/FIO₂) <150 mm Hg 30 minutes after initiating OLV, were enrolled in this study. Patients were randomly allocated into either ILO group (n = 20) or Control group (n = 20), in which iloprost (20 µg) and saline were inhaled, respectively. The PaO₂/FIO₂ ratio, dead space, dynamic compliance, and tissue Doppler imaging with myocardial performance index (MPI) were assessed 30 minutes after initiating OLV (pre-Tx) and 30 minutes after completion of drug inhalation (post-Tx). Repeated variables were analyzed using a linear mixed-model between the groups.

Results: At pre-Tx, no differences were observed in measured parameters between the groups. At post-Tx, PaO₂/FIO₂ ratio (P < .001) and dynamic compliance (P = .023) were significantly higher and dead space ventilation was significantly lower (P = .001) in iloprost group (ILO group) compared to Control group. Left (P = .003) and right ventricular MPIs (P < .001) significantly decreased in ILO group compared to Control group.

Conclusions: Inhaled iloprost improved pulmonary oxygenation, lung mechanics, and cardiac function simultaneously during OLV in COPD patients with poor lung oxygenation.

术中电子警报提高了对国家质量计划措施中围手术期温度管理的依从性

Intraoperative Electronic Alerts Improve Compliance With National Quality Program Measure for Perioperative Temperature Management

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Anesthesia & Analgesia: [2020 130 1167-1175](#)

背景: 麻醉服务的报销已从按服务付费模式转变为以价值为基础的模式, 该模式将支付与质量指标挂钩。医疗保险和医疗补助服务中心 (CMS) 的基于价值的支付计划包括围手术期温度管理的质量测量 (措施 424, 围手术期温度管理)。该政策的实施可能会对临床实践、数据收集和报告中提出新的挑战。因此我们调查了此新兴标准中相关的电子决策支持工具所造成的影响。

方法: 在这项回顾观察性研究中, 我们收集了能够测量温度并维持正常体温的电子决策支持工具实施前后单个学术医学中心的病例围术期温度数据, 这些病例均符合向 CMS 上报的条件。本研究使用分段回归分析评估了新措施依从性的比例, 还评估了术中体温测量的比例。并进行了多变量 logistic 回归以评估患者和手术因素与测量依从性之间的关联。

结果: 评估了 2017 年符合条件的 24,755 例病例, 并将 2016 年以后的 25,274 例也纳入以扩展基线。 分段时间序列回归在度量依从性方面未显示明显的基线趋势。引入电子警报与总体依从性从 84.4% (95% 置信区间[CI], 83.6%-85.2%) 增加到 92.4% (91.4%-93.4%) 相关, 术中依从性从 26.8% 增加 (25.8%-27.8%) 至 71.0% (69.6%-72.4%)。警报与总体依从性之间的关联也出现在多变量分析中。

结论: 在符合向 CMS 报告的病例中, 术中决策支持工具的实施与正常体温维持的显著改善相关。 这可以提高措施 424 的依从性, 也表明了电子警报可以帮助医务工作者提高其绩效并且以此支付奖金。

(李玮珊译潘艳、薛张纲校)

BACKGROUND: Reimbursement for anesthesia services has been shifting from a fee-for-service model to a value-based model that ties payment to quality metrics. The Centers for Medicare & Medicaid Service's (CMS) value-based payment program includes a quality measure for perioperative temperature management (Measure #424, Perioperative Temperature Management). Compliance may impose new challenges in clinical practice, data collection, and reporting. We investigated the impact of an electronic decision-support tool on adherence to this emerging standard.

METHODS: In this retrospective observational study, perioperative temperature data were collected from cases eligible for reporting this measure to CMS from a single academic medical center before and after the implementation of an electronic decision-support tool that prompted temperature measurement and maintenance of normothermia. Proportions of measure compliance were assessed using segmented regression analysis. Proportions of intraoperative temperature measurement were also assessed, and multivariable logistic regression was performed to assess the association between patient and surgical factors and measure compliance.

RESULTS: A total of 24,755 cases eligible for reporting in 2017 were assessed, and 25,274 cases from 2016 were included as an extended baseline. Segmented time-series regression did not show a significant baseline trend in measure compliance. Introduction of the alerts was associated with an increase in overall compliance from 84.4% (95% confidence interval [CI], 83.6%-85.2%) to 92.4% (91.4%-93.4%), and an increase in intraoperative compliance from 26.8% (25.8%-27.8%) to 71.0% (69.6%-72.4%). The association between the alerts and overall compliance was also present on multivariable analysis.

CONCLUSIONS: Implementation of an intraoperative decision-support tool was associated with statistically significant improvement in the maintenance of normothermia in cases eligible for reporting to CMS. This led to improved compliance with Measure #424 and suggests that electronic alerts can help practices improve their performance and payment bonus eligibility.

通过深度学习从睡眠脑节律预测深度催眠状态:一种数据再利用的方法
Predicting Deep Hypnotic State From Sleep Brain Rhythms Using Deep Learning: A Data-Repurposing Approach

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背景:通过脑电图(EEG)来追踪定量大脑活动从而预测催眠水平的脑电监测器被认为是一种节省人力的方法。由于药物存在特异性脑电图模式,任何新开发的经过处理的脑电图监测器都需要通过昂贵的临床试验来检测每一种药物和药物组合的脑电图反应,从而验证其有效性和安全性。因此,我们需要一种可替代的、高效的、经济的方法。

方法:利用深度学习法,我们开发了一种新的数据重组框架来预测睡眠脑节律的催眠水平。通过使用一个线上大型睡眠数据库(由 5723 个临床脑电图组成)来训练深度学习法和一个临床试验催眠数据库(由 30 个脑电图组成)来测试输注右美托咪定期间的睡眠水平。利用准确度和人工特性曲线下面积(AUC)对模型性能进行评估。

结果:使用右美托咪定为药物模型,在睡眠水平上训练的深度学习模型中,预测深度催眠水平的准确率(95%置信区间 CI) = 81 (79.2-88.3)%, AUC (95% CI) = 0.89(0.82-0.94)。同时,我们还证明了右美托咪定诱导的深度催眠阶段的脑电图模式与非快动眼睡眠阶段 3 的脑电图睡眠是同源的。

结论:通过对大型睡眠脑电图数据深入学习和再处理,我们提出了一种新的开发催眠水平监测器的方法,并通过优化这一系统,使得可以监测任何需要检测的个人。我们提供了一个新的数据重组框架使用睡眠脑电图预测催眠水平,从而无需开展新的临床试验用于开发睡眠水平监测器。

(石平 译潘艳、薛张纲校)

BACKGROUND: Brain monitors tracking quantitative brain activities from electroencephalogram (EEG) to predict hypnotic levels have been proposed as a labor-saving alternative to behavioral assessments. Expensive clinical trials are required to validate any newly developed processed EEG monitor for every drug and combinations of drugs due to drug-specific EEG patterns. There is a need for an alternative, efficient, and economical method.

METHODS: Using deep learning algorithms, we developed a novel data-repurposing framework to predict hypnotic levels from sleep brain rhythms. We used an online large sleep data set (5723 clinical EEGs) for training the deep learning algorithm and a clinical trial hypnotic data set (30 EEGs) for testing during dexmedetomidine infusion. Model performance was evaluated using accuracy and the area under the receiver operator characteristic curve (AUC).

RESULTS: The deep learning model (a combination of a convolutional neural network and long short-term memory units) trained on sleep EEG predicted deep hypnotic level with an accuracy (95% confidence interval [CI]) = 81 (79.2–88.3)%, AUC (95% CI) = 0.89 (0.82–0.94) using dexmedetomidine as a prototype drug. We also demonstrate that EEG patterns during dexmedetomidine-induced deep hypnotic level are homologous to nonrapid eye movement stage 3 EEG sleep.

CONCLUSIONS: We propose a novel method to develop hypnotic level monitors using large sleep EEG data, deep learning, and a data-repurposing approach, and for optimizing such a system for monitoring any given individual. We provide a novel data-repurposing framework to predict hypnosis levels using sleep EEG, eliminating the need for new clinical trials to develop hypnosis level monitors.

对于行心脏外科手术的患者，术中自体血回输对凝血因子浓度的影响

.Impact of Intraoperative Cell Salvage on Blood Coagulation Factor Concentrations in Patients Undergoing Cardiac Surgery

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背景: 心胸外科手术常涉及大量失血和同种异体浓缩红细胞的输注。为了最大限度减少同种异体红细胞的输注，术中自体血回输技术在临床上已经被运用多年。这项研究的目的是评估自体血回输对凝血因子的影响。

方法: 我们在一家学术型医院的一项前瞻性单中心观察队列研究中，招募了 30 位择期行心脏手术的患者。从自体血回输系统的储存系统和处理过的红细胞浓缩液中分别获得了患者血液样本。在患者血液经过自体血回输系统处理之前和之后，我们分别评估了凝血因子、纤维蛋白原、抗凝血酶和 von Willebrand 因子生物活性以及浓度，并使用 Wilcoxon 配对符号秩检验进行统计分析。

结果: 我们的结果显示，与储存系统中凝血因子的浓度/活性相比，处理过的红细胞浓缩液中纤维蛋白原(P<.001)、凝血因子 II(P=.004)、凝血因子 VII、X、XIII(P<.001)和其他所有测量的凝血因子浓度/或活性均显著降低。

结论: 本研究的结果表明，自体血回输系统洗涤处理使凝血因子浓度/活性显著降低。因此，对于大量失血且有大量红细胞输注需要的患者，医生需要考虑适当的凝血功能管理。

(王甲利译 潘艳、薛张纲校)

BACKGROUND: Cardiothoracic surgery is associated with major blood loss and allogeneic transfusion of red blood cell concentrates. To minimize allogeneic red blood cell (RBC) transfusion, intraoperative cell salvage has been effectively used for years. The objective of this study was to evaluate the impact of cell salvage on blood coagulation factors.

METHODS: We enrolled 30 patients scheduled for cardiac surgery in a prospective single-center observational cohort study at an academic hospital. Blood samples from the cell salvage system were obtained from both the reservoir and the processed red blood cell concentrate. Coagulation factors, fibrinogen, antithrombin and von Willebrand activity, and antigen were assessed before and after cell salvage. Statistical analysis was performed using Wilcoxon matched-pairs signed rank test.

RESULTS: Our results revealed a significant decrease of fibrinogen (P < .001), coagulation factors II (P = .004), factors VII, X, and XIII (P < .001), and all other measured coagulation factor concentrations/activities in the processed red blood cell concentrate, when compared to the concentrations/activities of the reservoir.

CONCLUSIONS: The results of the present study revealed a significant reduction of coagulation factor concentrations/activities by the washing process. Therefore, physicians need to consider adequate management of coagulation in patients with major blood loss and the need of large volumes of RBC transfusion.

POEM 手术患者的麻醉：文献综述

Anesthesia for Patients Undergoing Peroral Endoscopic Myotomy Procedures: A Review of the Literature

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特发性贲门失弛缓症是食管的一种运动障碍，对麻醉和围手术期处理具有重要意义。随着新的和更复杂的治疗方式的发展，麻醉医生越来越多地参与到这些患者的治疗中。贲门失弛缓症的主要症状如下：吞咽困难，反流，胸痛和体重减轻。贲门失弛缓也与吸入风险增加有关。贲门失弛缓的病人经常通过内镜下肉毒杆菌毒素注射，食管下括约肌的气动扩张，腹腔镜 Heller 肌切开术或经口内镜肌切开术（POEM）来治疗患者。POEM 手术基于“自然孔腔内腔镜手术”的概念。由于在 POEM 手术中破坏了食道壁的完整性，可能会暴露出纵隔或腹膜腔。因此，吹入的二氧化碳经常引起高碳酸血症，张力性腹膜炎，纵隔气肿或气胸。一个多学科团队，必须擅长病人情况的诊断和紧急处理，例如过度换气，经皮腹部针减压或胸膜腔引流，因此成功进行 POEM 围手术期管理至关重要。POEM 是一种需要全身麻醉的内窥镜检查手术。但是，目前尚无针对这些患者的麻醉专用管理或循证医学推荐。由于全球各地的机构经验差异很大，因此，本综述基于 7 个回顾性病例，1 项前瞻性研究和我们的个人经验，得出了麻醉建议和 POEM 手术的围手术期管理策略。

（王硕译 潘艳、薛张纲校）

Idiopathic achalasia is a motility disorder of the esophagus with important implications on anesthesia and perioperative management. As new and more complex treatment options develop, anesthesiologists are increasingly involved with these patients. The cardinal symptoms of achalasia are as follows: dysphagia, regurgitation, chest pain, and weight loss. Achalasia is also associated with an increased risk of aspiration. Patients are frequently treated by endoscopic botulinum toxin injections, pneumatic dilation of the lower esophageal sphincter, laparoscopic Heller myotomy, or peroral endoscopic myotomy (POEM). The POEM procedure is based on the concept of “natural orifice transluminal endoscopic surgery.” Because the integrity of the esophageal wall is deliberately interrupted during POEM, the mediastinum and the peritoneal cavity may be exposed. Thus, the insufflated carbon dioxide frequently causes hypercapnia, tension capnoperitoneum, capnomediastinum, or pneumothoraces. An interdisciplinary team, skilled in diagnostics and emergency measures such as therapeutic hyperventilation, percutaneous abdominal needle decompression, or pleural drainage, is essential for the successful perioperative management of POEM. POEM is one endoscopic procedure that requires general

anesthesia. But neither anesthesia-specific care algorithms nor evidence-based recommendations are currently available for these patients. Because institutional experience varies broadly across the globe, this review examines anesthesia recommendations and perioperative management of POEM procedures based on 7 retrospective case series, 1 prospective study, and our personal experience.

全麻期间通过 3 种镇痛监测指标指导使用阿片类药物改变术中舒芬太尼用量及应激激素释放：一项随机对照的初步研究

Guiding Opioid Administration by 3 Different Analgesia Nociception Monitoring Indices During General Anesthesia Alters Intraoperative Sufentanil Consumption and Stress Hormone Release: A Randomized Controlled Pilot Study

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背景：该项初步研究探讨了在全身麻醉过程中，3 种不同的镇痛监测装置或临床体征对舒芬太尼滴定的影响。

方法：将 48 例接受七氟醚/舒芬太尼麻醉行耻骨后前列腺癌根治术的患者随机分为 4 组，分别在 3 种镇痛监测装置（手术指数（SPI）、瞳孔疼痛指数（PPI）、痛觉水平（NoL））中的 1 种或临床判断（对照组）的指导下使用舒芬太尼。主要终点是术中舒芬太尼的用量。在手术当天的 4 个时间点测定促肾上腺皮质激素（ACTH）和皮质醇（cortisol）。数据通过 Kruskal-Wallis 和 Mann-Whitney U 检验、混合模型和面积下曲线（AUC）进行分析和组间比较，并对应激激素的时间效应进行分析。

结果：舒芬太尼给药总量($\mu\text{g}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}\cdot 10^{-3}$)各组间的差异(中位数[四分位数]: 对照组=5.6[4.4-6.4], SPI=7.2[4.8-8.4], PPI=2.0[1.8-2.9], NoL=3.8[3.3-5.1]; PPI 对 SPI, -5.1[-6.6 至 -1.3], $P < .001$; NoL 对 SPI, -3.0 [-5.2 至 0.2], $P = .024$; 对照组对比 SPI, -1.6[-3.7 至 1.7], $P = .128$; NoL 对比 PPI, 1.7[0.6-3.4], $P < .001$; 对照组对比 PPI, 3.4 [2.0-4.6], $P < .001$; 对照组对比 NoL, 1.6 [-0.2 to 3.3], $P = .017$)(Hodges-Lehmann 估计量[99%置信区间{CI}], P 值)。AUC 分析显示各组间 NoL 对 PPI (-1.079 [-1.950 to -0.208], $P = .001$)、PPI 对 SPI (1.192 [0.317-2.068], $P = .001$)和 PPI 对 SPI (1.192 [0.317-2.068], $P = .001$)累积 ACTH 水平 ($\text{ng}\cdot\text{liter}^{-1}\cdot\text{min}^{-1}$)存在差异, PPI 对 SPI (46,710 [21,145-72,274], $P < .001$)、NoL 对 SPI (27,645 [3163-52,126], $P = .003$)、以及对照组对 SPI (31,824 [6974-56,675], $P = .001$)的皮质醇水平 ($\mu\text{g}\cdot\text{l}^{-1}\cdot\text{min}^{-1}$) 也存在差异。次要终点（术后恢复、疼痛程度和镇痛药物）无差异。

结论：镇痛-痛觉监测的类型影响舒芬太尼的总用量。PPI 组较低的舒芬太尼剂量与内分泌应激反应增加有关。与对照组相比, SPI 滴定法不会引起阿片类药物减少, 但与内分泌应激反应降低有关。

（魏婉婷译 潘艳、薛张纲校）

BACKGROUND: This pilot study investigated the effect of sufentanil titration by 3 different analgesia monitoring devices or clinical signs during general anesthesia.

METHODS: Forty-eight patients undergoing radical retropubic prostatectomy with sevoflurane/sufentanil anesthesia were randomly assigned into 4 groups and received sufentanil guided either by 1 of 3 analgesia monitoring devices (Surgical Pleth Index [SPI], Pupillary Pain Index [PPI], Nociception Level [NoL]) or by clinical judgment (control). The primary end point was intraoperative sufentanil consumption. Adrenocorticotrophic hormone (ACTH) and cortisol were measured at 4 time points during the day of surgery. Data were analyzed by Kruskal–Wallis and Mann–Whitney *U* tests and by mixed model and area under the curve (AUC) analyses for group comparisons and time effects of stress hormones.

RESULTS: The total amount of sufentanil administration ($\mu\text{g}\cdot\text{kg}^{-1}\cdot\text{minute}^{-1}\cdot 10^{-3}$) differed between the groups (median [quartiles]: control = 5.6 [4.4–6.4], SPI = 7.2 [4.8–8.4], PPI = 2.0 [1.8–2.9], NoL = 3.8 [3.3–5.1]; PPI versus SPI, -5.1 [-6.6 to -1.3], $P < .001$; NoL versus SPI, -3.0 [-5.2 to 0.2], $P = .024$; control versus SPI, -1.6 [-3.7 to 1.7], $P = .128$; NoL versus PPI, 1.7 [0.6 – 3.4], $P < .001$; control versus PPI, 3.4 [2.0 – 4.6], $P < .001$; control versus NoL, 1.6 [-0.2 to 3.3], $P = .017$) (Hodges–Lehmann estimator [99% confidence interval {CI}], *P* values). The AUC analysis indicated differences among groups in cumulative ACTH levels ($\text{ng}\cdot\text{liter}^{-1}\cdot\text{minute}$, natural logarithm (ln)-transformed data) of NoL versus PPI (-1.079 [-1.950 to -0.208], $P = .001$) and PPI versus SPI (1.192 [0.317 – 2.068], $P = .001$), as well as differences in cortisol levels ($\mu\text{g}\cdot\text{liter}^{-1}\cdot\text{minute}$) for PPI versus SPI ($46,710$ [$21,145$ – $72,274$], $P < .001$), NoL versus SPI ($27,645$ [3163 – $52,126$], $P = .003$), and control versus SPI ($31,824$ [6974 – $56,675$], $P = .001$) (differences in means [99% CI], *P* value). Secondary end points (postoperative recovery, pain level, and analgesia medication) showed no differences.

CONCLUSIONS: The type of analgesia nociception monitoring affected the total amount of sufentanil administered. Lower sufentanil doses in the PPI group were associated with an increased endocrine stress response. Titration by SPI caused no opioid reduction compared to the control but was associated with a reduced endocrine stress response.

一项关于2020年麻醉自动化系统地位的叙述性综述：在2020年的地位如何？

Autonomous Systems in Anesthesia: Where Do We Stand in 2020? A Narrative Review
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众所周知，几乎社会每个方面，无论好坏，都变得越来越依赖技术的发展。技术的进步使自动化系统（也称为机器人）成为包括医学在内的多个领域中不可或缺部分。机器人在麻醉中的应用可分为三种类型。首先是药理机器人。这些机器人基于闭环系统，可在全身麻醉和镇静期间进行更好的个性化麻醉药输注，以实现最佳体内稳态。最近证据表明，自动化系统可以很好地控制血流动力学参数，要优于手术室中的手动控制。第二种类型的机器人是机械的。

它们使要求高手工灵巧度的任务变为自动化机械性复制成为可能。这种机器人比人类更准确，因此对患者来说更安全。第三类是认知机器人，也称为决策支持系统。这种类型机器人能够识别需要人工干预的关键临床情况。当这些事件发生时，系统会通知主治医师，描述相关的临床观察结果，提出相关的治疗选择，并且在主治医师允许的情况下甚至可以进行治疗。认知机器人也许可以提高患者的安全性。麻醉机器人不仅可以使主治医师摆脱重复性工作，而且还可以减轻精神负担，使他们能够专注于需要人类智慧的任务，例如分析性和临床性方法，抢救决策和与病人间互动。然而，还需要进行进一步的研究来测试这三种类型机器人的组合，以同时保持多种生物学变量的稳态，并在大规模人群中测试这种组合的安全性。

(周循 译 陈杰 校)

As most of us are aware, almost every facet of our society is becoming, for better or worse, progressively more technology-dependent. Technological advancement has made autonomous systems, also known as robots, an integral part of our life in several fields, including medicine. The application of robots in anesthesia could be classified into 3 types of robots. The first ones are pharmacological robots. These robots are based on closed-loop systems that allow better-individualized anesthetic drug titration for optimal homeostasis during general anesthesia and sedation. Recent evidence also demonstrates that autonomous systems could control hemodynamic parameters proficiently outperforming manual control in the operating room. The second type of robot is mechanical. They enable automated motorized reproduction of tasks requiring high manual dexterity level. Such robots have been advocated to be more accurate than humans and, thus, could be safer for the patient. The third type is a cognitive robot also known as decision support system. This type of robot is able to recognize crucial clinical situation that requires human intervention. When these events occur, the system notifies the attending clinician, describes relevant related clinical observations, proposes pertinent therapeutic options and, when allowed by the attending clinician, may even administer treatment. It seems that cognitive robots could increase patients' safety. Robots in anesthesia offer not only the possibility to free the attending clinicians from repetitive tasks but can also reduce mental workload allowing them to focus on tasks that require human intelligence such as analytical and clinical approach, lifesaving decision-making capacity, and interpersonal interaction. Nevertheless, further studies have yet to be done to test the combination of these 3 types of robots to maintain simultaneously the homeostasis of multiple biological variables and to test the safety of such combination on a large-scale population.

2. 简易血流动力学数据足以发现出血

Parsimony of Hemodynamic Monitoring Data Sufficient for the Detection of Hemorrhage

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背景: 个体化的血流动力学监测方法尚未得到充分验证。因此作者在猪手术模型中评估了从无创监测 (NIM) 转向有创监测时, 由于可以连续监测并且有可以参考的稳定基线而可能得到辨别出血能力的改善。

方法: 将38只约克夏猪麻醉后30min开始以20 mL / min的速度放血直至平均动脉压降至30 mm Hg, 收集期间的NIM, 中心静脉 (CVC), 动脉 (ART) 和肺动脉 (PAC) 导管, 混合静脉血氧饱和度和心输出量数据的生理波形 (WF) 数据 (250 Hz)。放血前生理数据为每个受试者单独定义了个人稳定基线。套入模型使用平均超过20秒窗口的简单血流动力学指标 (SM) 进行评估, 每分钟采样一次, 使用随机森林分类模型点对点和对波形进行分析来识别出血, 无论个体基线是否稳定, 并使用交叉验证来使模型过度拟合减小到最低。调整模型参数以检测稳定状态或出血状态。比较每个样本的基线和该组平均值。通过比较低假阳性率 (FPR) 和最短出血时间, 评估出血检测的及时性。使用受试者工作特征的一种变体来评估预测性能, 该变体分别针对真阳性率和真阴性率, 侧重于最小化FPR和假阴性率 (FNR)。

结果: 与使用通用基线数据相比, 将模型引用到个体化基线可以提高所有监测导管的出血检测性能。从SM到B2B和WF的粒度增加逐渐提高了出血检测能力。在出血检测时间、低FPR和FNR方面, 有创监测均优于NIM。在这方面, 当参考SM分析的个体化基线时, PAC和ART+PAC表现最好; 对于B2B CVC, PAC和ART+PAC表现最好; 而对于WF PAC, CVC、ART+CVC和ART+PAC表现同样好于其他监测方法。在没有个体化基线的情况下, NIM在各层面表现都很差, 而所有监测导管在SM方面的表现都相似, B2B-PAC和ART+PAC表现最好, 而在WF-PAC方面, ART、ART+CVC和ART+PAC表现同样好于其他监测方法。

结论: 通过增加采样频率和参考个体化基线, 提高血流动力学监测的特异性, 可显著提高有创监测的出血检测能力。

(周循 译 陈杰 校)

Background: Individualized hemodynamic monitoring approaches are not well validated. Thus, we evaluated the discriminative performance improvement that might occur when moving from noninvasive monitoring (NIM) to invasive monitoring and with increasing levels of featurization associated with increasing sampling frequency and referencing to a stable baseline to identify bleeding during surgery in a porcine model.

Methods: We collected physiologic waveform (WF) data (250 Hz) from NIM, central venous (CVC), arterial (ART), and pulmonary arterial (PAC) catheters, plus mixed venous O₂ saturation and cardiac output from 38 anesthetized Yorkshire pigs bled at 20 mL/min until a mean arterial pressure of 30 mm Hg following a 30-minute baseline period. Prebleed physiologic data defined a personal stable baseline for each subject independently. Nested models were evaluated using simple hemodynamic metrics (SM) averaged over 20-second windows and sampled every minute, beat to beat (B2B), and WF using Random Forest Classification models to identify bleeding with or without normalization to personal stable baseline, using a leave-one-pig-out cross-validation to minimize model overfitting. Model hyperparameters were tuned to detect stable or bleeding states. Bleeding models were compared use both each subject's personal baseline and a grouped-average (universal) baseline. Timeliness of bleed onset detection was evaluated by comparing the tradeoff between a low false-positive rate (FPR) and shortest time to bleed detection. Predictive performance was evaluated using a variant of the receiver operating characteristic

focusing on minimizing FPR and false-negative rates (FNR) for true-positive and true-negative rates, respectively.

Results: In general, referencing models to a personal baseline resulted in better bleed detection performance for all catheters than using universal baselined data. Increasing granularity from SM to B2B and WF progressively improved bleeding detection. All invasive monitoring outperformed NIM for both time to bleeding detection and low FPR and FNR. In that regard, when referenced to personal baseline with SM analysis, PAC and ART + PAC performed best; for B2B CVC, PAC and ART + PAC performed best; and for WF PAC, CVC, ART + CVC, and ART + PAC performed equally well and better than other monitoring approaches. Without personal baseline, NIM performed poorly at all levels, while all catheters performed similarly for SM, with B2B PAC and ART + PAC performing the best, and for WF PAC, ART, ART + CVC, and ART + PAC performed equally well and better than the other monitoring approaches.

Conclusions: Increasing hemodynamic monitoring featurization by increasing sampling frequency and referencing to personal baseline markedly improves the ability of invasive monitoring to detect bleed.

使用围术期数据早期检测非心脏手术患者射血分数降低的心衰：一种机器学习方法

Early Detection of Heart Failure With Reduced Ejection Fraction Using Perioperative Data Among Noncardiac Surgical Patients: A Machine-Learning Approach

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背景: 射血分数降低的心力衰竭 (HFrEF) 造成严重的医疗负担。鉴于其症状性质和常常隐匿起病, 只有在临床表现提示进一步评估后才能作出诊断。早期检测 HFrEF 可以进行早期干预以改变疾病进展。围术期收集的精细数据可能是提高 HFrEF 诊断率的一种未充分利用的方法。作者假设术后最终诊断为 HFrEF 的患者可以通过术前和术中数据的机器学习方法进行识别。

方法: 回顾了 2010 年至 2016 年间在学院第四监护中心接受全麻下大型外科手术成人患者的围术期数据。排除已知 HFrEF、射血分数保留的心衰、术前危重症或接受心脏、心脏病或电生理检查的患者。患者分为健康对照组和未诊断 HFrEF 组。未诊断 HFrEF 定义为术前缺乏 HFrEF 诊断, 但术后 730 天内确诊。未诊断 HFrEF 的诊断由临床专家回顾判定, 排除继发于围术期突发事件的 HFrEF 或与 HFrEF 自然疾病进展无关的任何事件的病例。利用 628 例术前和 1195 例术中的围术期数据, 建立了包括 L1 正则 logistic 回归、随机森林模型和极端梯度增强的机器学习模型来检测未诊断的 HFrEF。训练/验证和测试数据集用于参数调整。使用受试者工作特征曲线 (AUROC) 下面积、阳性预测值和其他标准度量来评估测试集模型性能。

结果: 分析 67697 例病例, 279 例 (0.41%) 患者有未诊断 HFrEF。logistic 回归模型、随机森林模型、极端梯度增强模型的 AUROC 分别为 0.869 (95%置信区间, 0.829-0.911), 0.872 (0.836-0.909) 以及 0.873 (0.833-0.913)。相应的阳性预测值分别为 1.69% (1.06%-2.32%), 1.42% (0.85%-1.98%), 和 1.78% (1.15%-2.40%)。

结论: 利用围术期数据的机器学习模型可以很好地检测出未诊断 HFrEF。然而, 该病的低患病率导致低阳性预测值, 并且为了使临床意义上的敏感性阈值具有可操作性, 在模型检测后需高特异性试验 (如超声心动图或心脏生物标记物) 进行验证。未来的研究需要在其他中心外部验证算法性能, 并探索将算法嵌入围术期电子健康记录中以供临床医生实时使用的可行性。

(周循 译 陈杰 校)

Background: Heart failure with reduced ejection fraction (HFrEF) is a condition imposing significant health care burden. Given its syndromic nature and often insidious onset, the diagnosis may not be made until clinical manifestations prompt further evaluation. Detecting HFrEF in precursor stages could allow for early initiation of treatments to modify disease progression. Granular data collected during the perioperative period may represent an underutilized method for improving the diagnosis of HFrEF. We hypothesized that patients ultimately diagnosed with HFrEF following surgery can be identified via machine-learning approaches using pre- and intraoperative data.

Methods: Perioperative data were reviewed from adult patients undergoing general anesthesia for major surgical procedures at an academic quaternary care center between 2010 and 2016. Patients with known HFrEF, heart failure with preserved ejection fraction, preoperative critical illness, or undergoing cardiac, cardiology, or electrophysiologic procedures were excluded. Patients were classified as healthy controls or undiagnosed HFrEF. Undiagnosed HFrEF was defined as lacking a HFrEF diagnosis preoperatively but establishing a diagnosis within 730 days postoperatively. Undiagnosed HFrEF patients were adjudicated by expert clinician review, excluding cases for which HFrEF was secondary to a perioperative triggering event, or any event not associated with HFrEF natural disease progression. Machine-learning models, including L1 regularized logistic regression, random forest, and extreme gradient boosting were developed to detect undiagnosed HFrEF, using perioperative data including 628 preoperative and 1195 intraoperative features. Training/validation and test datasets were used with parameter tuning. Test set model performance was evaluated using area under the receiver operating characteristic curve (AUROC), positive predictive value, and other standard metrics.

Results: Among 67,697 cases analyzed, 279 (0.41%) patients had undiagnosed HFrEF. The AUROC for the logistic regression model was 0.869 (95% confidence interval, 0.829–0.911), 0.872 (0.836–0.909) for the random forest model, and 0.873 (0.833–0.913) for the extreme gradient boosting model. The corresponding positive predictive values were 1.69% (1.06%–2.32%), 1.42% (0.85%–1.98%), and 1.78% (1.15%–2.40%), respectively.

Conclusions: Machine-learning models leveraging perioperative data can detect undiagnosed HFrEF with good performance. However, the low prevalence of the disease results in a low positive predictive value, and for clinically meaningful sensitivity thresholds to be actionable, confirmatory testing with high specificity (eg, echocardiography or cardiac biomarkers) would be required following model detection. Future studies are necessary to externally validate algorithm

performance at additional centers and explore the feasibility of embedding algorithms into the perioperative electronic health record for clinician use in real time.

自动脉氧饱和度波形分析追踪麻醉诱导期间血压变化：一项概念验证研究

Automated Pulse Oximeter Waveform Analysis to Track Changes in Blood Pressure During Anesthesia Induction: A Proof-of-Concept Study

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背景：术中低血压与术后并发症和死亡有关。示波肱动脉袖带用于测量大多数外科病人的动脉压（AP），但可能会错过AP的急性变化。作者假设**脉氧饱和度**波形分析有助于监测麻醉诱导期间收缩压（SAP）和平均动脉压（MAP）的变化。

方法：在40名需要全身麻醉和有创性AP监测的择期手术患者中评估**脉氧饱和度**波形分析算法（光学血压监测[oBPM]）的性能，以评估SAP、MAP及其在全身麻醉诱导期间的变化。采用四象限图和极坐标图比较有创监测（对照）和oBPM评估的SAP和MAP的急性AP变化（>20%）。算法的追踪能力是根据在不断增加的时间跨度（从30秒到5分钟）内发生的变化来评估的。研究次要目的是评估oBPM算法是否符合医疗器械进步协会（AAMI）制定标准。在算法校准后的不同时刻，从30秒到5分钟，评估oBPM估计绝对SAP和MAP值的准确性和精确度。

结果：由oBPM评估的SAP和MAP的快速变化（发生在≤60秒的时间跨度内）与有创监测AP的变化有很好的相关性（最坏情况下Pearson相关为0.94[0.88, 0.97][95%可信区间]，且一致率为100%[100%, 100%]，角一致率为±30°的100%[100%, 100%]）。趋势预测能力随着变化发生时间跨度的延长而逐渐下降，最坏情况下Pearson相关为0.89（0.85, 0.91），一致率为97%（95%, 100%）角度一致率为90%（85%, 94%）。关于准确度和精密度，oBPM衍生SAP值在校准后2分钟内符合AAMI标准，而oBPM衍生MAP值在任何时候都符合标准。

结论：脉氧饱和度波形分析有助于追踪麻醉诱导期间SAP和MAP的快速变化。在初始校准后至少5分钟内，观察到该方法衍生MAP与对照的有创监测的良好一致性。将来该方法可用于追踪间歇示波测量之间AP的变化，并在检测到AP的显著变化时自动触发臂袖充气。

（周循 译 陈杰 校）

Background: Intraoperative hypotension is associated with postoperative complications and death. Oscillometric brachial cuffs are used to measure arterial pressure (AP) in most surgical patients but may miss acute changes in AP. We hypothesized that pulse oximeter waveform analysis may help to detect changes in systolic AP (SAP) and mean AP (MAP) during anesthesia induction.

Methods: In 40 patients scheduled for an elective surgery necessitating general anesthesia and invasive AP monitoring, we assessed the performance of a pulse oximeter waveform analysis algorithm (optical blood pressure monitoring [oBPM]) to estimate SAP, MAP, and their changes during the induction of general anesthesia. Acute AP changes (>20%) in SAP and MAP assessed by the reference invasive method and by oBPM were compared using 4-quadrant and polar plots. The tracking ability of the algorithm was evaluated on changes occurring over increasingly larger time spans, from 30 seconds up to 5 minutes. The second objective of the study was to

assess the ability of the oBPM algorithm to cope with the Association for the Advancement of Medical Instrumentation (AAMI) standards. The accuracy and precision of oBPM in estimating absolute SAP and MAP values compared to the invasive method was evaluated at various instants after algorithm calibration, from 30 seconds to 5 minutes.

Results: Rapid changes (occurring over time spans of ≤ 60 seconds) in SAP and MAP assessed by oBPM were strongly correlated and showed excellent concordance with changes in invasive AP (worst-case Pearson correlation of 0.94 [0.88, 0.97] [95% confidence interval], concordance rate of 100% [100%, 100%], and angular concordance rate at $\pm 30^\circ$ of 100% [100%, 100%]). The trending ability tended to decrease progressively as the time span over which the changes occurred increased, reaching 0.89 (0.85, 0.91) (Pearson correlation), 97% (95%, 100%) (concordance rate), and 90% (85%, 94%) (angular concordance rate) in the worst case. Regarding accuracy and precision, oBPM-derived SAP values were shown to comply with AAMI criteria up to 2 minutes after calibration, whereas oBPM-derived MAP values were shown to comply with criteria at all times.

Conclusions: Pulse oximeter waveform analysis was useful to track rapid changes in SAP and MAP during anesthesia induction. A good agreement with reference invasive measurements was observed for MAP up to at least 5 minutes after initial calibration. In the future, this method could be used to track changes in AP between intermittent oscillometric measurements and to automatically trigger brachial cuff inflation when a significant change in AP is detected.

锁骨上路臂丛阻滞与肌间沟路臂丛阻滞对肩关节手术后急性镇痛效果的比较：一项系统评价和荟萃分析

Is Supraclavicular Block as Good as Interscalene Block for Acute Pain Control Following Shoulder Surgery? A Systematic Review and Meta-analysis

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背景: 肌间沟路臂丛阻滞 (ISB) 是肩部手术后急性疼痛管理的首选技术, 但其呼吸相关的副作用促使人们寻求替代方法。锁骨上路臂丛阻滞 (SCB) 被建议作为 ISB 的替代方案, 但两者镇痛效果和呼吸保护作用比较的证据却并不一致。作者比较了 SCB 和 ISB 对肩部手术的镇痛作用和呼吸影响的差异。

方法: 纳入对象为肩部手术中对 ISB 和 SCB 进行比较的试验。SCB 作为可替代方案的前提为其在 (1) 术后 24 小时口服吗啡累积消耗当量 (主要结局, 非劣效性界值 $\Delta = -25$ mg) 和 (2) 术后疼痛 (次要结局, 非劣效性界值 $\Delta = 4.0$ cm · 小时⁻¹) 方面非劣于 ISB; 并在 (3) 阻滞后呼吸功能障碍 (主要结局) 方面优于 ISB。同样对阿片类药物相关副作用和阻滞相关并发症也进行评估。

结果: 分析了 15 项研究 (共 1065 例患者)。对于单次阻滞, SCB 分别在 24 小时吗啡消耗量、24 小时疼痛评分方面, 非劣于 ISB 【(SCB-ISB 的均值差, MD [95% 置信区间 {CI}] = -3.11

mg [-9.42 至 3.19], $\Delta = -25$ 毫克); (MD = 0.78 cm · hour⁻¹ [0.07-1.49], $\Delta = 4.0$ cm · hour⁻¹); 并在呼吸功能障碍发生率方面优于 ISB (优势比[OR] [95%CI] = 0.08[0.01-0.68])。类似地,对于连续阻滞,SCB 在 24 小时吗啡消耗量方面非劣于 ISB (MD = 0.46 mg [-6.08 至 5.15], $\Delta = -25$ mg), 在呼吸功能障碍发生率方面优于 ISB (OR = 0.22 [0.08 - 0.57])。SCB 在轻度阻滞相关不良事件发生率方面优于 ISB (单次阻滞和连续阻滞分别为 OR = 0.36 [0.20-0.68]和 OR = 0.25 [0.15-0.41])。因此,拒绝零假设,SCB 被认为是 ISB 的可接受替代方案。

结论: 对于肩部手术后的急性疼痛管理,高质量的证据表明,SCB 可以作为 ISB 的有效替代方案。SCB 在术后阿片类药物的消耗和急性疼痛管理方面非劣于 ISB,且在术后呼吸功能障碍发生率方面优于 ISB。

(陈陈 译 陈杰 校)

BACKGROUND: Interscalene block (ISB) is the acute pain management technique of choice for shoulder surgery, but its undesirable respiratory side effects have prompted seeking alternatives. Supraclavicular block (SCB) is proposed as an ISB alternative, but evidence of comparative analgesic and respiratory-sparing effects is inconsistent. We compared the analgesic and respiratory effects of SCB and ISB for shoulder surgery.

METHODS: Trials comparing ISB to SCB for shoulder surgery were sought. We decided a priori that SCB would be an acceptable alternative if it were noninferior for (1) postoperative 24-hour cumulative oral morphine equivalent consumption (primary outcome, noninferiority margin $\Delta = -25$ mg) and (2) postoperative pain (secondary outcome, noninferiority margin $\Delta = 4.0$ cm · hour⁻¹); and superior for (3) postblock respiratory dysfunction (primary outcome). Opioid-related side effects and block-related complications were also evaluated.

RESULTS: Fifteen studies (1065 patients) were analyzed. In single-injection blocks, SCB was noninferior to ISB for 24-hour morphine consumption (mean difference for SCB-*ISB*, MD [95% confidence interval {CI}] = -3.11 mg [-9.42 to 3.19], $\Delta = -25$ mg); it was also noninferior for 24-hour pain scores (MD = 0.78 cm · hour⁻¹ [0.07 - 1.49], $\Delta = 4.0$ cm · hour⁻¹); and decreased the odds of respiratory dysfunction (odds ratio [OR] [95% CI] = 0.08 [0.01 - 0.68]). Similarly, in continuous blocks, SCB was noninferior to ISB for 24-hour morphine consumption (MD = 0.46 mg [-6.08 to 5.15], $\Delta = -25$ mg), and decreased the odds of respiratory dysfunction (OR = 0.22 [0.08 - 0.57]). SCB also decreased odds of minor block-related complications (OR = 0.36 [0.20 - 0.68] and OR = 0.25 [0.15 - 0.41] for single-injection and continuous blocks, respectively). Consequently, the null joint-hypothesis was rejected, and SCB can be considered an acceptable alternative to ISB.

CONCLUSIONS: For acute pain control following shoulder surgery, high-quality evidence indicates that SCB can be used as an effective ISB alternative. SCB is noninferior for postoperative opioid consumption and acute pain, and it reduces the odds of postblock respiratory dysfunction.

产科病房中的认知辅助: 设计, 实施与使用

Cognitive Aids in Obstetric Units: Design, Implementation, and Use

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产科对于 2 位以上患者的高风险和动态临床监护具有独特考虑。产科危机情况需要整个多学科团队的有效而协调的响应。团队执行或忽略的操作会严重影响围产期和围生期结局。认知辅助是旨在提高患者安全性，医疗保健管理效率和患者预后的工具。但是它们应与临床判断和培训相结合，而非作为患者管理的绝对或详尽的监护标准。基于模拟证据显示，当结合本地定制和执行工作时，随着越来越多的文献支持在产科和非产科临床环境中的使用，尤其是存在读者角色，危机期间认知辅助工具可以增强团队管理能力。本文目的是总结当前对认知辅助设计、实施和在产科中使用的理解和可用资源，并强调现有的差距以促进该领域相关工作的加强。

(陈陈 译 陈杰 校)

Obstetrics has unique considerations for high stakes and dynamic clinical care of ≥ 2 patients. Obstetric crisis situations require efficient and coordinated responses from the entire multidisciplinary team. Actions that teams perform, or omit, can strongly impact peripartum and perinatal outcomes. Cognitive aids are tools that aim to improve patient safety, efficiency in health care management, and patient outcomes.

However, they are intended to be combined with clinician judgment and training, not as absolute or exhaustive standards of care for patient management. There is simulation-based evidence showing efficacy of cognitive aids for enhancing appropriate team management during crises, especially with a reader role, with growing literature supporting use in obstetric and nonobstetric clinical settings when combined with local customization and implementation efforts. The purpose of this article is to summarize current understanding and available resources for cognitive aid design, implementation, and use in obstetrics and to highlight existing gaps that can stimulate further enhancement in this field.

非体外循环冠状动脉搭桥术后体温与全因死亡率之间的关系：一项回顾性观察性研究

Association Between Postoperative Body Temperature and All-Cause Mortality After Off-Pump Coronary Artery Bypass Graft Surgery: A Retrospective Observational Study

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背景：非体外循环冠状动脉搭桥术(OPCAB)中常会发生意外的围术期低体温。作者调查 OPCAB 患者术后早期体温与全因死亡率之间的关系。

方法：作者回顾了 1714 例接受 OPCAB 患者的电子病历 (中位随访时间为 47 个月)。根据术后进入重症监护室时的体温将患者分为 4 组 (中度至重度低体温, $<35.5^{\circ}\text{C}$; 轻度低体温, $35.5^{\circ}\text{C} - 36.5^{\circ}\text{C}$; 正常体温, $36.5^{\circ}\text{C} - 37.5^{\circ}\text{C}$; 体温过高, $\geq 37.5^{\circ}\text{C}$)。使用 Cox 比例风险模型评估体温与全因死亡率之间的关系。还根据术后进入重症监护病房时测量体温和术后前 3 天的平均体温将患者分为 4 类, 评估术后早期体温变化与全因死亡率之间的关系。

结果: 与正常体温组相比, 中度至重度低体温组、轻度低体温组的全因死亡率校正危险比分别为 2.030 (95%置信区间为 1.407-2.930), 1.445 (95%置信区间为 1.113-1.874)。在术后进入重症监护室时低体温人群中, 与未恢复正常体温患者相比, 之后恢复正常体温患者的全因死亡率更低 (校正危险比, 0.631; 95%置信区间, 0.453 - 0.878), 但其全因死亡率仍然比那些始终体温正常的人更高 (校正危险比 1.435; 95%置信区间 1.090-1.890)。

结论: 即使轻度术后低体温也与 OPCAB 术后的全因死亡率相关。与未恢复正常体温的患者相比, 术后恢复正常体温的患者全因死亡率更低。

(陈陈 译 陈杰 校)

BACKGROUND: Inadvertent perioperative hypothermia is common in patients undergoing off-pump coronary artery bypass grafting (OPCAB). We investigated the association between early postoperative body temperature and all-cause mortality in patients undergoing OPCAB.

METHODS: We reviewed the electronic medical records of 1714 patients who underwent OPCAB (median duration of follow-up, 47 months). Patients were divided into 4 groups based on body temperature at the time of intensive care unit admission after surgery (moderate-to-severe hypothermia, $<35.5^{\circ}\text{C}$; mild hypothermia, $35.5^{\circ}\text{C} - 36.5^{\circ}\text{C}$; normothermia, $36.5^{\circ}\text{C} - 37.5^{\circ}\text{C}$; and hyperthermia, $\geq 37.5^{\circ}\text{C}$). Cox proportional hazards models were used to assess the association between body temperature and all-cause mortality. The association between early postoperative changes in body temperature and all-cause mortality was also assessed by dividing the patients into 4 categories according to the body temperature measured at postoperative intensive care unit admission and the average body temperature during the first 3 postoperative days.

RESULTS: Compared to the normothermia group, the adjusted hazard ratios of all-cause mortality were 2.030 (95% confidence interval, 1.407 - 2.930) in the moderate-to-severe hypothermia group and 1.445 (95% confidence interval, 1.113 - 1.874) in the mild hypothermia group. Patients who were hypothermic at postoperative intensive care unit admission but attained normothermia thereafter were at a lower risk of all-cause mortality compared to patients who did not regain normothermia (adjusted hazard ratio, 0.631; 95% confidence interval, 0.453 - 0.878), while they were still at a higher risk of all-cause mortality than those who were consistently normothermic (adjusted hazard ratio, 1.435; 95% confidence interval, 1.090 - 1.890).

CONCLUSIONS: Even mild early postoperative hypothermia was associated with all-cause mortality after OPCAB. Patients who regained normothermia postoperatively were at lower risk of all-cause mortality compared to those who did not.

8. BOSTN 束相关干预对可疑阻塞性睡眠呼吸暂停患者的术前筛查和管理: 一项医院注册研究

BOSTN Bundle Intervention for Perioperative Screening and Management of Patients With Suspected Obstructive Sleep Apnea: A Hospital Registry Study

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背景: 研究者制定并实施了一项围术期阻塞性睡眠呼吸暂停 (OSA) 指南, 其中包括一项术前筛查工具 (BOSTN) 和临床管理路径。疑似 OSA 具有以下两种或两种以上症状: 体重指数 $\geq 30 \text{ kg / m}^2$, 观察到呼吸暂停, 大声打鼾, 白天疲倦, 女性颈围 ≥ 16.5 英寸, 男性 ≥ 17.5 英寸。这项研究主要目的是评估 BOSTN 高分与术后有创机械通气需求之间的关系。

方法: 在这项医院注册的研究中, 分析了 2008 年 5 月至 2017 年 9 月在马萨诸塞州波士顿的贝斯以色列女执事医疗中心 (BIDMC) 进行的 169,662 例非心脏手术病例。通过使用对患者相关因素和病例相关手术和麻醉学混杂因素校正后的多变量逻辑回归, 评估高 BOSTN 评分 (得分 ≥ 2) 与 7 天内有创机械通气需求的主要结局之间的相关性。BOSTN 评分 ≥ 2 的患者被认为患有 OSA 的可能性很高。关键的次要结局是术后低氧, 定义为拔管后 10 分钟内外周血氧饱和度测量值 $< 90\%$ 。

结果: 3170 例 (2.3%) 低危病例 (BOSTN 评分 < 2) 和 664 例 (2.1%) 高危病例 (BOSTN 评分 ≥ 2) 需要在术后 7 天内进行有创机械通气。得分 ≥ 2 与更低的术后有创通气概率相关 (校正后比值比 [aOR] 为 0.89; 95% 置信区间 [CI] 为 0.80-0.98; $P = .017$), 拔管后低氧的风险更高 (aOR, 1.34; 99.3% CI, 1.21-1.48; $P < .001$)。得分 ≥ 2 的患者术后平均住院时间为 3.71 天, 而得分 < 2 的患者平均住院时间为 4.27 天 (校正后发生率 [aIRR], 0.87; 99.3% CI, 0.84-0.91; $P < .001$)。

结论: 具有高 OSA 风险的患者更少需要术后机械通气, 但术后低氧概率更高, 但住院时间更短。

(陈陈 译 陈杰 校)

BACKGROUND: We developed and implemented a perioperative guideline for obstructive sleep apnea (OSA), comprising a preoperative screening tool (BOSTN) and clinical management pathways. OSA was suspected with 2 or more of the following: body mass index $\geq 30 \text{ kg/m}^2$, observed apnea, loud snoring, daytime tiredness, and neck circumference ≥ 16.5 inches in women or ≥ 17.5 inches in men. The primary objective of this study was to assess the association between high BOSTN scores and the requirement of invasive mechanical ventilation after surgery.

METHODS: In this hospital registry study, 169,662 noncardiac surgical cases performed at Beth Israel Deaconess Medical Center (BIDMC), Boston, MA, between May 2008 and September 2017 were analyzed. We assessed the association between a high BOSTN Score (score ≥ 2) and the primary outcome of requirement of invasive mechanical ventilation within 7 days after surgery using multivariable logistic regression adjusted for patient-specific factors and case-specific surgical and anesthesiological confounders. Patients with a BOSTN Score ≥ 2 were assumed to have a high likelihood of suffering from OSA. Key secondary outcome was postoperative desaturation, defined as a peripheral oxygen saturation measurement $< 90\%$ within 10 minutes of extubation.

RESULTS: Invasive mechanical ventilation within 7 days of surgery was necessary in 3170 (2.3%) low-risk cases (BOSTN Score < 2) and 664 (2.1%) high-risk cases (BOSTN Score ≥ 2). A score ≥ 2 was associated with significantly lower odds of requiring postoperative invasive ventilation (adjusted odds ratio [aOR], 0.89; 95% confidence interval [CI], 0.80 - 0.98; $P = .017$), but with an increased risk of postextubation desaturation (aOR, 1.34; 99.3% CI, 1.21 - 1.48; $P < .001$). Patients with a score ≥ 2 were hospitalized for an average of 3.71 days after surgery, compared to 4.27 days

with a score <2 (adjusted incidence rate ratio [aIRR], 0.87; 99.3% CI, 0.84 - 0.91; P < .001).

CONCLUSIONS: Patients at high risk of OSA required postoperative mechanical ventilation less frequently, had higher odds of postoperative desaturation, and were hospitalized for shorter periods of time.