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Anesthesia & Analgesia. 117(6):1493-1502, December 2013.

[在離體及麻醉豬在體實驗中藥物輸注系統匯合管死腔對輸注藥物劑量改變時輸注回應時間的影響](#)

Drug Infusion System Manifold Dead-Volume Impacts the Delivery Response Time to Changes in Infused Medication Doses In Vitro and Also In Vivo in Anesthetized Swine

Lovich, Mark A. MD, PhD*; Wakim, Matthew G. BS*; Wei, Abraham BS*; Parker, Michael J. MD†; Maslov, Mikhail Y. MD, PhD*; Pezone, Matthew J. BA*; Tsukada, Hisashi MD‡; Peterfreund, Robert A. MD, PhD§

Anesthesia & Analgesia: 2013 117 1313–1318

背景：靜脈輸注系統可被認作是將多種藥物輸液線與經皮導管相連接的匯合管。既往離體研究表明，藥物輸送存在顯著延時，無法反映泵設置輸注率的即刻改變，特別是藥物和載體液流量較低，以及輸液系統死腔流量較高時。藥用匯合管允許多個輸注連接到一個單一導管埠，但增加了死腔量。本研究推測，在體藥物輸注的生理反應時間過程反映了死腔量對藥物輸送的影響。

方法：分別比較離體和在體實驗中高低死腔量對開始及停止腎上腺素輸注（以 3ml/h 速度溶入 10ml/h 載體液進行恆速輸注）的動力學反應，對比體內和體外實驗中大死腔量和低死腔量的 T 管的影響。藥物從最上游埠進入的四個相鄰旋塞組成的匯合管與一種在導管下游接頭處並聯若干共軸通道的新型管道進行比較，後者的結構基本上消除了由匯合管本身造成的死腔。計算初始和停止藥物輸注時離體實驗中增加或減少 50% 和 90% 藥物輸送的時間（T50 和 T90），以及豬模型活體實驗中的藥物收縮效應。

結果：在離體或在體實驗中，共軸低死腔量匯合管組開始和停止藥物輸注達到穩態的時間比高死腔量設計組更短。低死腔量匯合管和高死腔量匯合管組在離體實驗中藥物輸送達到 50% 和 90% 穩態時間分別為 $1.4 \pm 0.12\text{min}$ 和 $2.2 \pm 0.42\text{min}$ ，以及 $7.1 \pm 0.58\text{min}$ 和 $9.8 \pm 1.6\text{min}$ 。在體實驗中，兩組收縮效應在藥物使用後達到完全反應 50% 和 90% 的時間分別為 $4.3 \pm 1.3\text{min}$ 和 $9.9 \pm 3.9\text{min}$ ，以及 $11 \pm 1.2\text{min}$ 和 $17 \pm 2.6\text{min}$ 。在離體實驗中，兩組在停止輸注後藥物輸送下降 50% 和 90% 的時間分別為 $1.9 \pm 0.17\text{min}$ 和 $3.5 \pm 0.61\text{min}$ ，以及 $10.0 \pm 1.0\text{min}$ 和 $17.0 \pm 2.8\text{min}$ 。在體實驗中，兩組在停止輸注後收縮效應下降 50% 和 90% 的時間分別為 $4.1 \pm 1.1\text{min}$ 和 $14 \pm 5.2\text{min}$ ，以及 $12 \pm 2.7\text{min}$ 和 $23 \pm 5.6\text{min}$ 。

結論：匯合管的結構影響泵設置的藥物輸注速率改變後的在體生物學反應和藥物輸送速率。

（談婧華 譯 陳傑 校）

BACKGROUND: IV infusion systems can be configured with manifolds connecting multiple drug infusion lines to transcutaneous catheters. Prior in vitro studies suggest that there may be significant lag times for drug delivery to reflect changes in infusion rates set at the pump, especially with low drug and carrier flows and larger infusion system dead-volumes. Drug manifolds allow multiple infusions to connect to a single catheter port but add dead-volume. We hypothesized that the time course of physiological responses to drug infusion in vivo reflects the impact of dead-volume on drug delivery.

METHODS: The kinetic response to starting and stopping epinephrine infusion ([3 mL/h] with constant carrier flow [10 mL/h]) was compared for high- and low-dead-volume manifolds in vitro and in vivo. A manifold consisting of 4 sequential stopcocks with drug entering at the most upstream port was contrasted with a novel design comprising a tube with separate coaxial channels meeting at the downstream connector to the catheter, which virtually eliminates the manifold contribution to the dead-volume. The time to 50% (T50) and 90% (T90) increase or decrease in drug delivery in vitro or contractile response in a swine model in vivo were calculated for initiation and cessation of drug infusion.

RESULTS: The time to steady state after initiation and cessation of drug infusion both in vitro and in vivo was much less with the coaxial low-dead-volume manifold than with the high-volume design. Drug delivery after initiation in vitro reached 50% and 90% of steady state in 1.4 ± 0.12 and 2.2 ± 0.42 minutes with the low-dead-volume manifold and in 7.1 ± 0.58 and 9.8 ± 1.6 minutes with the high-dead-volume manifold, respectively. The contractility in vivo reached 50% and 90% of the full response after drug initiation in 4.3 ± 1.3 and 9.9 ± 3.9 minutes with the low-dead-volume manifold and 11 ± 1.2 and 17 ± 2.6 minutes with the high-dead-volume manifold, respectively. Drug delivery in vitro decreased by 50% and 90% after drug cessation in 1.9 ± 0.17 and 3.5 ± 0.61 minutes with the low-dead-volume manifold and 10.0 ± 1.0 and 17.0 ± 2.8 minutes with the high-dead-volume manifold, respectively. The contractility in vivo decreased by 50% and 90% with drug cessation in 4.1 ± 1.1 and 14 ± 5.2 with the low-dead-volume manifold and 12 ± 2.7 and 23 ± 5.6 minutes with the high-dead-volume manifold, respectively.

CONCLUSIONS: The architecture of the manifold impacts the in vivo biologic response, and the drug delivery rate, to changes in drug infusion rate set at the pump.

使用依託咪酯而非異丙酚進行麻醉誘導可增加非心臟手術後 30 天內死亡及心血管發病率

Anesthetic Induction with Etomidate, Rather than Propofol, Is Associated with Increased 30-Day Mortality and Cardiovascular Morbidity After Noncardiac Surgery

Komatsu, Ryu MD*; You, Jing MS†‡; Mascha, Edward J. PhD†‡; Sessler, Daniel I. MD‡; Kasuya, Yusuke MD§; Turan, Alparslan MD‡

Anesthesia & Analgesia: 2013 117 1329–1337

背景：由於依託咪酯損害腎上腺功能並且弱化手術刺激相關的皮質醇釋放，本研究假設接受依託咪酯誘導的患者比接受異丙酚誘導的患者有更高的死亡率和發病率。

方法：本研究評估了克利夫蘭醫學中心電子病歷中 31148 名 ASAIII~IV 級接受非心臟手術的患者。在這些患者中，2616 名接受了依託咪酯誘導，揮發性麻醉劑維持的麻醉方式，而 28532 名接受了異丙酚誘導，揮發性麻醉藥維持。將 2144 名接受依託咪酯誘導的患者與 5233 名接受異丙酚誘導的患者進行傾向性配對，比較兩組術後 30 天死亡率、住院天數、心血管和感染疾病發病率、升壓藥需求量和術中血流動力學參數。

結果：接受依託咪酯誘導的患者比接受異丙酚誘導的患者死亡概率高 2.5 倍（98% 可信區間，1.9-3.4）。前者心血管疾病發病率也顯著高於後者（比值比的 98% 可信區間為：1.5[1.2-2.0]），並且住院天數明顯延長（風險比的 95% 可信區間為：0.82[0.78-0.87]）。然而，兩者之間的感染疾病發病率（比值比的 98% 可信區間為：1.0[0.8-1.2]）和術中升壓藥的使用情況（比值比的 95% 可信區間為：0.92[0.82-1.0]）並沒有差異。

結論：依託咪酯大幅增加術後 30 天死亡率、心血管疾病發病率和住院時間延長發生的風險。本研究結論中，特別是術後 30 天死亡率可經受一種明顯不可預測的二元混淆參數的考量。雖然本研究只是揭示了依託咪酯的使用與患者不良預後之間的聯繫而非因果關係，但是鑒於誘導期穩定的血流動力學可能伴隨著極其不利的長期預後，臨床醫生應該明智地使用依託咪酯。

（邊文玉 譯 陳傑 校）

BACKGROUND: Because etomidate impairs adrenal function and blunts the cortisol release associated with surgical stimulus, we hypothesized that patients induced with etomidate suffer greater mortality and morbidity than comparable patients induced with propofol.

METHODS: We evaluated the electronic records of 31,148 ASA physical status III and IV patients who had noncardiac surgery at the Cleveland Clinic. Among these, anesthesia was induced with etomidate and maintained with volatile anesthetics in 2616 patients whereas 28,532 were given propofol for induction and maintained with volatile anesthetics. Two thousand one hundred forty-four patients given etomidate were propensity matched with 5233 patients given propofol and the groups compared on 30-day postoperative mortality, length of hospital stay, cardiovascular and infectious morbidities, vasopressor requirement, and intraoperative hemodynamics.

RESULTS: Patients given etomidate had 2.5 (98% confidence interval [CI], 1.9–3.4) times the odds of dying than those given propofol. Etomidate patients also had significantly greater odds of having cardiovascular morbidity (odds ratio [OR] [98% CI]: 1.5 [1.2–2.0]), and significantly longer hospital stay (hazard ratio [95% CI]: 0.82 [0.78–0.87]). However, infectious morbidity (OR [98% CI]: 1.0 [0.8–1.2]) and intraoperative vasopressor use (OR [95% CI] 0.92: [0.82–1.0]) did not differ between the agents.

CONCLUSION: Etomidate was associated with a substantially increased risk for 30-day mortality, cardiovascular morbidity, and prolonged hospital stay. Our conclusions, especially on 30-day mortality, are robust to a strong unmeasured binary confounding variable. Although our

study showed only an association between etomidate use and worse patients' outcomes but not causal relationship, clinicians should use etomidate judiciously, considering that improved hemodynamic stability at induction may be accompanied by substantially worse longer-term outcomes.

聲門下狹窄患者的氣道管理：一個學術機構的經驗之談

Airway Management in Patients with Subglottic Stenosis: Experience at an Academic Institution

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本文描述一個關於調查氣道技術的初步研究，這些技術被應用於聲門下狹窄患者的麻醉管理中。收集密西根大學健康系統中經歷手術的聲門下狹窄患者的電子臨床資訊資料。通過 159 例患者資訊分析人口統計學、氣道技術、低氧血症的發生率以及操作失敗等。結果顯示使用 4 種最普通技術和使用不常見的技術間具有較低的低氧血症發生率；個人操作技術間的結果沒有差異。此研究表明需要一個更大的前瞻性多中心研究進一步探討聲門下狹窄的患者上述調查結果。

（朱浩 譯 陳傑 校）

We describe a pilot study investigating the airway techniques used in the anesthetic management of subglottic stenosis. We searched the electronic clinical information database of the University of Michigan Health System for cases of subglottic stenosis in patients undergoing surgery. Demographics, airway techniques, incidence of hypoxemia, and technique failure were extracted from 159 records. A lower incidence of hypoxemia was found between the 4 most commonly used techniques and the less common techniques. We detected no difference in outcome between individual techniques. This study suggests a larger prospective multicenter study is required to further investigate these outcomes in patients with subglottic stenosis.

麻醉誘導時使用視頻眼鏡作為術前焦慮兒童管理的一項娛樂工具

Anesthesia Induction Using Video Glasses as a Distraction Tool for the Management of Preoperative Anxiety in Children

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背景：適合圍術期的娛樂技術唾手可得，但是目前缺乏與術前口服咪達唑侖緩解焦慮進行比較的臨床證據。視頻眼鏡可以讓兒童接受電影和動畫片的視聽信息，在其說明下可完成患兒的麻醉吸入誘導。本研究比較口服咪達唑侖和使用視頻眼鏡分散患兒注意力在術前兒童焦慮管理方面的有效性。

方法：在此項前瞻、隨機的研究生中，96 名年齡在 4-9 歲之間的門診手術患兒入選，分為三組，分別接受口服咪達唑侖，使用視頻眼鏡及複合應用。使用改良 YALE 術前焦慮量表作為評估術前基線時、20 分鐘後送至手術室時和面罩誘導時焦慮狀態的主要判斷方法。

結果：在基線和手術室轉運期間，三組的焦慮評分均無顯著增加（P 值分別為 0.21、0.42、0.57），觀察到在基線至麻醉誘導期間，咪達唑侖組（P = 0.02）和複合組（P = 0.03）而非視頻眼鏡組（P = 0.38）的焦慮值有所增加，但無臨床意義。三組間改良 YALE 術前焦慮量表變化的兩兩比較的可信區間都無臨床顯著差異（以 15 個單位為臨界值）。

結論：單獨應用視頻眼鏡、口服咪達唑侖或聯合使用都能在患兒進入手術室時保持其基線水準的鎮靜狀態。並可預防患兒在麻醉誘導期間焦慮的增加。視頻眼鏡是一種安全、無創、非藥物性和令人愉快的緩解術前焦慮的手段，其效果不亞于咪達唑侖。

（李峰日 譯 陳傑 校）

BACKGROUND: Distraction technology suitable for the perioperative setting is readily available, but there is little evidence to show how it compares with oral midazolam in managing anxiety. Video glasses, which enable children to view and listen to cartoons and movies, may be used through the completion of inhaled induction. We compared the efficacy of oral midazolam and behavioral distraction with video glasses in managing preoperative anxiety in children.

METHODS: In this prospective, randomized study, 96 children aged 4 to 9 years undergoing outpatient surgery were recruited to one of 3 intervention groups receiving midazolam, video glasses, or both. The Modified Yale Preoperative Anxiety Scale was the primary dependent measure used to assess anxiety at baseline before intervention, 20 minutes later at transport to the operating room (OR), and during mask induction.

RESULTS: There was no significant increase in anxiety score within any group between baseline and OR transport ($P = 0.21, 0.42,$ and 0.57 for midazolam, video glasses, and combined groups, respectively). An increase in anxiety, though not large enough to be clinically significant, was observed from baseline to induction in the midazolam and combined groups ($P = 0.02$ and 0.03) but not in the video glasses group ($P = 0.38$). Confidence intervals for pairwise comparisons in Modified Yale Preoperative Anxiety Scale changes among groups were all within a clinically significant difference of 15 units.

CONCLUSIONS: The use of video glasses and midazolam alone or in combination maintains baseline levels of anxiety at time of transport to the OR and prevents significantly increased anxiety during induction of anesthesia in children. Video glasses are not inferior to midazolam for preoperative anxiolysis and provide a safe, noninvasive, nonpharmacologic, and pleasant alternative.

兒童尿道下裂手術應用陰部神經阻滯和骶管阻滯麻醉的有效性對比研究

The Effectiveness of Pudendal Nerve Block Versus Caudal Block Anesthesia for Hypospadias in Children

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背景：骶管阻滯（CB）有諸多不利之處，其中之一即其單次注射後作用持續時間較短。陰部神經阻滯（PNB）由於其在包皮環切術上的麻醉成功應用，對於尿道下裂修復術亦可能成爲一種合適的替代方法。本研究通過測量術後 24h 鎮痛藥物使用量以比較 PNB 和 CB 的效果。

方法：本次前瞻性雙盲實驗研究中，病人隨機分爲 2 組：接受 CB 或神經刺激儀引導的 PNB。在 PNB 組，爲患兒注射 0.25% 布比卡因（0.3ml/kg）以及可樂定（1ug/kg）。在 CB 組，爲患兒注射 0.25% 布比卡因（1ml/kg）以及可樂定（1ug/kg）。記錄患兒在手術後 24h 內的鎮痛藥物用量。使用 Hannalah 和 Broadman 提出的“客觀疼痛分級”方法來評估患兒術後疼痛。

結果：80 名患兒參與了本項研究，兩組各 40 人。PNB 組的平均年齡爲 3.1（1.1）歲，CB 組平均年齡爲 3.2（1.1）歲。PNB 組和 CB 組的平均體重分別爲 15.3（2.8）kg 和 15.3

（2.2）kg。CB 組在術後首個 24h 內使用鎮痛藥物的比例（70%）顯著高於 PNB 組（20%， $P < 0.0001$ ）。CB 組中每名患兒的平均鎮痛藥物使用量更多（撲熱息痛 $P < 0.0001$ ，曲馬多 $P = 0.003$ ）。

結論：相較於 CB，使用 PNB 能顯著減少患兒在術後首個 24h 所使用的鎮痛藥物用量。

（賀加貝 譯 陳傑 校）

BACKGROUND: Caudal block (CB) has some disadvantages, one of which is its short duration of action after a single injection. For hypospadias repair, pudendal nerve block (PNB) might be a suitable alternative since it has been successfully used for analgesia for circumcision. We evaluated PNB compared with CB as measured by total analgesic consumption 24 hours postoperatively.

METHODS: In this prospective, double-blinded study, patients were randomized into 2 groups, either receiving CB or nerve stimulator-guided PNB. In the PNB group, patients were injected with 0.3 mL/kg 0.25% bupivacaine and 1 µg/kg clonidine. In the CB group, patients were injected with 1 mL/kg 0.25% bupivacaine and 1 µg/kg clonidine. Analgesic consumption was assessed during the first 24 hours postoperatively. The “objective pain scale” developed by Hannalah and Broadman¹⁷ was used to assess postoperative pain.

RESULTS: Eighty patients participated in the study, 40 in each group. The mean age in the PNB group was 3.1 (1.1) years and in the CB group was 3.2 (1.1) years. The mean weights in the PNB and CB groups were 15.3 (2.8) kg and 15.3 (2.2) kg, respectively. The percentage of patients who received analgesics during the first 24 hours were significantly higher in the CB (70%) compared with the PNB group (20%, $P < 0.0001$). The average amount of analgesics consumed per patient within 24 hours postoperatively was higher in the CB group (paracetamol $P < 0.0001$, Tramal $P = 0.003$).

CONCLUSION: Patients who received PNB had reduced analgesic consumption and pain within the first 24 hours postoperatively compared with CB.

新生大鼠在出生後暴露在七氟烷下會導致海馬長時程增強作用的明顯抑制

Neonatal Exposure to Sevoflurane Causes Significant Suppression of Hippocampal Long-Term Potentiation in Postgrowth Rats

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背景：吸入麻醉藥七氟醚在臨床上用於新生兒是非常普遍的。最近研究表明，新生齧齒動物暴露於七氟醚可引起急性廣泛神經退行性疾病和持久的神經認知功能障礙。雖然七氟醚對海馬細胞活性的急性毒性作用在一些研究中已有報導，但新生兒的七氟醚暴露對長期海馬突觸可塑性的作用知之甚少，後者被認為與學習和記憶形成過程相關。本研究首次檢驗暴露于有臨床意義相關濃度七氟醚中的新生大鼠其長期電生理影響。

方法：在出生後第 7 天，將大鼠暴露於與氧氣混合的七氟醚中（1%或 2%濃度 2 小時）。為了消除七氟烷誘導後呼吸抑制所造成的血氣異常的影響，一組大鼠暴露于高濃度的二氧化碳（8%濃度）2 小時來模擬暴露於 2%七氟醚所引起呼吸障礙。

結果：新生大鼠在出生後暴露在 2%七氟醚 2 小時能引起長時程增強（LTP）誘導作用的顯著抑制。對照組和二氧化碳暴露組在長時程增強（LTP）誘導作用方面無顯著差異，這表明七氟醚介導的長時程增強（LTP）作用的抑制不是由血氣異常引起的。

結論：本研究結果表明：新生大鼠接觸較高濃度七氟烷能改變海馬突觸可塑性，並且持續到成年。

（林甲票 譯 陳傑 校）

BACKGROUND: The inhaled anesthetic sevoflurane is commonly used for neonates in the clinical setting. Recent studies have indicated that exposure of neonatal rodents to sevoflurane

causes acute widespread neurodegeneration and long-lasting neurocognitive dysfunction. Although acute toxic effects of sevoflurane on cellular viability in the hippocampus have been reported in some studies, little is known about the effects of neonatal sevoflurane exposure on long-term hippocampal synaptic plasticity, which has been implicated in the processes of learning and memory formation. Our study is the first to examine the long-term electrophysiological impact of neonatal exposure to a clinically relevant concentration of sevoflurane.

METHODS: On postnatal day 7, rats were exposed to sevoflurane (1% or 2% for 2 hours) with oxygen. To eliminate the influence of blood gas abnormalities caused by sevoflurane-induced respiratory suppression, a group of rats were exposed to a high concentration of carbon dioxide (8% for 2 hours) to duplicate respiratory disturbances caused by 2% sevoflurane exposure.

RESULTS: Exposure of neonatal rats to 2% sevoflurane for 2 hours caused significant suppression of long-term potentiation (LTP) induction in the postgrowth period. There was no significant difference between the control group and the CO₂-exposed group in LTP induction, indicating that sevoflurane-induced LTP suppression was not caused by blood gas abnormalities.

CONCLUSION: Our present findings indicate that neonatal exposure to sevoflurane at a higher concentration can cause alterations in the hippocampal synaptic plasticity that persists into adulthood.

持續肌間溝神經阻滯在門診肩袖修復手術患者中的應用：一項前瞻隨機試驗

Continuous Interscalene Block in Patients Having Outpatient Rotator Cuff Repair Surgery: A Prospective Randomized Trial

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背景：本隨機研究對比了接受單次肌間溝注射（SISB）和持續肌間溝臂叢阻滯（CISB）或全身麻醉（GA）行肩關節鏡肩袖修復手術的患者持續至術後一周的恢復情況。主要預期結果是在研究結束時，接受 CISB 患者的最高疼痛數字分級（NRS），即最痛評分低於接受 SISB 或者全麻的患者。

方法：71 例患者接受了門診擇期肩關節鏡肩袖修復術。CISB 組患者通過導管行單次 0.5% 羅呱卡因 20ml 注射，SISB 組患者通過穿刺針也進行相同配方劑量的單次注射。CISB 組患者同時還在 48 小時內接受了 0.2% 羅呱卡因 5ml/h 的持續輸注和每小時患者自控的單次 5ml 藥物注射。全麻組患者僅進行標準全麻。分別在術後第 1,2,3,7 天在麻醉恢復室和家中記錄術後一周內最高疼痛數字評分、首次疼痛時間、鎮痛藥物用量、快速轉出麻醉恢復室率、麻醉恢復室停留時間、出院時間、總睡眠時間以及相關副反應。

結果：CISB 和 SISB 組患者的 NRS 評分均未 ≥ 1 ，在麻醉恢復室也未要求鎮痛。多數 CISB 和 SISB 患者都快速轉出 PACU，而全麻患者均未快速轉出恢復室 ($X^2P = 0.003$)。CISB 組和 SISB 組麻醉恢復室停留時間顯著短於全麻組（分別為 20 ± 31 , 30 ± 42 , 165 ± 118 min, (CISB vs GA, $P < 0.001$; SISB vs GA, $P < 0.001$)。出院時間 CISB、SISB 組也顯著快於全麻組。CISB 組首次疼痛出現時間較晚。術後第 1、2 天 CISB 組平均 NRS 分數和麻醉藥用量（劑量 ≥ 1 ）低於 SISB 組和全麻組直到術後第 3 天。術後 48 小時內 CISB 組睡眠時間顯著長於 SISB 組和全麻組 ($P < 0.01$)。研究結束時，CISB 組有 26% 的患者，SISB 組有 83% 的患者，全麻組有 58% 的患者 $NRS \geq 4$ (P 均 ≤ 0.05)

結論：CISB 帶來的鎮痛優勢體現在麻醉恢復室，且延續至出院後的恢復中期，終止於術後第 7 天。

（陸秉璋 譯 陳傑 校）

BACKGROUND: We performed this randomized trial to compare the recovery profile of patients receiving single injection (SISB) and continuous interscalene brachial plexus block (CISB) or general anesthesia (GA) for arthroscopic rotator cuff repair surgery through the first postoperative week. Our primary hypothesis was that the highest pain numeric rating scale (NRS) (worst pain score) at the end of the study week would be lower for patients in the CISB group than for patients in the SISB or GA groups.

METHODS: Seventy-one patients scheduled for elective outpatient arthroscopic rotator cuff repair were enrolled. CISB patients received 20 mL of 0.5% ropivacaine as a bolus through a catheter, whereas SISB patients received the same injection volume through a needle. CISB patients received an infusion of 0.2% ropivacaine at 5 mL/h with a patient-controlled bolus of 5 mL hourly for 48 hours. GA-only patients received a standardized general anesthetic. Postoperative highest NRS pain scores through the first postoperative week, time-to-first pain, analgesic consumption, fast-tracked postoperative anesthesia care unit (PACU) bypass rate, length of PACU stay, time-to-discharge home, total hours of sleep, and related adverse effects were recorded in the PACU and at home on postoperative days 1, 2, 3, and 7.

RESULTS: No patient in the CISB or SISB groups reported a NRS ≥ 1 or required analgesics while in the PACU. While most patients in the CISB and SISB groups were fast-tracked to PACU discharge, no patient in the GA group was fast-tracked (X²P = 0.003). Length of stay in the PACU was significantly shorter for the CISB and SISB groups than for the GA group (20 \pm 31, 30 \pm 42, and 165 \pm 118 minutes, respectively (CISB vs GA, P < 0.001; SISB vs GA, P < 0.001), and time-to-discharge home was significantly shorter when compared with the GA group. Time to first pain report was longer in the CISB group. Mean NRS scores were lower for patients in the CISB group than in the SISB and GA groups on postoperative days 1 and 2, and use of narcotics (doses ≥ 1) was lower until postoperative day 3. Patients who received CISB slept significantly longer than patients who received SISB or GA (P < 0.01) during the first 48 hours postoperatively. By the end of the study week, 26% of patients in the CISB group, 83% in the SISB group, and 58% of GA patients reported NRS ≥ 4 (both P-values).

CONCLUSION: The analgesic benefits of CISB found in the PACU and immediately after discharge extend through the intermediate recovery period ending on postoperative day 7.

在肝部分切除術中患者使用脈搏波傳送時間測得的心輸出量：對 esCCO 系統與熱稀釋法的比較

Pulse Wave Transit Time Measurements of Cardiac Output in Patients Undergoing Partial Hepatectomy: A Comparison of the esCCO System with Thermodilution

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背景：在麻醉狀態下精確地測量心輸出量有助於安全控制血流動力學。一些微創的測量心輸出量的方式逐步發展，以替代通過肺動脈導管置入術的熱稀釋法。在進行肝部分切除術的患者中，我們評估了一項新的通過脈搏波傳送時間測量心輸出量的方法針對通過熱稀釋法所測得的心輸出量變化趨勢的可靠性。

方法：對 31 例全麻下行肝部分切除術的患者（ASA 評級 II 或 III 級）進行了評估。在麻醉誘導後、體位元變為頭高位 20°後、體位變為頭低位 20°後、用 6% 羥乙基澱粉 10 mL•kg⁻¹ 擴容後、在肝門阻斷時以及肝門阻斷後開放後的瞬間，記錄通過脈搏波傳送時間法和通過熱稀釋法測得的心輸出量測量值。使用 Bland-Altman 分析和一致性分析對這一趨勢進行評估。

結果：在使用連續脈衝波傳送時間測量值和相應的熱稀釋測量值之間的變化方向顯示了96.0%的一致率（95%的置信區間下限=64%），一致限為-1.51 到 1.61 L•min⁻¹。

結論：雖然脈搏波傳送時間測量法有很好的的一致性，但是它在前負荷和外周血管阻力有變化的患者中的趨勢有相當寬的一致限。當升壓藥用於治療與外周血管阻力降低相關的低血壓時存在潛在的誤差。該研究的局限性是心輸出量資料是以非盲方式收集的，並且用了已經存在的動脈內導管，儘管這個系統只需要常規的無創心血管監測。這是一項有前途的技術，不過目前仍有其局限性，它將需要進一步的改進和臨床評估。

（趙曉 譯 馬皓琳 李世通 校）

BACKGROUND: Measuring cardiac output accurately during anesthesia is thought to be helpful for safely controlling hemodynamics. Several minimally invasive methods to measure cardiac output have been developed as alternatives to thermodilution with pulmonary artery catheterization. We evaluated the reliability of a novel pulse wave transit time method of cardiac output assessment to trend with thermodilution cardiac output in patients undergoing partial hepatectomy.

METHODS: Thirty-one patients (ASA physical status II or III) undergoing partial hepatectomy under general anesthesia were evaluated. Cardiac output measurements by pulse wave transit time method and by thermodilution were recorded after induction of anesthesia, after a change in body positioning to 20° head up, after a change to 20° head down, after volume challenge with 10 mL•kg⁻¹ hydroxyethyl starch 6%, during the Pringle maneuver, and immediately after Pringle maneuver release. Trending was assessed using Bland-Altman analysis and concordance analysis.

RESULTS: The direction of change between consecutive pulse wave transit time measurements and the corresponding thermodilution measurements showed a concordance rate of 96.0% (lower 95% confidence interval = 64%), with limits of agreement -1.51 and 1.61 L•min⁻¹.

CONCLUSIONS: The pulse wave transit time method had good concordance but fairly wide limits of agreement with regard to trending in patients with changes in preload and systemic vascular resistance. There are potential inaccuracies when vasopressors are used to treat hypotension associated with decreased systemic vascular resistance. The study limitations are that the cardiac output data were collected in a nonblinded fashion, and an existing intraarterial catheter was used, although the system requires only routine, noninvasive cardiovascular monitors. This is a promising technique that currently has limitations and will require further improvements and clinical assessment.

使用 COOK 換管器時的換管失敗和併發症：對 1177 名患者的單中心佇列研究

Airway Exchange Failure and Complications with the Use of the Cook Airway Exchange Catheter® : A Single Center Cohort Study of 1177 Patients

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關於使用換管器時失敗和氣道損傷概率的數據有限。我們進行了一項使用換管器的單中心回顧性分析以確定換管失敗和氣道損傷發生率和相關因素。在 1177 個案例中，嘗試換管過程中插管失敗的發生率是 73/527(13.8%)。在換管器用於雙腔管插管的過程中和手術後嘗試在導管上方插管時的換管失敗發生率最高。氣胸在嘗試換管後的發生率是 1.5%。8 名氣胸患者中有 6 名遭遇了困難換管。

（盛嘉君 譯，馬皓琳、李士通 審校）

There are limited data on rates of failure and airway injury with the use of airway exchange catheters. We performed a single-center retrospective analysis of airway exchange catheters to determine the incidence and associated factors for tube exchange failure and airway injury. Among 1177 cases, failed intubation during attempted tube exchange was noted in 73/527 (13.8%). Airway exchange failure rates were greatest during exchange catheter use for double-lumen tube insertion and when intubation was attempted over the catheter postoperatively. Pneumothorax was noted after 1.5% of attempted tube exchanges. Difficult tube exchange was encountered in 6 of 8 patients with pneumothorax.

甲頰高度:預測喉鏡檢查困難的一項新的臨床測試

Thyromental Height: A New Clinical Test for Prediction of Difficult Laryngoscopy

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背景：據報導喉鏡檢查困難的發生率為 1.5% 至 20%。我們假設喉鏡檢查困難的發生與當患者仰臥口唇閉合時下頰前緣至甲狀軟骨的高度密切相關。我們稱之為甲頰高度測試 (TMHT)。此項研究目的在於確定其預測喉鏡檢查困難的實用性。

方法：314 例大於等於 16 歲計畫接受全身麻醉的連續的男女患者被邀請入組。在術前門診使用改良 Mallampati 分級、甲頰距離和胸頰距離及甲頰高度進行氣道評估。之後，在氣管插管時評價喉鏡檢查視野的 Cormack 和 Lehane 分級。喉鏡檢查者不知道氣道評估結果。分別計算出甲頰高度的有效性和預測指數作為主要觀察指標。對其他三種氣道評估方法的有效性進行計算是本研究的次要觀察指標。

結果：最佳靈敏度和特異性值的範圍為 47.46 至 51.02 毫米。為了便於臨床應用，選用 50mm 作為臨界值。甲頰高度比其他測試更準確 (所有 $P < 0.0001$)。

結論：甲頰高度測試比現有解剖學測量更能準確預測喉鏡檢查困難。

(邢怡安 譯 馬皓琳 李士通 校)

BACKGROUND: The incidence of difficult laryngoscopy is reported in the range of 1.5% to 20%. We hypothesized that there is a close association between the occurrence of difficult laryngoscopy and the height between the anterior borders of the mentum and thyroid cartilage, while the patient lies supine with her/his mouth closed. We have termed this the “thyromental height test” (TMHT). Our aim in this study was to determine its utility in predicting difficult laryngoscopy.

METHODS: Three hundred fourteen consecutive male and female patients aged ≥ 16 years scheduled to undergo general anesthesia were invited to participate. Airway assessments were performed with the modified Mallampati test, thyromental distance and sternomental distance, and TMHT in the preoperative clinic. Afterward, Cormack and Lehane grade of laryngoscopy views was assessed during intubation. The laryngoscopist was unaware of airway assessments. As a primary end point, the validity and prediction indexes for the TMHT were calculated. Calculation of validity indexes for the 3 other methods of airway assessment was a secondary objective of this study.

RESULTS: The optimal sensitivity and specificity values were in the range of 47.46 to 51.02 mm. To facilitate clinical application, a cutoff value equal to 50 mm was chosen. TMHT was more accurate than the other tests (all $P < 0.0001$).

CONCLUSIONS: The TMHT appears to be a more accurate predictor of difficult laryngoscopy than the existing anatomical measurements.

剖宮產後椎管內嗎啡鎮痛後呼吸抑制發生率的回顧性研究

A Retrospective Assessment of the Incidence of Respiratory Depression After Neuraxial Morphine Administration for Postcesarean Delivery Analgesia

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呼吸抑制可以發生在椎管內給予嗎啡後。在產科人群中，對剖宮產婦女椎管內給予嗎啡後呼吸抑制的相關資料很少。在這個單中心回顧性研究的 5036 名產科患者（平均體重指數 = 34 kg/m²）均進行了剖宮產術並接受了椎管內嗎啡給藥，我們沒有發現需要給予納洛酮或快速反應小組參與的呼吸抑制病例。因此，在我們的研究中發生呼吸抑制的 95% 可信區間的上限為 0.07%（每 1429 案例發生 1 例事件）。

(董靜譯 馬皓琳 李士通 校)

Respiratory depression can occur after neuraxial morphine administration. In the obstetric population, there are little data on respiratory depression after neuraxial morphine administration in women undergoing cesarean delivery. In this single-center, retrospective study in 5036 obstetric patients (mean body mass index = 34 kg/m²) who underwent cesarean delivery and received neuraxial morphine, we did not identify any instances of respiratory depression requiring naloxone administration or rapid response team involvement. Therefore, the upper 95% confidence limit for respiratory depression in our study is 0.07% (1 event per 1429 cases).

順阿曲庫銨和羅庫溴銨對麻醉兒童肺功能的影響

The Effect of Cisatracurium and Rocuronium on Lung Function in Anesthetized Children

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背景：肌松藥和術中支氣管痙攣有密切關係。我們檢測了臨床相關劑量的順阿曲庫銨和羅庫溴銨對小兒的呼吸力學的效應。我們假設順阿曲庫銨和羅庫溴銨有支氣管收縮效應。

方法：我們研究了 ASA 評分 I-II 級、需要用順阿曲庫銨或羅庫溴銨進行全麻氣管內插管進行擇期牙科或泌尿科手術的小兒。在用肌松藥之前、之後及用沙丁胺醇後再次進行肺功能測試。通過用力放氣和被動放氣方法，獲得用力肺活量（FVC）和在 FVC 的 10% 時的最大呼氣流速（MEF10）。用相對於基線的分數變化來比較受試者。MEF10 的變化 >30% 被認為有臨床差異。用 t 核對總和威爾科克森秩和檢驗來分析資料。

結果：研究了 25 個受試者（中位年齡 5.25 歲；範圍為 9 個月到 9.9 歲）；12 個接受順阿曲庫銨和 13 個接受羅庫溴銨。資料表示成變化比例 ± 標準差或者在非正太分佈的案例裡為變化比例的中位數（第一，第三四分位數）及 P 值。在順阿曲庫銨組，FVC 相對於基線的分數變化在用肌松藥之後與基線之間沒有差異 (1.00 ± 0.04, P = 0.5)，但 MEF10 顯著降低 (0.80 ± 0.18, P = 0.002)。在羅庫溴銨組，FVC 有小的但顯著的減少 (0.99 [第一個四分位數 0.97, 第三個四分位數 1], P = 0.02)，MEF10 顯著降低 (0.78 ± 0.26, P = 0.008)。在順阿曲

庫鉍組給予沙丁胺醇後，FVC 與基礎值比較略增加但有顯著意義(1.02 ± 0.02 , $P = 0.005$)。MEF10 與基礎值比較顯著增加(1.24 ± 0.43 , $P = 0.04$)。在羅庫溴鉍組，FVC (1.02 ± 0.02 , $P = 0.004$) and MEF10 (1.23 ± 0.29 , $P = 0.01$)在給予沙丁胺醇後與基線比較也有顯著差異。

結論：用臨床相關劑量時，順阿曲庫鉍和羅庫溴鉍都可引起肺功能改變，表明小氣道有收縮。一般來說，這些改變是輕微的在臨床不被觀察到。然而，在羅庫溴鉍組，13 個病人中的 3 個在 MEF10 表現出明顯的減少 ($\leq 50\%$)，證明了在敏感的病人有顯著的支氣管-細支氣管收縮的潛在性。

(王曉莉譯 馬皓琳 李士通校)

BACKGROUND: Neuromuscular blocking drugs have been implicated in intraoperative bronchoconstrictive episodes. We examined the effects of clinically relevant doses of cisatracurium and rocuronium on the lung mechanics of pediatric subjects. We hypothesized that cisatracurium and rocuronium would have bronchoconstrictive effects.

METHODS: We studied ASA physical status I and II pediatric subjects having elective dental or urological procedures, requiring general anesthesia with endotracheal intubations with either cisatracurium or rocuronium. Pulmonary function tests were performed before and after neuromuscular blocking drug dosing and again after albuterol administration. Using forced deflation and passive deflation techniques, forced vital capacity (FVC) and maximum expiratory flow rate at 10% (MEF10) of FVC were obtained. Fractional changes from the baseline were used to compare subjects. Changes in MEF10 of $>30\%$ were considered clinically significant. A Shapiro-Wilk test, paired t test, and Wilcoxon rank sum test were used to analyze the data.

RESULTS: Twenty-five subjects (median age = 5.25 years; range = 9 months–9.9 years) were studied; 12 subjects received cisatracurium and 13 subjects received rocuronium. Data are shown as mean proportional change \pm SD or, in the case of not normally distributed, median proportional change (first, third quartile) with P values. In the cisatracurium group, there were no differences between baseline and postneuromuscular blocker administration in the fractional change from the baselines of FVC (1.00 ± 0.04 , $P = 0.5$), but there was a significant decrease in MEF10 (0.80 ± 0.18 , $P = 0.002$). In the rocuronium group, there were small yet significant decreases of FVC (0.99 [first quartile 0.97, third quartile 1], $P = 0.02$) and significant decreases in MEF10 (0.78 ± 0.26 , $P = 0.008$). After administration of albuterol in the cisatracurium group, FVC increased slightly but significantly from baseline values (1.02 ± 0.02 , $P = 0.005$). MEF10 increased significantly beyond baseline values (1.24 ± 0.43 , $P = 0.04$). In the rocuronium group, there were also significant differences between baseline and postalbuterol administration from the baseline value of FVC (1.02 ± 0.02 , $P = 0.004$) and MEF10 (1.23 ± 0.29 , $P = 0.01$).

CONCLUSIONS: At clinically relevant doses, both cisatracurium and rocuronium caused changes in lung function, indicating constriction of smaller airways. In general, these changes were mild and not clinically detectable. However, in the rocuronium group, 3 of 13 patients showed more noticeable decreases in MEF10 ($\leq 50\%$), demonstrating the potential for significant broncho-bronchiolar constriction in susceptible patients.

嬰兒期暴露于全身麻醉對 12 歲兒童學習成績的影響

The Effects of Exposure to General Anesthesia in Infancy on Academic Performance at Age 12

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背景：最近來自于幼年動物模型的證據表明在神經生長期暴露於閾值劑量以上麻醉藥物會導致廣泛的神經元凋亡，造成不可逆的腦損傷和隨後的學習困難。此項研究結果與因小手術暴露於全身麻醉的人類嬰兒的相關性尚未得知。在這項試驗性的觀察性研究中，我們試圖確定嬰兒期因小手術暴露於全身麻醉的 12 歲兒童與從未暴露于麻醉或鎮靜的兒童相比，在學習成績上是否表現出不同，其證據為(1)在新加坡標準小學畢業考試(PSLE)中較低的總分和(2)正式診斷的學習功能障礙。

方法：我們比較了 100 個 1 歲前在我們機構因小手術暴露於全身麻醉的足月且表面上健康的 12 歲兒童與 106 名年齡匹配的從未暴露于麻醉或鎮靜的兒童。兒童的父母完成一個耗時 20 分鐘的關於孩子的病史、學校環境和家庭環境的電話採訪。

結果：平均 PSLE 總分(3.0; 95% 可信區間[CI], -8.3 至 14.3)在暴露組(197.0; 95% CI, 185.6–208.4)和對照組(194.0; 95% CI, 182.9–205.1)之間無統計學差異($P = 0.603$)。暴露組中學習功能障礙正式診斷率為 15% (100 人中有 15 人)，而對照組為 3.77% (106 人中有 4 人) ($P < 0.001$)。曾暴露于全身麻醉的兒童的學習功能障礙正式診斷相對於對照組的比值比為 4.5(95% CI, 1.44–14.1)。

結論：嬰兒期曾因小手術暴露於全身麻醉的表面上健康的兒童在 12 歲時被正式診斷為學習功能障礙的概率比從未暴露於麻醉的同齡兒童大 4.5 倍。然而，研究精確性不足以發現 PSLE 分數的臨床相關差異。

(張怡譯馬皓琳李士通校)

BACKGROUND: Recent evidence from juvenile animal models has shown that exposure to anesthetic drugs above threshold doses during a critical neurodevelopmental window causes widespread neuronal apoptosis, resulting in irreversible brain damage and subsequent learning difficulties. The relevance of this to human infants having general anesthesia for minor surgery is unknown. In this pilot observational cohort study, we sought to determine whether children exposed to general anesthesia for minor surgery during infancy exhibited differences in academic achievement at age 12 years, as evidenced by (1) lower aggregate scores in the Singapore standardized Primary School Leaving Examination (PSLE) and (2) formally diagnosed learning disability, compared with children who were never exposed to anesthesia or sedation.

METHODS: We compared 100 full-term, apparently healthy children aged 12 years who were exposed to general anesthesia for minor surgery before age 1 at our institution with an age-matched cohort of 106 children who were never exposed to anesthesia or sedation. Parents of children completed a 20-minute telephone interview with questions regarding their children's medical history, school environment, and home environment.

RESULTS: The difference in mean PSLE aggregate scores (3.0; 95% confidence interval [CI], -8.3 to 14.3) between exposed (197.0; 95% CI, 185.6–208.4) and control groups (194.0; 95% CI, 182.9–205.1) was not statistically significant ($P = 0.603$). The presence of formally diagnosed learning disability was 15% (15 of 100) in the exposed group compared with 3.77% (4 of 106) in the control group ($P < 0.001$). The odds ratio for a formal diagnosis of learning disability in those exposed to general anesthesia relative to controls was 4.5 (95% CI, 1.44–14.1).

CONCLUSION: The odds of a formal diagnosis of learning disability by age 12 years in apparently healthy children exposed to general anesthesia for minor surgery during infancy were 4.5 times greater than their peers who had never been exposed to anesthesia. However, study precision was inadequate to detect a clinically relevant difference in PSLE scores.

Datta 短喉鏡手柄的發展及歷史背景

The Development and Historical Context of the Datta Short Laryngoscope Handle

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懷孕期間的激素、生理及解剖學的改變會對麻醉產生一系列的顯著影響，其中包括氣管插管困難或失敗的可能性。美國麻醉醫師協會總結了 1970 年代的索賠資料庫，發現 30% 的所有產科索賠涉及產婦死亡，大部分源于插管或通氣困難。在 1970 年代後期，布萊根婦產科醫院 (麻塞諸塞州，波士頓) 的一位產科麻醉醫師 Sanjay Datta 醫生 (醫學學士學位)，發現在美國的產科麻醉實踐與他以前在英國和加拿大的經歷相比較有一些差異。Datta 醫生認識到北美產婦的體重指數更高，同時觀察到剖宮產率及全麻應用的比例較高。這些不同使他評估可以改變哪種喉鏡本身來改善產婦插管的容易性；這導致了短喉鏡柄的發展。本文將闡述 Datta 短喉鏡手柄的起源及伴隨的歷史背景。

(王贊譯 馬皓琳 李士通校)

The hormonal, physiologic, and anatomic changes of pregnancy have a number of significant anesthetic implications, including the potential for difficulties and failures in tracheal intubation. The American Society of Anesthesiology closed claims database in the 1970s observed that maternal deaths were involved in 30% of all obstetrics claims, most stemming from difficulty with intubation or ventilation. In the late 1970s, Dr. Sanjay Datta, MBBS, an obstetric anesthesiologist at Brigham and Women's Hospital (Boston, MA), observed a number of differences in the practice of obstetric anesthesia in the United States when compared with his prior experiences in the United Kingdom and Canada. Dr. Datta perceived that parturients within North America had a higher body mass index. In addition, he observed an increased rate of cesarean delivery and general anesthesia use. These differences led him to evaluate ways in which the laryngoscope itself could be altered to improve the ease of intubation of parturients; this led to the development of the short laryngoscope handle. The genesis of the Datta short laryngoscope handle, and the accompanying historical context, will be explored.

脂肪乳劑對細胞內布比卡因的影響為脂質復蘇的機制：使用電壓門控質子通道的電生理研究

The effect of lipid emulsion on intracellular bupivacaine as a mechanism of lipid resuscitation: an electrophysiological study using voltage-gated proton channels.

Hori K, Matsuura T, Mori T, Kuno M, Sawada M, Nishikawa K.

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背景：脂質復蘇局麻藥的全身毒性反應已成為標準化的治療方案，但是其中的機制仍不甚明瞭。雖然分隔作用是機制之一，但難以從其他機制中獨立評價，或者說難以測定胞內局麻藥的濃度。胞內局麻藥的濃度才是造成局麻藥中毒的主要原因。我們近期報導過局麻藥帶弱鹼基，增加了細胞內 pH 值，從而減小了電壓門控質子電流。電壓門控質子電流能用電通道可逆電位來估算。基於這種特性，我們更詳細地分析了脂質體的分隔作用及復蘇機制。

方法：用全細胞電壓鉗夾技術記錄大鼠小膠質細胞株 (GMI-R1) 的質子通道電流，又用 Intralipid® 20% 作為脂肪乳劑。通過測量電流幅值和通道的可逆電位來評估脂肪乳劑對胞內局麻藥濃度的影響。胞內局麻藥的濃度用 Henderson-Hasselbalch 公式代入估測的胞內 pH 值計算得出。為了確認分隔作用的重要性，我們離心分離脂質。資料都用平均值±標準差表示，除非另有說明。

結果：布比卡因(1 mM)減少對照組質子電流到 $43\% \pm 10\%$ ，使可逆電位上升(從 -88.0 ± 4.1 到 -76.0 ± 5.5 mV, 每組 $n = 5$, $P = 0.02$)。另一組濃度的結果是恢復質子電流到 $79\% \pm 2\%$ ，可逆電位恢復接近於對照值 (-86.0 ± 7.1 mV, $n = 5$, $P = 0.03$)。4% 脂質濃度中質子電流和可逆電位的測定結果和離心水提物中的結果大致相同 (-85.6 ± 4.9 mV, $n = 5$, $P = 0.9$ ，

95% CI -9.3 to 8.6)。當在細胞外加入 1 mM 布比卡因，胞內的濃度估測為 18.1 ± 3.9 mM，而用了 4% 脂質體後胞內的濃度估測為 5.4 ± 1.8 mM。

結論：通過即時測定分析電壓門控通道，第一次計量分析了脂質體對胞內脂質體的分割作用。我們的結果表明脂質體能顯著減少胞內布比卡因濃度，這個特性主要是基於其分隔作用。這讓我們能更好理解其復蘇局麻藥中毒的機制。

(陳實玉譯 薛張綱校)

BACKGROUND: Lipid resuscitation has become a standard treatment for local anesthetic (LA) systemic toxicity, but its mechanisms remain to be fully elucidated. Although the partitioning effect is one of the proposed mechanisms, it is difficult to evaluate its impact independently from several other mechanisms or to examine the intracellular concentration of a LA, which is primarily responsible for LA systemic toxicity. We recently reported that LAs as weak bases reduced voltage-gated proton currents by increasing intracellular pH, which could be estimated from the reversal potentials of the channels (V_{rev}). Using this characteristic, we examined the partitioning effect in detail and showed its impact on lipid resuscitation.

METHODS: A whole-cell voltage clamp technique was used to record proton channel currents in a rat microglial cell line (GMI-R1). We used Intralipid® 20% as lipid emulsion. The effects of lipid emulsion on the intracellular concentrations of LAs were evaluated by measuring the current amplitude and the V_{rev} . The intracellular concentrations of LAs were calculated by the Henderson-Hasselbalch equation, using estimated intracellular pH. To confirm the importance of partitioning, we separated lipid by centrifugation. Data are means \pm SD unless otherwise stated.

RESULTS: Bupivacaine (1 mM) decreased proton currents to $43\% \pm 10\%$ of the control and shifted the V_{rev} to positive voltages (from -88.0 ± 4.1 to -76.0 ± 5.5 mV, $n = 5$ each, $P = 0.02$). An addition of the lipid emulsion recovered the currents to $79\% \pm 2\%$ of the control and returned the V_{rev} toward the control value (to -86.0 ± 7.1 mV, $n = 5$, $P = 0.03$). Both recoveries of the current and V_{rev} in the centrifuged aqueous extract were almost the same as in the 4% lipid solution (-85.6 ± 4.9 mV, $n = 5$, $P = 0.9$, 95% confidence interval for difference = -9.3 to 8.6). When 1 mM bupivacaine was applied extracellularly, the intracellular concentration of the charged form of bupivacaine was estimated to reach about 18.1 ± 3.9 mM but decreased to 5.4 ± 1.8 mM by the 4% lipid solution.

CONCLUSIONS: Here we quantitatively evaluated for the first time the partitioning effect of lipid emulsion therapy on the intracellular concentration of bupivacaine in real-time settings by analyzing behaviors of voltage-gated proton channels. Our results suggested that lipid emulsion markedly reduced the intracellular concentration of bupivacaine, which was mostly due to the partitioning effect. This could contribute to our understanding of the mechanisms underlying lipid resuscitation, especially the importance of the partitioning effect.

麻醉設備與表觀死腔容積，一個臨床以及實驗室研究

Apparent Dead Space with the Anesthetic Conserving Device, AnaConDa® : A Clinical and Laboratory Investigation

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背景：麻醉藥物節約設備 (ACD) 通過吸附呼出氣中的藥物以及在吸入時釋放藥物能夠中等量的降低揮發性麻醉藥的使用。儘管通過增加潮氣量以彌補較大的設備死腔，在使用 ACD 的患者中仍能觀察到二氧化碳分壓的 ($PaCO_2$) 升高。在一使用常溫乾燥氣體測試試驗肺的試驗中證實這是由於 ACD 在呼出時吸收 CO_2 並在吸氣時釋放 CO_2 引起的。在

試驗肺中這一現象現在比在患者中更顯著。研究者測試了一假設，即較小的死腔在患者中達到的效果是通過較高的溫度和/或濕度來減少 CO₂ 的再吸入。

方法：6 例心臟手術術後的患者的肺通過常規的濕熱交換器(HME)或 ACD 通氣。研究通過實驗肺在不同的溫度和濕度中測試了 ACD。使用紅外光譜法通過二氧化碳單次呼吸測試以及二氧化碳重複吸入測量死腔量。

結果：在患者中，表觀死腔容積的平均數為 136 mL (95% 可信區間[CI], 120-167) 與濕熱交換器 HME 相比 ACD 大得多 (校正後內部容積分別為 50ml 和 100ml)。ACD 呼出 CO₂ 重複吸入量平均數為 53% (範圍為 48-58)，HME 為 29% (範圍為 27-32)。二氧化碳重複吸入平均差異為 23% (95% 可信區間為 18-27)。在實驗肺的測試中 ACD 的死腔不受身體的溫度影響，在增加濕度後死腔量從 360ml 減少到 260ml。這將二氧化碳重吸收率從 62% 下降至 48%。

結論：使用 ACD 所增加的表觀死腔容積的程度可通過其內部容積解釋。這是由於 ACD 在呼氣時吸收 CO₂ 以及吸氣時釋放 CO₂ 導致的。CO₂ 的重吸收可以通過濕化來減少。由 ACD 造成的死腔在臨床上可能與急性呼吸窘迫綜合征和其他呼吸機相關疾病有關，但其臨床重要性的證實需要更大量的樣本研究。

(陳婉南譯 薛張綱校)

BACKGROUND: The anesthetic conserving device (ACD) reduces consumption of volatile anesthetic drug by a conserving medium adsorbing exhaled drug during expiration and releasing it during inspiration. Elevated arterial CO₂ tension (PaCO₂) has been observed in patients using the ACD, despite tidal volume increase to compensate for larger apparatus dead space. In a test lung using room temperature dry gas, this was shown to be due to adsorption of CO₂ in the ACD during expiration and release of CO₂ during the following inspiration. The effect in the test lung was higher than in patients. We tested the hypothesis that a lesser dead space effect in patients is due to higher temperature and/or moisture attenuating rebreathing of CO₂.

METHODS: The lungs of 6 postoperative cardiac surgery patients were ventilated using a conventional heat and moisture exchanger (HME) or an ACD. The ACD was studied with a test lung at varying temperatures and moistures. Infrared spectrometry was used to measure apparent dead space by the single-breath test for CO₂ as well as rebreathing of CO₂.

RESULTS: In patients, the median apparent dead space was 136 mL (95% confidence interval [CI], 120-167) larger using the ACD compared with an HME (after correction for difference in internal volume 100 and 50 mL, respectively). Median rebreathing of CO₂ using the ACD was 53% (range 48-58) of exhaled CO₂ compared with 29% (range 27-32) with an HME. The median difference in CO₂ rebreathing was 23% (95% CI, 18-27). In the test lung apparent dead space using ACD was unaffected by body temperature but decreased from 360 to 260 mL when moisture was added. This decreased rebreathing of CO₂ from 62% to 48%.

CONCLUSIONS: The use of an ACD increases apparent dead space to a greater extent than can be explained by its internal volume. This is caused by adsorption of CO₂ in the ACD during expiration and release of CO₂ during inspiration. Rebreathing of CO₂ was attenuated by moisture. The dead space effect of the ACD could be clinically relevant in acute respiratory distress syndrome and other diseases associated with ventilation difficulties, but investigations with larger sample sizes would be needed to determine the clinical importance.

如何改進圍手術期風險評估模型:通過生命體征使用外科 Apgar 評分系統一例

How to improve the performance of intraoperative risk models: an example with vital signs using the surgical apgar score.

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背景：通過電腦整合病人資料,早期準確地區分出風險病人和安全病人,可提高臨床服務品質。病人生命體征資料抽樣策略的重要性尚不明確。通過 SAS 評分系統實例,我們假設更大的抽樣間隔可改進此項工具的特異性和總體預測能力。

方法：我們使用電子化圍手術期資料,病人來源於美國外科醫師協會品質改進計畫納入的單中心註冊的普通外科和血管外科的病人。SAS 評分系統包括最低心律,最低平均動脈壓,以及切皮與皮膚縫合期間評估的血液丟失量,並通過 5 種方法計算:即刻、5 分鐘間隔伴或不伴間隔重疊、10 分鐘間隔伴或不伴間隔重疊。包括死亡在內的主要併發症於術後 30 天評估。

結果：3000 例病人中,272 (9.1%) 例發生了主要併發症或死亡。隨著抽樣間隔由即時增加到 10 分鐘不伴間隔重疊,靈敏度、陽性預測值和陰性預測值沒有顯著改變,然而特異度 (79.5%到 82.9%, $P < 0.001$) 和準確度 (76.0%到 79.3%, $P < 0.01$)。在多變數模型中,通過 c-統計算出 SAS 系統的預測效用幾乎由最短抽樣間隔的 $\Delta c = +0.012$ ($P = 0.038$) 增加到最長抽樣間隔的 $\Delta c = +0.021$ ($P < 0.002$)。與術前風險評估模型相比,淨改敘得以改善 0.01 ($P = 0.8$) vs 0.06 ($P = 0.02$),綜合歧視同樣得以改善 0.008 ($P < 0.01$) vs 0.015 ($P < 0.001$)。

結論：當生命體征資料按照 ASA 標準相容方式記錄時,抽樣間隔顯著影響 SAS 評分系統的實施。電腦整合病人資料受抽樣方法的影響,具有優化安全有效臨床策略的潛能。

(李春譯 薛張綱校)

BACKGROUND: Computerized reviews of patient data promise to improve patient care through early and accurate identification of at-risk and well patients. The significance of sampling strategy for patient vital signs data is not known. In the instance of the surgical Apgar score (SAS), we hypothesized that larger sampling intervals would improve the specificity and overall predictive ability of this tool.

METHODS: We used electronic intraoperative data from general and vascular surgical patients in a single-institution registry of the American College of Surgeons National Surgical Quality Improvement Program. The SAS, consisting of lowest heart rate, lowest mean arterial blood pressure, and estimated blood loss between incision and skin closure, was calculated using 5 methods: instantaneously and using intervals of 5 and 10 minutes with and without interval overlap. Major complications including death were assessed at 30 days postoperatively.

RESULTS: Among 3000 patients, 272 (9.1%) experienced major complications or death. As the sampling interval increased from instantaneous (shortest) to 10 minutes without overlap (largest), the sensitivity, positive predictive value, and negative predictive value did not change significantly, but significant improvements were noted for specificity (79.5% to 82.9% across methods, P for trend < 0.001) and accuracy (76.0% to 79.3% across methods, P for trend < 0.01). In multivariate modeling, the predictive utility of the SAS as measured by the c-statistic nearly increased from $\Delta c = +0.012$ ($P = 0.038$) to $\Delta c = +0.021$ ($P < 0.002$) between the shortest and largest sampling intervals, respectively. Compared with a preoperative risk model, the net reclassification improvement and integrated discrimination improvement for the shortest versus largest sampling intervals of the SAS were net reclassification improvement 0.01 ($P = 0.8$) vs 0.06 ($P = 0.02$), and for integrated discrimination improvement, they were 0.008 ($P < 0.01$) vs 0.015 ($P < 0.001$).

CONCLUSIONS: When vital signs data are recorded in compliance with American Society of Anesthesiologists' standards, the sampling strategy for vital signs significantly influences performance of the SAS. Computerized reviews of patient data are subject to the choice of

sampling methods for vital signs and may have the potential to be optimized for safe, efficient patient care.

臨床產科麻醉期間的過敏反應：文獻綜述

Anaphylaxis in the Clinical Setting of Obstetric Anesthesia: A Literature Review.

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妊娠期間過敏反應的發生率大約為 3/100000 例。由於存在主動脈、腔靜脈壓迫和過敏引起的心血管功能障礙這兩方面的累加效應，妊娠末三個月內發生的過敏反應的臨床處理極具挑戰性。這篇綜述總結了自然分娩和剖宮產手術期間發生過敏反應的臨床表現，探討了此期間造成過敏反應較為常見的過敏源，並制定合理的方法來鑒別誘發過敏反應的物質。我們還對妊娠晚期過敏反應的處理策略提出建議，包括在處理嚴重過敏性休克的患者時緊急應用腎上腺素和行急診剖宮產。從個案報導、非致死性和致死病例，病理生理學的解釋和共識意見獲得的證據是有限的。

（凌曉敏譯 薛張綱校）

The prevalence of anaphylaxis occurring during pregnancy is approximately 3 cases per 100,000 deliveries. The management of anaphylaxis occurring during the third trimester of pregnancy may be challenging because of the additive effects of aortocaval compression and cardiovascular disturbances of anaphylaxis. In this review, we identify the clinical signs of anaphylaxis occurring during labor and cesarean delivery, discuss the more common allergens that cause anaphylaxis during this clinical setting, and develop a rational approach to the identification of the offending allergen. We also suggest strategies for the management of anaphylaxis occurring during the third trimester of pregnancy, including the prompt administration of epinephrine and emergency cesarean delivery in cases of severe reactions. Evidence is limited to case reports and extrapolation from nonfatal and fatal cases, interpretation of pathophysiology, and consensus opinion.

兒童輸液反應預測：系統性綜述

Predicting Fluid Responsiveness in Children: A Systematic Review

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背景：血流動力復蘇的主要方法是通過輸液來提高心排血量。但輸液並不是對所有患者都起作用，而且過多地輸液是有害的。預測輸液的反應具有挑戰性，特別是對於兒童。大量血液動力變數被當作液體反應的預測指標而提出。基於心肺相互反應的動態變數似乎可以作為預測成年人液體反應的良好指標，但是其對患兒的液體反應卻沒有預測作用。

方法：我們系統地回顧了患兒液體反應預測指標的現有證據。使用文獻服務檢索系統（PubMed（1947-2013））和荷蘭醫學文摘資料庫（EMBASE（1974-2013））進行了一個系統的搜索。搜索術語包括液體，體積，反應，回應，挑戰，推注，負荷，預測和指

引。涉及兒科（嬰兒，小孩，青少年）這一課題的研究結果是有限的。資料的抽取是由兩位作者使用預定義的資料欄獨立完成的，包括研究品質指標。任何變數在接受者操作特徵曲線這一區間，即明顯大於 0.5 時，均被認為是可以預測的。

結果：涉及在 438 位兒科患者中使用（年齡範圍 1 天-17.8 歲）的 501 種口服液的 12 項研究包括在內。對 24 個變數進行了調查。許多研究顯示的唯一可預測的變數是主動脈血流量峰值流速的呼吸變數（5 個研究）。發現被動抬腿試驗產生的心搏量指數，心搏距離變數以及心臟指數（心搏量）變化只有在單獨的研究中才可以被預測。基於心率，動脈收縮壓，預負荷（中央靜脈壓，肺動脈閉塞壓），熱稀釋（整體舒張末期容量指數），超聲波稀釋（活躍迴圈血容量，中心血容量，總舒張末期容量，總射血分數），超聲心動圖（左心室末端舒張區）和多普勒（心搏量指數，校正流動時間）的靜態變數無法預測孩子身上的血流動力學反應。基於動脈血壓的動態變數法（動脈收縮壓變化、脈壓變化、每搏量變異度、動脈收縮血壓最大值與最小值的差值以及呼氣末暫停時的收縮壓）和體積描記法（脈搏血氧計體積描記幅度變化）也是不可預測的。體積描記器的變數指標和下腔靜脈直徑變數之間存在矛盾的結果。

結論：主動脈血流量峰值流速的呼吸變數是所顯示的唯一可以預測患兒輸液反應的變數。靜態變數不能預測患兒的輸液反應，該反應與成年人所表現的跡象一致。基於動脈血壓的動態變數無法預測患兒輸液反應，而且基於體積描記法的動態變數的證據不夠充分。

（劉毅譯 薛張綱校）

BACKGROUND: Administration of fluid to improve cardiac output is the mainstay of hemodynamic resuscitation. Not all patients respond to fluid therapy, and excessive fluid administration is harmful. Predicting fluid responsiveness can be challenging, particularly in children. Numerous hemodynamic variables have been proposed as predictors of fluid responsiveness. Dynamic variables based on the heart-lung interaction appear to be excellent predictors of fluid responsiveness in adults, but there is no consensus on their usefulness in children.

METHODS: We systematically reviewed the current evidence for predictors of fluid responsiveness in children. A systematic search was performed using PubMed (1947-2013) and EMBASE (1974-2013). Search terms included fluid, volume, response, respond, challenge, bolus, load, predict, and guide. Results were limited to studies involving pediatric subjects (infant, child, and adolescent). Extraction of data was performed independently by 2 authors using predefined data fields, including study quality indicators. Any variable with an area under the receiver operating characteristic curve that was significantly above 0.5 was considered predictive.

RESULTS: Twelve studies involving 501 fluid boluses in 438 pediatric patients (age range 1 day to 17.8 years) were included. Twenty-four variables were investigated. The only variable shown in multiple studies to be predictive was respiratory variation in aortic blood flow peak velocity (5 studies). Stroke volume index, stroke distance variation, and change in cardiac index (and stroke volume) induced by passive leg raising were found to be predictive in single studies only. Static variables based on heart rate, systolic arterial blood pressure, preload (central venous pressure, pulmonary artery occlusion pressure), thermodilution (global end diastolic volume index), ultrasound dilution (active circulation volume, central blood volume, total end diastolic volume, total ejection fraction), echocardiography (left ventricular end diastolic area), and Doppler (stroke volume index, corrected flow time) did not predict fluid responsiveness in children. Dynamic variables based on arterial blood pressure (systolic pressure variation, pulse pressure variation and stroke volume variation, difference between maximal or minimal systolic arterial blood pressure and systolic pressure at end-expiratory pause) and plethysmography (pulse oximeter plethysmograph amplitude variation) were also not predictive. There were contradicting results for plethysmograph variation index and inferior vena cava diameter variation.

CONCLUSIONS: Respiratory variation in aortic blood flow peak velocity was the only variable shown to predict fluid responsiveness in children. Static variables did not predict fluid responsiveness in children, which was consistent with evidence in adults. Dynamic variables

based on arterial blood pressure did not predict fluid responsiveness in children, but the evidence for dynamic variables based on plethysmography was inconclusive.

兒科麻醉的品質及安全性

Quality and Safety in Pediatric Anesthesia

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當今，醫療保健專業人士和政策制定者最爲關心的問題是患者的醫療品質和價值。結局、安全以及服務是評估醫療品質的要素，以此來評估成本。醫療保健機構和專業人員都面臨著提高醫療品質，同時減少相關成本和提高價值的挑戰。什麼是有效且必要的品質測量、什麼不是，是評估提高產品品質和價值的工作的方式。然而目前只有很少的手段用於評估醫療品質，臨床醫生往往缺乏進行相關品質改進工作所需的資源和技能。在這篇文章中，我們簡要回顧了兒科麻醉在品質改進方面的努力。

（徐升譯 薛張綱校）

Health care quality and value are leading issues in medicine today for patients, health care professionals, and policy makers. Outcome, safety, and service—the components of quality—have been used to define value when placed in the context of cost. Health care organizations and professionals are faced with the challenge of improving quality while reducing health care related costs to improve value. Measurement of quality is essential for assessing what is effective and what is not when working toward improving quality and value. However, there are few tools currently for assessing quality of care, and clinicians often lack the resources and skills required to conduct quality improvement work. In this article, we provide a brief review of quality improvement as a discipline and describe these efforts within pediatric anesthesiology.

以沙灘椅位置進行的肩關節鏡手術在全身麻醉狀態下，精氨酸利尿劑能預防防止低血壓，但同時會影響腦部供氧

Under general anesthesia arginine vasopressin prevents hypotension but impairs cerebral oxygenation during arthroscopic shoulder surgery in the beach chair position.

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背景：以沙灘椅位置進行手術的患者存在腦缺血的危險。我們評估了精氨酸利尿劑在手術期間對血流動力學以及腦部氧供的影響，

方法：三十例接受肩部手術的患者在異丙酚和瑞芬太尼靜脈麻醉下被隨機分爲兩組，分別在接受 BCP 前 2 分鐘靜注精氨酸升壓素 0.07 U/kg（精氨酸升壓素組，N = 15）或等體積的生理鹽水（對照組，N = 15）。麻醉誘導前後及接受 BCP 後測定患者的平均動脈壓，心率，頸靜脈血氧飽和度，和局部腦組織氧飽和度。

結果：AVP 本身在給藥後能增加平均動脈壓，降低 S_{jo}O₂ 和 S_{cto}O₂ (P < 0.0001)，同時不影響心率。雖然在 BCP 過程的兩組中 MAP 都會下降，但是它在精氨酸加壓素組降得更多 (P < 0.0001)。而在 BCP 過程中，HR 在對照組保持不變，在 AVP 組降低。頸靜脈血氧飽和度在 BCP 過程中的兩組沒有顯著差異。S_{cto}O₂ 在 BCP 過程中兩組都下降，在 AVP 組直到研究結束更顯著。低血壓的發生率 (13% 比 67% ; P = 0.003) 不常見，而腦部氧供減少 (>20% presitting S_{cto}O₂ 下降值) (80% 比 13% ; P = 0.0003) 明顯高於 AVP 組。頸靜脈氧飽和度 (S_{jo}O₂ < 50%) 組與組之間可比較。

結論：預防性注射精氨酸升壓素可以對全麻狀態下的肩部手術因為 BCP 引起的低血壓有預防作用。然而，它與局部腦組織而不是頸靜脈氧飽和度降低的垂直位置。

(徐崢譯 薛張綱校)

BACKGROUND: Patients undergoing surgery in the beach chair position (BCP) are at a risk of cerebral ischemia. We evaluated the effect of arginine vasopressin (AVP) on hemodynamics and cerebral oxygenation during surgery in the BCP.

METHODS: Thirty patients undergoing shoulder surgery in BCP under propofol-remifentanyl anesthesia were randomly allocated either to receive IV AVP (AVP group,) or an equal volume of saline (control group,) 2 minutes before taking BCP. Mean arterial blood pressure (MAP), heart rate (HR), jugular venous bulb oxygen saturation (S_{jo}O₂), and regional cerebral tissue oxygen saturation (S_{cto}O₂) were measured after induction of anesthesia and before (presitting in supine position) and after patients took BCP.

RESULTS: AVP itself given before the positioning increased MAP and decreased S_{jo}O₂ and S_{cto}O₂ (P < 0.0001), with HR unaffected. Although MAP was decreased by BCP in both groups, it was higher in the AVP group (P < 0.0001). While in BCP, HR remained unaltered in the control and decreased in the AVP group. S_{jo}O₂ in BCP did not differ between the groups. S_{cto}O₂ was decreased by BCP in both groups, which was more pronounced in the AVP group until the end of study. The incidence of hypotension (13% vs 67%; P = 0.003) was less frequent, and that of cerebral desaturation (>20% S_{cto}O₂ decrease from presitting value) (80% vs 13%; P = 0.0003) was higher in the AVP group. The incidence of jugular desaturation (S_{jo}O₂ < 50%) was comparable between the groups.

CONCLUSIONS: A prophylactic bolus administration of AVP prevents hypotension associated with BCP in patients undergoing shoulder surgery under general anesthesia. However, it was associated with regional cerebral but not jugular venous oxygen desaturation on upright positioning.

坐骨神經部分離斷術大鼠鞘內給予超低劑量納洛酮可增強嗎啡的抗痛覺過敏作用，並下調脊髓背角 TNF- α 和 TNFR1 表達

Intrathecal Ultra-Low Dose Naloxone Enhances the Antihyperalgesic Effects of Morphine and Attenuates Tumor Necrosis Factor- α and Tumor Necrosis Factor- α Receptor 1 Expression in the Dorsal Horn of Rats with Partial Sciatic Nerve Transection

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背景：谷氨酸鹽穩態和小膠質細胞啟動在神經病理性疼痛形成及持續過程中起到了重要的作用。我們設計本實驗旨在研究超低劑量納洛酮單獨給藥或複合給予嗎啡是否能夠改變經行坐骨神經部分離斷術 (PST) 的大鼠興奮性氨基酸 (EAAs) 谷氨酸和天冬氨酸的濃度，以及脊髓背角 TNF- α 及其受體 TNFR1 和 TNFR2 的表達。

方法：選取雄性 Wistar 大鼠，行鞘內導管置入並根據不同的手術給藥方案分為 7 組：假手術+生理鹽水 (sham)，PST+生理鹽水 (S)，PST+15 ng 納洛酮 (n)，PST+15 μ g 納洛酮 (N)，PST+10 μ g 嗎啡 (M)，PST+15 ng 納洛酮+10 μ g 嗎啡 (Mn)，PST+15 μ g 納洛酮+10 μ g 嗎啡 (MN)。觀察指標包括有：熱退縮潛伏期和機械退縮閾值，TNF- α 和 TNFR 在脊髓和背根神經節的表達，腦滲析液中興奮性氨基酸谷氨酸和天冬氨酸濃度的濃度。

結果：PST 術後 10 天大鼠出現痛覺過敏 ($P < 0.0001$) 和痛覺異常 ($P < 0.0001$)，且同側脊髓背角 TNF- α ($P < 0.0001$) 和 TNFR1 ($P = 0.0009$) 表達上調。大劑量的納洛酮 (15 μ g; $P = 0.0031$) 抑制了嗎啡 (10 μ g) 的抗痛覺過敏和抗痛覺異常作用，而超低劑量的納洛酮 (15 ng; $P = 0.0015$) 使其作用增強，並同時下調脊髓背角 TNF- α ($P < 0.0001$)、TNFR1 ($P = 0.0009$) 的表達和降低腦滲析液中興奮性氨基酸濃度 (谷氨酸 $P = 0.0001$; 天冬氨酸 $P = 0.004$)。採用方差分析或 Bonferroni 校正的 T 檢驗進行統計學分析。

結論：PST 大鼠給予超低劑量納洛酮後，可能通過下調脊髓背角的 TNF- α 和 TNFR1 表達及降低興奮性氨基酸濃度，從而增強嗎啡的抗痛覺過敏作用及抗痛覺異常作用。在治療神經病理性疼痛時，給予超低劑量納洛酮也許可作為增強嗎啡抗痛覺過敏作用的有效佐劑。

(朱怡琦譯 薛張綱校)

BACKGROUND: Glutamate homeostasis and microglia activation play an important role in the development and maintenance of neuropathic pain. We designed this investigation to examine whether ultra-low dose naloxone administered alone or in combination with morphine could alter the concentration of the excitatory amino acids (EAAs) glutamate and aspartate, as well as the expression of tumor necrosis factor- α (TNF- α) and its receptors (TNFR1 and TNFR2) in the spinal cord dorsal horn of rats with partial sciatic nerve transection (PST).

METHODS: Male Wistar rats underwent intrathecal catheter implantation for drug delivery and were divided in 7 groups: sham-operated + saline (sham), PST + saline (S), PST + 15 ng naloxone (n), PST + 15 μ g naloxone (N), PST + 10 μ g morphine (M), PST + 15 ng naloxone + 10 μ g morphine (Mn), PST + 15 μ g naloxone + 10 μ g morphine (MN). Thermal withdrawal latency and mechanical withdrawal threshold, TNF- α and TNFR expression in the spinal cord and dorsal root ganglia, and EAAs glutamate and aspartate concentration in cerebrospinal fluid dialysates were measured.

RESULTS: Ten days after PST, rats developed hyperalgesia ($P < 0.0001$) and allodynia ($P < 0.0001$), and increased TNF- α ($P < 0.0001$) and TNFR1 expression ($P = 0.0009$) were measured in the ipsilateral spinal cord dorsal horn. The antihyperalgesic and antiallodynic effects of morphine (10 μ g) were abolished by high-dose naloxone (15 μ g; $P = 0.0031$) but enhanced by ultra-low dose naloxone (15 ng; $P = 0.0015$), and this was associated with a reduction of TNF- α ($P < 0.0001$) and TNFR1 ($P = 0.0009$) expression in the spinal cord dorsal horn and EAAs concentration (glutamate: $P = 0.0001$; aspartate: $P = 0.004$) in cerebrospinal fluid dialysate. Analysis of variance (ANOVA) or Student t test with Bonferroni correction were used for statistical analysis.

CONCLUSIONS: Ultra-low dose naloxone enhances the antihyperalgesia and antiallodynia effects of morphine in PST rats, possibly by reducing TNF- α and TNFR1 expression, and EAAs concentrations in the spinal dorsal horn. Ultra-low dose naloxone may be a useful adjuvant for increasing the analgesic effect of morphine in neuropathic pain conditions.