

CASA Bulletin of Anesthesiology



本期专栏：产科麻醉

美国华人麻醉医学会期刊

Volume 7 Number 4, 2020



《希望的田野》

新冠病毒流行半年多，在许多惨重的教训中，我们也对这个疾病有了更多的认识，治疗方案更灵活多样化，疫苗也在研制中，许多医院的择期手术都已恢复。麻醉医生与其他前线工作的医务人员一起，抢救病患，使得不少新冠患者能康复，其功不可没。在这片土地上，希望正在升起。

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主编之言

分秒必争！

Jack Zhang

围产期的母婴状况变化于瞬间，难以预测，在母婴生命受到威胁时，要刻不容缓实施紧急处置，包括可能的即刻剖宫产。团队医疗是救治成功的关键，其中产科麻醉的保驾护航是重中之重！

几周前值夜班，我在清晨6点醒来，暗自庆幸后半夜平安无事，睡了个难得的几小时不间断的好觉。突然，电话响起。值班护士急切地呼叫，“Dr. Zhang, we have a 35 weeker here. She has no palpable pulses! No fetus heart beats found! We need you right now!”多年的产科麻醉经历告诉我，这个产妇可能需要即刻心肺复苏，并需即刻剖宫产。我要求产科团队马上将孕妇推入手术室，同时跳下床，火速穿过分娩区冲向手术室。

这是一位25岁妊娠35周G2P1的孕妇，围产期诊断为胎盘前置、植入性胎盘、可能穿透性胎盘。10多小时前，她开始感觉下腹部隐隐作痛，逐渐加剧，伴随阴道出血，但直至清晨才打电话求救，当班的产科同事令她尽快来医院就诊。半小时后，救护车送她进医院，EMS快速用担架车直接送她到紧邻手术室的观察室。产科医护人员随即检查，发现和通报了上述病情。多人多次试图穿刺外周静脉，均不成功。孕妇很快失去意识。

当我冲进手术室，见到她面色苍白，毫无反应，脉搏不可及。监测仪屏幕上显示心率每分钟40次左右，无法测得氧饱和度和血压。我即刻与产科同事简单交流，初步诊断胎盘剥离出血、休克和宫内胎儿窘迫后，我马上宣布行ACLS。大家立即紧张有序地开始抢救，有的做胸部按压，有的保持子宫左倾位，有的则在左胫骨行IO (intraosseous) 钻骨穿刺开通输液管道，还有的人打开手术包。我立即行气管插管并确保位置正确，但是屏幕上只显示出丝丝的二氧化碳浓度，印证了心脏已失去了泵血功能。我们边行胸压心脏按摩，边行濒死期即刻剖宫产，剖出胎儿。术中发现子宫内积血两升多。

左胫骨IO (intraosseous) 穿刺成功后，经IO推注1毫克肾上腺素，产妇心血管循环随即开始恢复，心跳和血压有了起色，监测仪显示生命体征的数字跳跃，她的生命有了希望！我随即置管中心静脉和股动脉，继续人工呼吸、输血输液和药物治疗以及实验室检查，包括心动超声波检测。产科同事们毫不迟疑地迅速缝合了伤口，留置了子宫和胎盘。

后续几天，母婴均靠人工维持生命，低温保护。当产妇生命体征稳定后，接受了全子宫切除和膀胱修复。二十多单位血液成分的输血成功助她度过了DIC。她渐渐苏醒，拔管脱机，而且未留下明显后遗症。遗憾的是，35周的早产儿持续癫痫发作，不能苏醒。

虽然此病例比较极端，但是并非罕见。7年前类似的情景依然历历在目，当时我们成功地抢救了一例重度子痫、肺水肿的产妇，母婴平安归！

这些案例突显产科病情的特点：瞬息变化万千，难测难控，富有挑战性。包括麻醉科医生在内的团队医疗便极其重要，成功救治病人与我们平时的训练和配合默契不无关系。

最新全美医院的产科不良结果报告显示，以下措施将有益于提高母婴安全，改善母婴结局：产房定期进行模拟剖宫产手术，包括紧急剖宫产，并在模拟后向整个团队汇报情况，提高团队的整合优势。剖宫产手术是一项复杂的手术程序，这需要跨学科的医疗团队之间的有效沟通，包括产科医生、护士、麻醉医生、儿科医生和支持人员。

本期开辟了产科麻醉专栏，供您窥视美中产科及其麻醉工作的重要内容和CASA人所做的贡献。其它栏目的精彩内容，也与您分享。我们更欢迎您把自己的经历，和我们分享，和各位同仁交流，使得CASA Bulletin 这个园地，丰富多彩，充满生机。

谢谢各位同仁的关注和支持。

本期专栏

产科麻醉管理的挑战与应对

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UNICEF 发言人 Grusovin 曾说过:“孕产妇死亡水平是一个社会妇女地位的关键标记, 它们反映了一个国家健康服务的优劣和妇女在社会中的文化定位。” 1990年世界卫生组织 (WHO) 曾提出25年奋斗目标, 即到2015年时降低孕产妇死亡率75%。而客观上只下降了44%, 由1990年532,000 孕产妇死亡降低为2015年的303,000, 远低于预期目标^[1]。当前美国每年大约有900名孕产妇死于孕期和产后, 40.8% 的死亡发生在妊娠期和产后一周的时间内, 相当于孕产妇死亡率(maternal mortality ratio, MMR) 大约为 22名死亡/100,000活产, 这在高医疗资源国家中是最高的^[2]。另外一个令人担忧的趋势为美国的MMR逐年上升, 由1990年的17.5/100,000 到2015年的 26.4/100,000活产, 与另一项研究结果吻合^[3], 即2000年的MMR 18.8/100,000 递增到2014年的23.8/100,000 活产, 而同期世界范围内MMR呈减少趋势^[4]。同时美国的中至重度孕产妇合并症(moderate to severe maternal morbidity, SMM) 的发病率也在比死亡率更惊人的速度逐年递增^[5], 1993至2014的20年内美国的SMM增长了约200%^[6]。研究发现近一半的孕产妇死亡和SMM是可以预防的^[7]。我们需要严格审查, 去发现这个问题的原因和诱发因素, 采取预防手段; 也要分析为什么美国落后于其他发达国家, 如何从政策法规上弥补缺陷。

一、导致SMM和MMR升高的原因和影响因素

1. SMM的四大主要原因

- 1) 大出血
- 2) 子痫、先兆子痫、妊娠高血压, HELLP综合征
- 3) 感染、脓毒症
- 4) 血栓、栓塞

感染和高血压危像造成的产妇死亡常与没有及时发现情况和处理不积极有关, 剖宫产(C/D)率有升高的趋势, 这些都是今后需要集中精力改善的方面。先兆子痫和子痫引起死亡的主要原因是颅内出血^[8], 使用高血压管理流程重点在及时降压, 可以显著降低先兆子痫相关的SMM和死亡^[10]。妊娠期肥胖与SMM升高有关, 包括增加了先兆子痫、感染和脓毒症的危险^[11]。C/D妇女的SMM和孕产妇死亡率都显著高于阴道分娩, 减少初产妇C/D以便降低继发C/D及其伴随的SMM风险(例如子宫破裂、胎盘植入、C/D子宫切除)应该是全国的优先要事^[12]。然而研究发现随着初产妇C/D下降, 阴道分娩器具助产率增加, 同时3度和4度会阴撕裂发病率增加, 产程延长, 这样潜在意味着硬膜外使用率上升, 甚至对麻醉医护人员需求升高。可喜可贺的是由麻醉并发症造成的产妇死亡仍然很低还有明显下降, 达到百万分之一, 包括困难插管、高位腰脊麻和意外硬膜穿透^[9]。

表1. 美国孕产妇死亡的主要原因【8】

死亡原因	%	孕产妇死亡 特异死因 MMR [^]	1987-2013趋势 (↑或↓)
心血管病	26.4*	4.2/100,000	↓
大出血	11.4 - 14.0	1.8/100,000	↔
脓毒症/感染	10.7 - 12.7	2.2/100,000 (UK)	↔
静脉血栓栓塞	8.4 - 9.3	1.5/100,000	↓
先兆子痫 & 子痫	7.4 - 9.4	1.5/100,000	↓
精神心理健康状况	7.0		↓
脑血管意外	2.8 - 6.6		↔
羊水栓塞(AFE)	4.2 - 5.5	1.2-6.6/100,000	?
麻醉相关并发症	0.2 - 2.3	1/1,000,000	↓

[^]每 n 个活产; *包括“心血管情况”和“心肌病”

2. 造成产科合并症的主要影响因素【13】

1) 患者层面因素: 平均孕妇年龄上升(尤其是 ≥ 40岁), 孕产妇合并症增加(例如肺动脉高压、产后大出血、心脏病、先兆子痫), 生育能力不足/使用体外受精增加以及剖宫产(C/D)率上升。

2) 人口和医院层面因素: 肥胖症高发, 糖尿病, 高中未毕业率增加, 使用医疗救济卡Medicaid/无保险和非白人族裔的比例上升, 以及各州逐渐采用2003年死亡证明的不同等【14】。

可以改进的方面包括:

- 1) 医务人员: 处理延误或不当, 沟通不良, 缺乏病患教育
- 2) 患者: 控制慢性病不理想, 耽误寻找保健, 不遵医嘱, 社会经济地位低
- 3) 体质: 政策、手续, 延误转送更高一级诊疗中心, 沟通, 种族之间医疗不公平

表2. 孕产妇死亡率在不同族裔中有明显差异(2011-2015年)

种族	孕产妇死亡率/100,000活产
黑人	42.8
亚裔/太平洋岛居民	14.2
白人	13
西班牙拉丁裔	11

二、从认识问题到预防: 产科合并症指数(Obstetric Comorbidity Index, OCI)

近年已经提出一系列孕产妇风险预估模式。Bateman 和同事们创立了孕产妇并发症指数(OCI) 用于预期高危孕产妇入住ICU风险、末端脏器损伤和孕产妇死亡【5】。OCI又进一步证实可以用于综合评估妊娠并发症负担, 可能具有评判哪些孕妇分娩时会发生SMM的预期价值【15】。一旦早期识别高危孕妇, 多学科团队甚至能够在怀孕前做好预案。团队会系统地创立详细的产前和围产期计划, 预计和准备应对并发症, 所有团队成员会定期沟通达成共识。哈佛医学院布兰根妇女医院去年的文章将推进OCI的应用(表3)。

表3. 孕产妇合并症指数评分重量和所研究人群中各个情况的流行率(总数N=2828) [15]

孕产妇状况	合并症分数	人数n(%)
严重先兆子痫或子痫	5	115 (4.07)
先兆子痫/妊娠/慢性高血压	2	337 (11.92)
充血性心脏衰竭	5	2 (0.07)
肺动脉高压	4	0 (0)
缺血性心脏病/心律不齐	3	39 (1.38)
先天性心脏病和/或瓣膜病	4	33 (1.17)
多胎妊娠	2	82 (2.90)
胎儿死亡	2	19 (0.67)
胎盘前置/怀疑胎盘植入/早剥	4	73 (2.58)
既往剖宫产史/子宫肌瘤切除术	1	470 (16.62)
自身免疫病/红斑狼疮	2	91 (3.22)
HIV/获得性免疫缺陷症	2	1 (0.04)
镰状细胞病/出血疾病/凝血障碍/使用抗凝剂	3	103 (3.64)
癫痫/脑血管意外/神经肌肉疾病	2	50 (1.77)
慢性肾病	1	24 (0.85)
哮喘	1	431 (15.24)
糖尿病用胰岛素治疗	1	134 (4.74)
孕产妇年龄		
>44岁	3	20 (0.71)
40-44岁	2	179 (6.33)
35-39岁	1	723 (25.57)
药物滥用	2	29 (1.03)
酗酒	1	13 (0.46)
BMI kg/m ²		
>50	3	0.85)
>40	2	159 (5.62)

Easter 等. OB-CMI 评估孕产妇风险. Am J Obstet Gynecol 2019. 研究表明OCI得分越高, 患者住进ICU的可能性越大, 呈明显正相关。总结1998-2013年间麻省超过一百万孕产妇的大数据发现, OCI有逐年上升趋势, 相应的SMM比例亦逐年递增 [6]。58%的医院内分娩的OCI为0, OCI中间值由1998年的0.60增加到2013年的0.82, 说明麻省妊娠妇女总体的风险增加。平均SMM为44.9/10,000医院内分娩。OCI得分越高, 发生SMM的风险越高 [15]。出现SMM的频率由OCI零分的0.41%直到OCI 9分的18.75%, OCI每增加1分, 患者发生SMM的风险增加1.55倍(95%可信区间, 1.42-1.70)。更重要的是OCI得分越高, 可预防的SMM比例也越高, 意味着我们可以利用OCI这个筛选工具来预防SMM。

目前大力提倡用产妇早期预警系统(maternal early warning system, MEWS)及早发现可能有危险的患者, 实施评估和干预, 预防SMM。近来多项研究证实了MEWS可以有效降低SMM, 尤其是感染、心功能下降、严重高血压和出血的状况 [16-19]。MEWS具有高度敏感性, 负预期值高于90%, 显示出极高的预估SMM的可能性。

三、解决SMM这一问题: 下一步怎么办?

1. 孕产妇安全协同合作 (Safety Bundle)

全国孕产妇安全合伙机构(National Partnership for Maternal Safety, NPMS, www.safehealthcareforeverywoman.org) 包括美国麻醉医师协会ASA和围产期产科麻醉新生儿学会SOAP

等。过去几年内，NPMS 设立了10项产科安全协同合作。以便通过多学科合作推进行医文化的改变，进一步持续改善患者安全^[20]。每个协同合作，由4R核心组成：

- 1) 准备Readiness
- 2) 识别和预防Recognition and Prevention
- 3) 反应Response
- 4) 上报和系统学习Reporting/ Systems Learning

麻醉医生应参与所在医院安全合同协作的实施，访问NPMS 网站。比如大出血安全合同协作在加州99个合作医院与非合作医院比较，合作医院的SMM降低了20.8%，在产房护士参加安全模拟演练、失血定量、出血危险评估几方面有了明显的改善^[21]。

2. 孕产妇保健创新联盟：提供同行间支持，跟踪数据，通过基准测试来评定产妇结局，目标是消灭可预防的 SMM和孕产妇死亡^[22]。

3. 孕产妇死亡审查委员会(maternal mortality review committee, MMRC)

通过支持国家、州立和系统层面的孕产妇质控项目，我们可以构建安全平等的文化^[23]。当前迫切需要建立面对所有妇女的早期、可靠、平等和高质量的生殖保健系统，需要公开衡量、报道和讨论种族之间SMM和MMR的差异并使用数据进行有意义的改革，减少孕产妇结局的裂口。现存的全国围产期质量协作网(Perinatal Quality Collaboratives, PQC) 倡议在各州MMRC基础上成立国家级 MMRC, 重点分析孕产妇死亡病例以及制定一个针对性行动计划，降低孕产妇死亡^[2]。

4. 立法法案^[24]

1) Maternal Care Act: 参议院Bill 3363(2018年8月) -Maximizing Outcomes for Moms through Medicaid Improvement and Enhancement of Services (MOMMIES) Act:

参议院 Bill 3494(2018年9月)将产后Medicaid 资助由60天延长到365天。

2) Rural Maternal and Obstetric Modernization in Services (Rural MOMS) Act:SB 3568(2018年10月)

四、麻醉医生为降低SMM的特殊作用

我们作为多学科团队的一部分会发挥围产期医生特别是危重病医生的作用，特别是根据临床复杂性分级医院的 3-4级医院^[25]，需要有ABA证书甚至产科麻醉专科培训毕业的麻醉医生参与管理。

- 1) 对复杂的孕妇，鼓励早期产前麻醉会诊，参与多学科保健计划的制定和管理。
- 2) 参加医院和区域的MMRC, 参加全国孕产妇安全协同合作，使用MEWS 鉴别高危患者，辅助产科医生诊断和治疗分娩过程中的紧急危重事件，尤其是需要ICU处理的危重孕产妇。
- 3) 大出血时输血和心肺复苏，我们有责任协助减少危重情况下的SMM和死亡。

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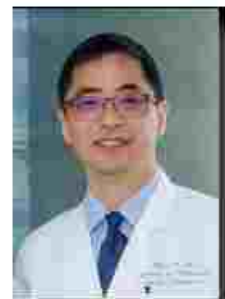
中国产科麻醉和分娩镇痛推广10年，我们如何可以做得更好？

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1983年毕业于武汉医学院本科，1991年获得同济医科大学博士学位，2003年在德克萨斯大学加尔维斯顿医学院完成麻醉住院医师培训。2003年至今，在达拉斯德克萨斯大学西南医学中心从事麻醉工作。自2011年，多次担任“无痛分娩中国行”领队，并参与编撰适合国内医生使用的产科麻醉系列丛书。

声明：以下描述的现象和见解，系根据本人近10多年在中国医院的耳闻目见和与国内同行交流所得，也含有参与“无痛分娩中国行”中美医生、护士和助产士的交流心得。个人体会，可能会与部分读者所在的医疗环境和现状不完全符合，敬请谅解。



本人自2004年开始，每年多次往返中国推广椎管内分娩镇痛和麻醉安全。2006年起，在国内最大生物医学论坛《丁香园》上进一步推广麻醉知识，讨论的重点也在产科麻醉和椎管内分娩镇痛方面。2011年起，本人参与了由美国西北大学胡灵群医生领头的“无痛分娩中国行”（中国行）系统性医学教学活动。在此期间，国内的医疗条件和环境也有了很大的改变。中国政府对中国较高的剖宫产率采取的一些行政措施，加上全面开放二胎政策和媒体对于陕西榆林产妇跳楼事件的关注，使得国内产科从过去几十年的大规模剖宫产慢慢回归到了提倡经阴道分娩的主流，也推进了椎管内分娩镇痛的发展。不过，多年来中国体制对产科和产科麻醉造成的深远影响在很多医院还比较明显。目前，在产科和麻醉界获得可喜进展的同时，我们也看到了可以改进的空间。

一、综合医院和妇产专科医院

中国的一大特色就是有妇产医院和妇幼保健院。综合医院对妇产科的经阴道分娩（顺产）不太重视。那里的产科医生也往往只注意复杂的产科手术。妇产专科医院的长处在于医院各级对妇科和产科麻醉镇痛质量和安全比较重视，“中国行”的突破口也是在这类医院打开的。一些有利于产妇椎管内分娩镇痛安全的措施和项目，比如麻醉科医生24小时进驻产房、产房内紧急剖宫产手术预案等措施得到推广，而且效果也比较确切。专科医院的缺点就是对于并发症的处理有欠缺，从设备和人员配置上比较被动，时常会出现将危重孕产妇临时转诊到上级综合医院的情况。

二、产科医生和助产士对经阴道分娩的管理

无论在综合医院还是妇产专科医院，产科医生的主要医疗阵地在大手术室。由于大部分医院剖宫产占很大比例且国内手术台位紧张，产科医生基本是在高效连台手术。产房的主要工作人员是助产士（身兼美国产房护士和助产士双重角色）和一些年资不太高的产科医生，是他们在管理经阴道分娩（顺产）。助产士在产程管理和分娩镇痛方式选择上，比如是选择药物镇痛还是“导乐”安慰，有很大的决定权，也是椎管内分娩镇痛是否能在医院推广的重要因素。理论上，产房内产妇出现并发症时，需要产科医生和麻醉科医生协同管理，但助产士对于并发症是否发生和严重程度警觉程度不一，并发症是否能得到及时观察和处理和助产士人手以及临床经验有关。

30年的高剖宫产率使得大多数医院的产科医生对经阴道分娩缺乏管理知识和临床经验，特别是综合医院不擅长经阴道分娩，往往需要派年轻医生到妇产专科医院学习阴道分娩技术。一些产科医生和助产士对于产程的进展和围产期并发症缺乏基本认识。产科最常见的并发症是妊娠期高血压，当产妇收缩压达到或超过140mmHg，有时被忽视。对于过期妊娠以及胎膜早破超过1天者引产措施不到位。用缩宫素引产（induction of labor）或增强宫缩（augmentation of labor），没有现代化系统的剂量递增方法，达不到缩宫素引产的预期效果。与现代医学最不合拍的是缩宫素的使用方法和剂量。许多医院还在参照一些教科书里讲述的数滴数方法，而没有用微泵（国产微泵一台3000-4000元）。缩宫素剂量没有按微单位程序化递增，也不依据宫内压力（国内无宫内测压装置）或子宫收缩强度和频率，甚至有些助产士不知道使用缩宫素后宫缩应该达到何种程度。其结果是缩宫素剂量不足，如同隔靴搔痒，根本达不到治疗目的。

对于产程长度的限制，不少医院还在保持第二产程不能超过2小时的理念。为了尽快结束产程，器械助产（产钳）使用率明显高于美国。此外，很多产科医生和助产士认为，会阴侧切可以减少会阴撕裂，所以会阴侧切率在某些医院高达75%。“中国行”所去过的医院，会阴侧切率可以大幅降低，但远远达不到美国会阴侧切仅仅用于紧急情况、总体不到0.5%的水平。现代文献认为，器械助产与导致会阴部损伤明显相关，而会阴侧切可以加重深度裂伤，其远期并发症高于自然撕裂。国内有些医生对这些概念不甚了解，认为器械助产是缩短产程的法宝，而会阴侧切是保护会阴的必要手段。

三、产科医生和助产士对椎管内分娩镇痛的疑虑

不少医院，椎管内分娩镇痛开展不久或尚未开展，产科医生和助产士对椎管内分娩镇痛存在很多疑问或古老的偏见。在“中国行”开展的初期，助产士抱怨，有了分娩镇痛，产妇不喊叫就无法得知产程进展。随着分娩镇痛开展，产科医生和助产士心中的偏见仍是分娩镇痛推广的阻碍。她们的顾虑集中反映在：分娩镇痛可以导致发热、宫缩减弱、胎心下降、产妇无力、产程延长。因此，分娩镇痛开展后，器械助产和会阴侧切在某些医院可能会增加。许多产科和助产士对分娩镇痛的施行时期有宫口扩张程度的限制，比如，3cm以下太早，8cm以上太晚，而“中国行”团队强调的是：只要进入产程就可以做，宫口没有最小也没有最大的限制。对于需要引产进入产程的产妇可以提前实施椎管内分娩镇痛。

产科医生和助产士对椎管内分娩镇痛后的最大管理难题在于完全无痛下产程的进展和第二产程用力（pushing）的管理。没有分娩镇痛的情况下，在宫口开全和胎先露下降后，产妇会有便意感，配合每次宫缩，按排便方式用力直到胎儿娩出。施行了良好的分娩镇痛后，产妇宫缩感和便意感都不明显，有时宫口开全后也不知道。在发现宫口已经开全后，助产士不知道如何在无宫缩痛和便意感不强的情况下指导产妇用力。“中国行”团队反复演示：利用手摸宫底或子宫张力，觉察到子宫收缩时，指导用力（必要时可用手指压迫产妇直肠，增加排便感）10秒，深吸气呼气，再重复2次。国内助产士普遍认为，这样的分娩方式，产妇满意，效果好，但比较耗费人力。

四、医院和体制的设置

大多数医院，产科医生在另一层楼普通手术室做剖宫产，助产士在产房管理产妇。产房和手术室属于独立的机构，没有产房手术室一体化的结构，产房内本身没有紧急手术室。这是推广经阴道分娩最大的安全隐患。“中国行”去过的医院，产房会临时改造一间紧急手术室，但其设备和普通手术室不能比拟，往往麻醉设备不全。很多医院产房内的手术室，只能说是为局麻下剖宫产提供了一个场所，

没有高级监护设备和处理大出血以及心肺复苏的能力。

产房内部的布局一般分为待产区和分娩区。这两个区加起来的床位数往往低于在院内已经进入产程的产妇人数。不少医院，产妇虽然已经进入产程，但宫口没扩张到3cm或胎膜未破裂，就只能在监护条件不足的病房里等候。这种体制为待产早期可能出现的紧急情况，包括脐带脱垂，留下了很大的安全隐患。

目前只有很少医院配备有中心化胎心监护系统，即使有中心化胎心监护的医院，也不能做到多屏幕、多场所、对所有产妇的胎心一目了然。

很多基层医院没有血库，需要时只能到管理整个区域的中心血站去取血。这种现象始于80年代，是由于输血管理不当导致严重传染病扩散后政府所采取的纠正措施。然而，产妇失血不分地点。去中心血站取血，往返可能需要1-2个小时。血液制品到达医院后，需要花费45分钟时间进行交叉配合。血库或血站发血，一般一次1-2U。血小板的使用需要预约，基本不可能及时输入。

五、麻醉科医生的配备和知识水平

全国都紧缺麻醉科医生，每位医生都在超时劳动，这是一个普遍现象。在年分娩量2万例的医院，产房内通常白天可能有1-2位麻醉医生当班，而夜班只有1位，外加1名麻醉护士（类似于美国的麻醉技术员）。中国医生的辛劳程度和奉献精神是任何国家都不能比拟的。

产科麻醉，目前在中国还没有进入专科发展阶段。医院里普通手术室，手术周转超快，盈利高。有些著名医院，节奏快得甚至连手术之间完全消毒清理（turnover）都做不到。与剖宫产相比，产房里的经阴道分娩和椎管内分娩镇痛，收费低，耗时长。麻醉科在人手已经不足的情况下，不可能把产房的需要放在重要位置。大多数麻醉科也没有把产科麻醉作为一门学科来培养带头人、组织专业队伍。由于没有专科训练的条件和环境，产科麻醉的发展依赖于少数对产科麻醉感兴趣医生的自学和摸索，理论知识和解决问题的能力进展较慢，缺乏系统性培训。

产科椎管内分娩镇痛和麻醉临床实践中还存在许多陈腐的理念。最常见的问题，就是硬膜外分娩镇痛药量很低，如5-6mL/h，而不是现代理念国家的12-15mL/h。由于药量太低，分娩镇痛质量不高，只能做到一过性减痛，而没有做到全程性和完全性无痛。有些医院，置入硬膜外导管后，给一定容量的2%利多卡因，产妇可以立刻减痛，但2小时后，疼痛感恢复。部分助产士熟知这一现象，特意要求产妇晚一点镇痛，以便在第一产程后期和第二产程获得一点镇痛效果。

第二产程镇痛效果差是一个很普遍的现象。硬膜外腔隙的顺应性，骶尾部较差，需要高容量、高压扩散。在泵速只有5-6mL/h的情况下，骶尾部镇痛是很难做到的，而麻醉医生对大剂量手工推药有一些顾虑。当然，麻醉科医生人手不足，不能做到全程巡视，不仅对第一产程突破性疼痛缺乏管理，对第二产程镇痛作用消失的观察和处理也不够。

麻醉科医生的产科知识不足也是一个比较普遍的现象。目前，能做到麻醉科医生“随叫随到”已经是很不错的医院了，麻醉医生“不请自到”积极参与产科患者管理的医院几乎没有。产房里，麻醉科医生对产科并发症的关注程度、胎心下降的床边处理、为产科医生积极提出麻醉方案（臀/横位外倒转）和共同处理（如建立静脉通道、有效成分输血）的时机不多。

阴道试产椎管内分娩镇痛后中转剖宫产（“顺转剖”）的管理，目前比较混乱，产科医生普遍抱怨肌松效果差，产妇抱怨痛。这里有3个因素：1) 产科与麻醉科交流不足；2) 麻醉科对分娩镇痛后产妇巡视不够；3) 麻醉科医生经验不足。产科决定“顺转剖”时，基本没有和麻醉科提前交流，往往是产妇进入手术室后，才把“麻醉师”叫上来加药。麻醉科医生工作太忙或者根本不在产房，对产房内有多少产妇、哪些人有镇痛、镇痛施行了多长时间、哪些产妇破膜多久、试产多久、用了缩宫素催产与否、是否已经发生了绒毛膜羊膜炎等情况根本不了解。“顺转剖”，分娩镇痛转变为剖宫产麻醉，最重要的先决条件是良好的镇痛，而在镇痛容量不足、镇痛效果本身就模棱两可的状态下，要分清哪些产妇镇痛效果好、哪些产妇镇痛效果不好是不可能的。一般医院，基本没有处理分娩镇痛效果不好的寻因逻辑图，也无及时更换效果不好者硬膜外导管的常规。产妇和助产士也似乎满足于反正做了“无痛”，镇痛效果不好就是个体差异，无法再改进了。麻醉科医生周密巡视、完全无痛无喊叫的产房，国内比较少见。

六、民间意识和收费体制对产科和分娩镇痛的影响

民间意识选择“良辰吉日”生产还有一定市场，而其分娩方式往往是择期剖宫产。椎管内分娩镇痛施行的阻力还来自于产妇和家属担心药物会对胎儿有影响，甚至有部分号称“自然派”的助产士也借势推波助澜，推行更为创收的导乐和水中分娩。

部分地区椎管内分娩镇痛无合理收费标准，也是医院和麻醉科积极性不高的原因。妇幼保健系统，近年来为了树立“自然分娩”的品牌，院领导比较支持椎管内分娩镇痛。很多地区实施生育保险承包式收费，比如一次分娩包干报销5000元。有了椎管内分娩镇痛，可以减少剖宫产，医院会净盈利，这对以“自然分娩”为主导的妇产医院是一个很好的鼓励。

由于中国文化对性生活避而不谈，对学生也没有避孕教育，导致人工流产比较多。有些医院每天人工流产数量可接近上百例。对这样的患者，医院基本是“批量化”处理：集体知情同意谈话、多患者一起上台、简易麻醉操作和监护、1-2名麻醉科医生负责、“遥听”氧饱和度监测声音。一些小医院，特别是某些民营医院，打着“无痛人流”的牌子，以“无痛清得很干净”为噱头，在不使用超声定位的条件下大面积深度清宫，这对子宫内膜伤害很大。这种情况造成了貌似胎盘植入低风险的第1-2胎剖宫产，术中会意外发现胎盘植入的情况。

对已知有胎盘植入者，国际上认可降低并发症和死亡率的手段是采取宫底切口娩出胎儿，然后对胎盘不经剥离而整块（en bloc）切除。目前这种方法在国内施行还不多，似乎医生们普遍认为施行子宫切除是弱者的表现或是把产妇去女性化了。有些医生纵容百姓子宫是女性根本的认知理念，承诺或暗示可以为高风险胎盘植入产妇保子宫，甚至以“保留子宫高手”的名誉自居。部分患者，为了拼命保子宫而付出了惨痛的代价。

总结

10多年来，国内产科和麻醉界已经有了很大的进步。在人员匮乏和制度不健全的情况下，努力降低高剖宫产率，为大量妇女解决安全生产问题，已经取得了一定的成就。但在进一步提高科学化管理、降低合并症和死亡率方面仍有一定的改善空间。系统化改变教科书里陈腐的理念是提高下一代产科和麻醉科医生素质的关键。笔者希望利用此文，找出我们的差距，并提供诚恳建议，期望中国的产科麻醉技术能与世界先进国家并驾齐驱。

注：本文引用：陶为科 致产房 中国产科麻醉和分娩镇痛推广10年，我们如何可以做得更好？J NPLD-GHI2020 Jun 21;7(6):21

鸡蛋与石头、黑猫与白猫

无痛分娩中国行

胡灵群

无痛分娩中国行当初矢志用10年时间来改变中国的无痛分娩现状。不少人好奇地问：“是怎么计算出10年的？”

中国学术的常规运作是由学科带头人们，通过全国年会，通过教科书，通过近年兴起的临床指南或中央的行政措施，由上而下地部署最终形成的。中国行早年的经历印证了这一点。

曾有两家无痛分娩中国行的医院要求我们出具介绍信，理由是他们从来没有接受过除了卫生局（之后改成了卫生计划生育委员会，现在正式更名为卫生健康委员会），或来自医学会的教育项目，我们这样的草根够资质吗？

有的说：“我们只能按照统编教材办事，不然患者告发我们，法官只认教科书！”

还有很多“中国通”给中国行出主意：要改变中国现状，走上层路线是捷径，也是唯一途径！

对，有道理！就这么干：至上而下。中国一共有8大军区，加上北京和上海，共10大区域；一个区域一家“领袖”医院，一年一家医院，中国行的10年计划也就这么形成了。

但计划永远赶不上变化！

到了十年后的2018年夏天，结果与设想大相径庭：中国行虽然有了99家合作医院，分布在全国各地。但不少合作医院的规模小到了区妇幼保健院，还有民营医院，高大上的“领袖”医院并不够数。来华人数也达到了700多人次，远远超过了计划中的160人次（16人次/年x10年）。

记得分别于2010年、2013年和2015年开始合作的3个“领袖”医院，一周下来几乎没有做一例无痛分娩，却是“敲锣打鼓”热闹非凡。这实实在在地“教诲”了无痛分娩中国行：在这里充其量只能开个学术会议，以团队中的洋面孔撑场面，而要上报纸或上医院的网页宣传开展“无痛分娩”这类“非高大上”和“非正道”的医疗项目，难上加难。但是，第一次领教后，每隔1、2年就“好了伤疤忘了痛”，对“既定计划”耿耿于怀一直期待，甚至是幻想。现实却是那么残酷，不以人们的意志为转移。

我们或许遇到了坚硬的石头而不是鸡蛋，而石头是永远孵不出小鸡来的。

在第一次“教诲”过后，中国行学会了“转弯”。通过《丁香园》麻醉版主、美国得克萨斯大学达拉斯西南医学中心陶为科医生引荐，我认识了深圳宝安区妇幼保健院的产科范静医生。她将无痛分娩中国行介绍给了自己所在的医院。2012年夏天，无痛分娩中国行一行12人，进入了这家计划外的区

级妇幼保健院，进行了为期一周的基本建设计划。整个过程非常圆满，我们团队实地进入了产房和手术室，24小时麻醉科医生进驻产房的无痛分娩也开展起来了。

后来，与类似的区级/市级妇幼保健院合作多了，很多人将这种运作称为“农村包围城市”。

但好事多磨，后续的进程其实不尽如人意，并非“农村包围城市”的转向就能使得无痛分娩顺利推进。在中国行团队离去后，深圳宝安区妇幼的无痛分娩并没有“轰轰烈烈”往前推进，月平均镇痛率在20%上下徘徊。或许是因受到了邻居香港很多非主流医疗“非药物分娩镇痛”的影响之故。非药物像绿色食品一样诱人，有的方法已流传了上千年，还一直没有证实其镇痛有效性。如果重新策划中国行，非药物分娩镇痛的方法及其历史，一定会在“无痛分娩中国行”的教育课程中详加介绍，而不只用《你一定要知道的无痛分娩-来自哈佛的完全解答》中的一章来讲解，以避免类似美国的法定禁酒年龄制度反而让叛逆年龄段的青少年对酒更好奇这一现象。

深圳宝安区妇幼保健院的转机始于一年后。2013年6月27日，应医院新任院长陈旭之约，通过医院副院长郭华医生牵线，我们在当时无痛分娩中国行团队在重庆市下榻的宾馆大堂见面，陈院长还带着至今我依然记忆犹新的两盒广东新鲜荔枝。他耐心地听取了无痛分娩在西方的现状，以及对母婴安全的利弊和未来的展望。不知不觉地我们一起交流了2个小时，也让我真正感觉到了知音的含义。后来，我们都见证了这家区级妇幼保健院的发展，他们的麻醉科正式从妇产科独立出来，妇产科主任和产房护士长也先后有了新面孔，这家医院的故事也因此于2016年8月香港举行的世界麻醉科医生大会广而告之。陈旭院长深有感触：“中国行能让人站在巨人的肩膀上，让我们跃进了30年的时间。”

迄今为止，陈院长已经迎接了大量全国各地的参观者，其中不缺高大上的三甲妇幼保健院的代表。目睹了这家区级医院的硬件条件、软件水平、团队合作后，他们惊奇无比。唐山市妇幼保健院的产科李淑英主任参观后告诉我：“感谢你的推荐。当时领导们顾虑去一家区级医院参观没有什么可学的，还感觉有点掉身份。以前也曾参观过北京一家号称是中国妇产领域象牙塔的酒店，再到宝安区妇幼保健院，令我们耳目一新，不敢相信差别是如此巨大，我都感动得掉了泪。大家都应该去那里开开眼界。这比去国外参观意义大多了，因为那就发生在我们的国家，我们的公立医院，离我们这么近，我

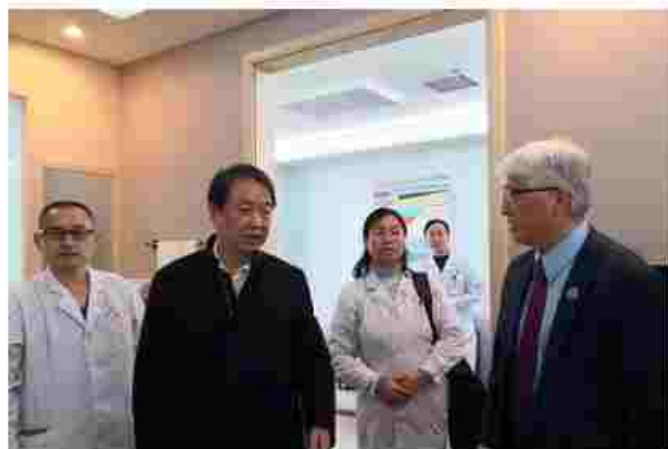


2018年深圳市宝安区妇幼保健院陈旭院长（右2）、郭华副院长（右1）、朱元方副院长兼妇产科主任（左1）和其他医护人员代表接受“现代产房”牌匾

们没有任何不适合国情的借口。它的鞭策是如此之大。”陈院长告诉来访者，没有无痛分娩中国行的理念，我们新建的医院只是重复了其他医院的硬件现代化而已。说实在，陈旭院长让我们学到了“不换思想就换人”的用人法则。后来便形象地说成“换不了脑袋换屁股”。

类似的场景在和陈旭院长见面2周前已经发生了1次。那是2013年6月7日，在武松打虎的景阳冈附近，山东省聊城市东昌府区妇幼保健院里，我正在和院长郭敬春医生交谈2014年合作之际，河北的威县人民医院孙英勇院长来电话，请求中国行帮助开展无痛分娩，而且他和产科主任吕书华正在驱车前来聊城会我。这让我非常纠结。因为一年后的2014年合作医院早已经确定，美方医护人员也已经基本确定。这一计划外的医院，非常真诚，也非常需要帮助，怎么办？

为难之际，聊城的郭敬春院长爽快地让从威县驱车赶来的孙英勇院长一行共进晚餐，一起讨论如何开展无痛分娩，以及和中国行合作等事宜。“梁山好汉”文化区的人，以自己的特质，意外结交了个志向相投的“结拜兄弟”，也激励和促使了中国行尽早与威县人民医院合作。



2018年河北省威县人民医院孙英勇院长(左2)和麻醉科主任齐学勤(左1)等陪同胡灵群医生参观医院现代产房

通过多方努力，无痛分娩中国行不负众望，次年派遣了一个以约翰霍普金斯大学人员为主的小分队到达了威县人民医院，也守住了当年许下的“没有中国行不努力的”诺言。2015年威县人民医院实施了现代产房高级计划，2018年有了现代产房挂牌计划。2020年原计划实施孕产妇心理健康计划，因为新冠病毒的大流行被迫推迟。但和中国行的合作一刻也没有因此停止。2020年我们用威县数据在《麻醉与镇痛》杂志发表了一篇临床研究文章，比较当年中国行一周前后母婴临床结局所发生的实质性变化。让世人知道了，中国有个威县人民医院，采用了西方先进理念开展现代产房建设后，母婴健康指标得到全面改善。

2014年6月15日晚上，山东省枣庄市妇幼保健院，在欢迎中国行队员到来的欢迎会上，山东淄博市桓台县妇幼保健院张勇院长、产科金彩芹主任、麻醉科赵立华主任出现在现场。我原以为同在山东，约他们过来是件轻而易举的事，万万未料到，他们从桓台县到枣庄，走高速公路至少需要4个多小时。他们长途跋涉而来只是为了一个请求：帮他们开展无痛分娩。后来他们加入当时的“无痛分娩中国行扶植计划”，迈开了第一步。此后毫无延迟地一路推进，成为第一批挂牌“现代产房”的医院之一。张勇院长感叹：“三年的无痛分娩中国行，培养的是一种意识，养成的是一个习惯，锻炼的是一种能力，获益的是无数的生命！”



2018年山东省桓台县妇幼保健院张勇院长和医护人员接受“现代产房”牌匾

在2014年夏天同一个星期，我正要去威县，意外接到了邢台人民医院刘登湘副院长的电话，要

求面谈一下合作意向。我的行程早已排满，11天要去18个医院，实在难以挤出额外时间。后来发现，去威县坐高铁正好要在邢台站下，驱车从邢台到威县还有1个多小时可以利用。我十分为难地提出了一个有点过分的要求：“刘院长，你能不能到高铁站接我，我们一起坐车去威县人民医院的路上开个短会？”想不到，这个近似“无理”的要求马上被采纳了。刘院长、产科乔宗旭主任、麻醉科曲振华医生一起挤在一辆轿车里，成全了无痛分娩中国行和邢台市人民医院在2016年的合作。这是一个与中国行合作为数不多的综合医院。在后来的2018年现代产房高级计划实施过程中，他们的陈树波院长发现，中国行的急救模拟医学教育对其他科室的工作有很好的借鉴作用，在模拟教学现场紧急召集有关科室主任前往产房，顺势召开了一个现场交流会。至今，这所医院将中国行教学的事件回放（debriefing）变成了一个全院学科管理的传统。他们也将通过“挂牌计划”继续和中国行的合作。



2018年6月河北省邢台市人民医院陈树波院长（右3）和产科乔宗旭主任（左1）

全国性的“无痛分娩中国行现代产房多学科论坛”起始于2009年，每年在上海召开年会。这是中国第一个多学科参与的围产医学研讨平台。2017年的年会改在上海以外的地方召开，并确定为专题讨论医院管理的院长现场交流大会。一共有56位公立私立、大小不同级别医院的正副院长出现在会场。陈旭院长讲了他的“换不了脑袋换屁股”，当场出现几位愿意合作的院长，这些都是意料之中的事。2008年在杭州第一次公开课的时候就有过一个温州院长来访的先例，后来也在深圳见过广东江门市新会区妇幼保健院的院长。但意外的是，贵州省遵义市妇幼保健院的院级领导班子全体现身于“院长专场”，强烈要求合作。这规模也是中国行历史上唯一的一次。在医院领导的齐心协力下，一年接一年，已经在2019年全部完成现代产房三级计划，挂上了“现代产房”的牌匾。

惊动一位医院的院长去见一位普通麻醉医生，为了开展一项不挣钱、还赔本（后来证实，规模化24小时麻醉科进驻产房并不亏本，而医院的间接收入增益大大出乎预料）、更折兵的医疗项目，给他们已经忙得不可开交的日程上又增加了一项工作，还有后续的一堆要人、要钱、要设备的事。上面几个院长可谓不按常理出牌。找上门的院长从一个人，变成两个人，到后来一帮人，实在出乎意料！这些都改变了对中国医院院长固有的“不务正业”、“外行领导内行”，“没有远大目光”的看法。



2017年遵义市妇幼保健院王健院长（第一排左2）等和全体无痛分娩中国行现代产房高级计划小分队合影

那些有心的院长，为了得到与中国行合作的机会，有诚意，有智谋。除了“登门拜访”，“不速之客”，“群起而围之”外，还有设“鸿门宴”的。可谓不达目的不罢休。

前广西柳州市妇幼保健院林墨菊院长正是这么一位。2012年夏天，通过麻醉科主任韦天全医生，以“想请你看看中国西部医院是怎么开展无痛分娩的”为由，我被邀请去他们医院考察和商讨合作。这位中规中矩、曾经要我们出具盖章介绍信的院长，不违反任何规定地在自己医院食堂宴请我们。她不沾酒，但坚定不移、不给讨价还价的余地，要求无痛分娩中国行2013年必须到柳州市妇幼保健院，不然就不放人！她认准这种教育方式比起她当年派一队人马去别的医院学习小儿心脏手术还要有效。下面是他们的进程：2013年6月现代产房基建计划（原名：产科麻醉基本建设计划），2014年3月现代产房高级计划（原名：高级产科麻醉123计划），2017年6月现代产房挂牌计划，2018年年底正式挂牌，2019年6月启动现代产房孕产妇心理健康计划。她马不停蹄，时不时还问：下一次合作什么项目呢？这所医院也因此“第一”上独占鳌头，成为第一家实施高级计划和心理健康计划的医院。

从外形上看，我们可以找到和鸡蛋一模一样的石头，“鹅卵石”，也同样可以作为装饰放在房间里点缀环境；从外观上看，我们或许可以找到比鸡蛋美丽无数倍的鹅卵石和精品雨花石；从功能上看，鸡蛋绝对没有石头抗压，也没有石头可以当作建筑材料的作用；但石头不是鸡蛋，没有生命，也永远孵不出小鸡。

那些愿意为母婴安全和人类医学作出自己贡献的院长们、医护人员们，赋予了他们所在医院远比石头丰富得多的内在能量，最终在外因作用下呈现出强大的生命力。

无痛分娩中国行能不能在一家医院帮上忙，更重要的是医院本身。中国行能帮上一家“鸡蛋”医院，但一定帮不了任何一家“石头”医院。中国行形似“农村包围城市”的运作，不正是“不管白猫黑猫，抓住老鼠就是好猫”的体现吗！这对于富有内在动力的医院的启蒙与推动作用不言而喻。

注：本文最初发表于：胡笑群.再回首,鸡蛋与石头、黑猫与白猫. JNPLD-GHI. 2020 Apr 3;7(4):3.

抗疫 COVID-19

Our True Potential

Qing Ding, MD

A Frontline Obstetrician and Gynecologist from NYC

The first COVID-19 case emerged on March 1, 2020. This initially disregarded disease quickly escalated into a nationwide emergency. At one point, melancholic statistics even emphasized that about one in seven expectant mothers testing positive for the Coronavirus.

March 18, 2020 was my first day back at our Labor and Delivery room during this unprecedented coronavirus attack. I was a part of the team who treated the first case of COVID-19 in our obstetric department. The patient was 17-year-old, hispanic female at approximately 36 weeks of gestational age. She was admitted around 2:00 am for a fever of 103° F and heavy coughing. The COVID swab was sent around 4:00 am. The CXR showed consolidation, and the laboratory works showed lymphocytopenia with a very low white blood cell count. Only a couple of days earlier, this patient presented lower abdominal pain, ruling out preterm labor, with no upper respiratory symptoms at all. In labor and delivery, we were not equipped with a negative pressure room. Thus, the patient was placed in an isolated triage room as a patient under investigation (PUI). She seemed stable with an oxygen mask, with an O2 saturation above 95%. Her fetal heart rate tracing also appeared reassuring by the time I took over the service at 8:00 am in the morning. She was put on vancomycin for the treatment of pneumonia.



As an obstetrician, I was never formally trained to use PPE. Luckily, I was just fitted for N95 last year. However, in early March, the CDC only recommended surgical masks for treating a COVID positive patient or PUI. I was also instructed during the morning huddle that only one attending physician should handle each COVID positive or PUI patient in an attempt to limit the exposure of the virus. Any resident physicians in training should not be allowed near the COVID positive or PUI patients.

As I was getting ready to focus on my PUI patient, I was given paper instructions on how to properly equip PPE. The nurturing hospital atmosphere that I had grown accustomed to turned into a warzone. My patients were my number one responsibility, but I was also burdened by the

fact that properly protecting myself would also mean safeguarding the lives of my family members at home. Luckily, our hospital always had enough PPE. As a physician, we routinely received two to three N95 masks and face shields weekly. In order to protect the N95 mask, we usually put a surgical mask outside of the N95. As a physician in the center of the pandemic, I was able to be with my family because they were so supportive and not afraid of contracting the virus.

Turning around, I reluctantly but boldly marched into the triage isolation room like an intrepid pilgrim. I donned my protective gear – covering my hair, masking my face, shielding my eyes. In a pandemic, healthcare workers are as much disease vectors as patients are, capable of transmitting the disease from patient to patient. So we protect ourselves in sterile plastic, almost yelling at our patients through the heavy PPE. Blocking my face increases the volume of my thoughts. As the pandemic marches on, every shift is different from the last. New policies, new tragedies, new conundrums. In what despicable ways will the coronavirus show up today?

A colleague OB/GYN attending paid me a visit from her shift in the adult intensive care unit. The hospital redeployed several members of the department in an attempt to stretch any and every available resource. A gynecologist managing ventilators – who could have imagined? We instinctively stood at opposite ends of the workroom, keeping a safe distance. How’ s it up there? She’ s wary. Today has been uneventful, but that’ s how yesterday started. Just before going home, the healthiest patient on her service coded and slipped away. Our gazes shift uneasily around the room. A few of our gynecology fellows were redeployed to the acute COVID floor as well. There was no training. They were learning on the fly. They generally carried about six patients each. All of the patients were on some form of oxygen, many on high flow oxygen which was the last step before intubation. The hospitalist attendings and the anesthesiologists had been great to work with. Most folks were working outside of their comfort zone. Everyone knew they had no idea how to treat this virus, and everyone they had interacted with had been nothing but supportive, pleasant and willing to do anything they could to help.

The day crept on. At 4:00 pm, 12 hours later, the lab result of the COVID test unfortunately returned positive for my PUI patient. A swift decision was then made to transfer the patient to the isolation floor accompanying with one of our labor room nurses for continuous fetal monitoring. The patient at this time remained stable on oxygen. On the second day, the patient’ s oxygen saturation level started to decline. A decision was made to transfer the patient to the ICU for possible intubation. On the third day, the nonreassuring fetal heart tracing was noted as the patient was on ventilator. A decision was made to perform an urgent primary cesarean section by our MFM and anesthesiology team in the main operating room with negative pressure. A healthy, live infant was born, and the apgar scores were 8 and 9. The baby was taken to the NICU for isolation and the mother was transferred to the ICU. Attempt was made for extubation, but it was not successful. The patient was continued being treated at ICU intubated while the newborn baby was discharged on hospital day 4 to the family with a negative COVID test. Thanks to our ICU and anesthesiology team, the patient was finally extubed on post op day 10 and was discharged home to her newborn baby and family on post op day 14.

We are in the midst of one of the most disruptive events in the modern times. The learning curve has been steep and it is mentally and emotionally challenging, but I have to say I have been inspired by everyone I have interacted with. Being a part of the NYC COVID-19 taskforce has been difficult but rewarding. From March to May, our hospital had a total of 1,359 COVID positive patients. We treated 1,429 inpatients with confirmed and suspected cases. The total number of deceased patients of COVID-19 was 234 - although of a disheartening magnitude, this was only a small fraction of those infected. We are currently testing every admitted obstetrical patient on our L&D. For patients who need elective surgery or induction of labor, we usually test them 2 days before the admission at our clinic. We will keep up with the great job until we win the war.

Out of all the fear and uncertainty brought about by this global pandemic, there comes a silver lining. The Coronavirus pandemic has only corroborated our community's ubiquitous vitality by bringing us closer and forging new friendships. We now stand more united and prosperous with newly created philanthropic enterprises that will far outlive any minuscule remnant of this invisible enemy.

回顾与展望

The Potential Impact of Artificial Intelligence on Anesthesia Practice

Report from the CASA ASA CSA SCA Presidents' Forum

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Key words: Artificial intelligence, anesthesia practice, practice management, machine learning

Background: Artificial Intelligence (AI) is increasingly used in clinical medicine. Surgical robot has been used in surgical procedures for almost two decades. However, AI application in anesthesia practice is scarce and future impact of AI on anesthesia practice has rarely been discussed. CASA, Chinese American Society of Anesthesiology, organized the panel discussion during ASA annual Meeting in Orlando, Florida. The participants of this panel discussion included ASA president Dr. Linda Mason, ASA immediate past president Dr. James Grant, ASA first vice-president Dr. Kimberly Phillip, Chinese Society of Anesthesiology (CSA) president Yuguang Huang, former CSA president Dr. Jin Liu, Society of Cardiovascular Anesthesiologists (SCA) president Dr. Stanton Sherman, and current CASA president Dr. Hong Wang. This is the second year CASA hosting such a panel discussion. Last year we discussed the challenging issues facing anesthesia practice, including opioid crisis and anesthetic drug shortages [1].

Dr. Henry Liu (Moderator, former CASA president) started with a statement. As you know, those most valuable companies in the world like Google, Apple, Amazon, Facebook, Microsoft, IBM etc. are investing

heavily on AI ^[2]. Russian President Putin said that who becomes the leader in AI will become the ruler of this world ^[3]. Healthcare spending on AI is estimated to reach \$6.6 Billion by 2021, which is an annualized 40% growth ^[4]. It is time for us anesthesiologists to think about the potential impact of AI on our medical specialty, anesthesia practice. The first question for all participants is “what roles of AI will play in anesthesia practice, from preoperative, intraoperative, and postoperative perspectives?”.

Dr. Linda Mason: Thanks for the opportunity to participate in this discussion here. I think there are some articles talking about this topic, there are enormous promises, but we as anesthesiologists are not quite there yet. Maybe we will be more involved in machine learning kind of things for now, but AI is evolving very quickly, it is not something we can ignore. Definitely there are opportunities for AI in anesthesiology in the future, we are just not quite there yet.

Dr. Jin Liu: I believe the cooperation between CSA and ASA is very important. The total number of anesthesiologists of our two countries probably accounts for one third of the total number of anesthesiologists in the world. In China, we have about 100,000 anesthesiologists, and the United States has about 60,000. The problem in China right now is we need more anesthesiologists. We are experiencing a severe shortage of anesthesia providers. Another point is about 50% of our anesthesiologists are younger than 35 years old. So, we need to make sure they will get adequate education and training. About four years ago, we implemented a nationwide standardized residency training.

Dr. Henry Liu interrupted with “it seems to me that China may need some AI help in assisting anesthesia service, is that right?”

Dr. Jin Liu: Yes, AI can really help us. We have an AI committee in CSA. This committee organizes research and development activities in China. We call it “AI-AAA”, which stands for Artificial Intelligence-Anesthesia, Analgesia and Assistance. AI can help us, but not replace us. AI can assist with preoperative evaluation, intraoperative monitoring and recording, and also potentially help us do the ultrasound imaging for us in the future. Our residents spend 50% of their time just sitting there monitoring patients. CSA intends to have AI to take over some of the monitoring function, so our residents can spend more time on other important tasks and training. So, I think AI will be very important in our anesthesia practice in the future. I hope we can do something together with ASA.

Dr. Kimberly Philip: It is interesting that both of our countries, even though we are the two largest groups of anesthesiologists, we both experience shortage of anesthesia personnel. Our problem in the United States is the other end of the age spectrum. We have a large percentage of anesthesiologists will retire shortly. With the postwar baby-boomers becoming elderly, and the growingly less invasive surgical technology, we will have more elderly patients to have surgical procedures, which can be done safely. We have more and more elderly patients perioperatively. Where AI can help us? I think AI can help us both preoperatively and postoperatively. Preoperatively, we already have good science to show AI can help collecting diagnostic information, so anesthesiologist can easily figure out whether the patient is the right patient to undergo this scheduled procedure safely. And postoperatively, AI can help the decision-making process, can help follow-up postoperative patients either at home or in the community center. We can watch the patients without leaving the hospital facility. This means we as physicians will oversee rather than collect information. I believe it is a more difficult issue intraoperatively for AI, because we don't yet know what anesthesia is, we just starting to learn the research.

Dr. Hong Wang: I agree with you regarding AI's preoperative and postoperative roles. But I also believe AI can have some roles intraoperatively. Take echocardiography as an example, especially advanced echo-

cardiography, it takes a long time to learn. I believe AI can play some roles there. Actually, ASE (American Society of Echocardiography) has a research project looking into AI recognition of echo images to help with diagnosis. GE ultrasound has a new product; it can detect automatically how many B-lines each segment of the lungs has.

Dr. Stanton Sherman: I have to humbly admit about 44 years ago I published an article regarding AI when I was in high school. At that time, AI was defined as “independent computer thinking”. Now my son is doing AI for a living. I think the definition has been changed, now the definition of AI is computer recognizing its environment, getting information and facilitating decision-making. We can argue whether it is independent thinking or consolidation of data. But I can tell AI is being used and we probably just don’t know it. It is guaranteed it will be used in the near future. What I am working on right now, I don’t want to break confidentiality agreement, there are a few studies showing that with high-fidelity blood pressure monitoring, the computer can predict hypotension about 15 minutes in advance, with certain pathway, trajectory, or patterns. We are doing several things to improve upon that. We are integrating ultrasound information as well as invasive measurements to look at broader spectrum outcomes of heart failure, not only whether hypotension will occur, but is it more likely to be associated with preload, afterload or contractility problem. The hope is in the ICU, this can be used not only by physicians, but also by nurses, and other personnel who are not very familiar with echocardiography, to make rational decisions about patient triage, either before physicians get there or when physicians are busy. With over 90% certainty, the computer will tell if this patient is having preload problem and suggest giving fluid bolus, is that independent thinking? I think it is a matter of discussion or debate. Is that artificial intelligence, absolutely. I think it is not only here today, it is going to be mandatory part of what we do as physicians, if we want to improve the outcomes of our patients. Because I think we as humans, we are overwhelmed, we are biased, in terms of decisions we make, and I think AI can be very helpful for us to make better clinical decisions.

Dr. Yuguan Huang: The biggest challenge we are facing right now is the shortage of anesthesia providers and the burnout of anesthesia providers in China. This will be the key issue for the Chinese Society of Anesthesiology in the future. Fortunately, we get the firm support from Chinese government, that means a lot to the Chinese anesthesia community. The policy support will make our mission possible. Dr. Jin Liu is a pioneer in AI’s application in Chinese anesthesia practice. I would also like to thank ASA’s support to CSA and CASA’s firm support to CSA for so many years. Many CASA members travel to remote areas of China to help the local hospitals, to help training of their anesthesiologists. One of our major problems is we have a huge variation in terms of the skills and training levels of anesthesiologists. We will welcome Dr. Mason to our CSA annual meeting in Hangzhou. And the theme of this year’s CSA meeting is “Together and Stronger.” When we are together, we will be stronger.

Dr. Henry Liu: I do believe AI will play a much larger role in our anesthesia practice in the near future. Lots of work currently being done at Pre-anesthesia Assessment Clinic can potentially be done remotely by a robot, that not only saves patient a trip to the hospital, but also other resources of the hospital and human labor. If we can develop Alpha-Go and Deep-Blue, which instantaneously demand enormous intelligence, we definitely can develop anesthesia machines which will make adjustments automatically based upon hemodynamic parameters or other measurements or data. Here comes the question for the leaders here. Currently, we have a shortage of anesthesia providers and we are trying to increase the total number of anesthesia providers. On the other hand, in the future, may not be too far away, AI may potentially replace many anesthesia providers, that potentially means thousands of practicing anesthesiologists may lose their jobs. What do you think about this?

Dr. Stanton Sherman: That will dependent upon how enthusiastic you are about AI. On one side, robots

will replace some manual labors, let us say on construction lines of work, on the other side, as new technology displaces some jobs, some new opportunities will be created. I believe the same thing will happen to anesthesiology. We devoted tremendous resources to transcatheter aortic valve replacement, we got so good at it and made it simple and safe, now we displaced ourselves (giving anesthesia) and most likely the nurses can do it as an outpatient procedure. But at the same time, what we learned is the whole structure of our practice, and industry is developing much more complex technology which will require our presence. So, we can't be afraid of it, we can't prevent it. We just need to know how to use it to benefit ourselves, and more importantly our patients.

Dr. James Grant: Are we talking about artificial intelligence? I think we will see a lot more AI in our practice. We are going to see a lot of more predictive intelligence what is going to happen. I can't tell exactly what is going to happen in the coming 10 minutes or 30 minutes. But we will need to stay on top and help developing programs for the future.

In summary, all anesthesia society leaders believe AI will have significant potential impact on our anesthesia practice. The impact will be reflected in preoperative, intraoperative and postoperative services. AI will likely help deliver anesthesia care but not less likely or unlikely replace anesthesia providers. AI will facilitate anesthesia training and education as well.

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综述

围术期血压管控的意义：麻醉管理和患者护理

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前言

众所周知高血压（HTN）是具有多种病因的临床综合征。全美成人中HTN的发病率约占人群的35%，其中仅有55%的患者得到适当的治疗和控制¹。根据世界卫生组织（WHO）全球观测发现高血压已是病患死亡的主要原因之一，每年约有750万人死于此综合征²⁻³。大量分析数据表明术前舒张压（dBP）>110 mmHg可使心、脑和肾脏受损机会增加35%。dBP <110 mmHg的患者似乎没有明显的风险。收缩压（sBP）水平与手术风险之间的关系尚不清楚^{1,3-8}。有些研究人员发现，在高血压患者中，脉压差（PP）增加与脑血管意外、外周动脉疾病（PAD）的风险和死亡率的关系更为密切。PP增加反映了外周动脉的弹性下降，心脏的后负荷增加，周围组织和器官的血液灌流量减少^{7,9-10}。

根据美国心脏协会2017年发布的HTN诊断和治疗标准修订版规定：正常血压值应低于120/80 mmHg，而持续高于130/80就应诊断为高血压。之所以修订诊断标准是根据大量数据和事实证明：心血管疾病（CVD）的风险从收缩压115mmHg至180mmHg和从DBP 75mmHg至105mmHg变化时呈对数线性上升；随机对照试验显示生活方式的改变和药物治疗以降低血压至130/80 mmHg以下时可预防CVD发生率。大量临床分析表明，当sBP维持在120至124 mmHg时，CVD死亡的风险降至最低^{3-4, 6, 11}。

HTN的早期治疗一般为：

1. 降低体重；
2. 调整饮食，注意补充含钾食品，减少含钠食品；
3. 降低饮酒量和吸烟；
4. 增加运动。

如这些方法尚不足以使血压恢复正常，就需药物降低血压。一线降压药多用Thiazide利尿剂，钙通道阻滞剂，血管紧张素受体阻滞剂或血管紧张素转换酶抑制剂（ARBs, ACEI）^{2-3, 6-7}。Alpha受体阻滞剂一般不用作抗HTN的一线治疗药，因其治疗HTN和预防CVD的疗效不及一线药。如HTN患者伴有稳定性缺血性心脏病时，β阻滞剂可做为一线药预防心绞痛，降低运动导致的心肌缺血，心肌梗塞，心脏骤停和死亡率³。

HTN的病因

HTN有两种类型：原发性和继发性。原发性HTN病因未明，约占所有HTN病例的95%。许多因素可触发原发性HTN，包括肥胖、糖尿病（DM）、高酒精和盐摄入、低钾和钙摄入、老年人、少运动和压力大等等。继发性HTN都有较明确的原因。常见原因多为肾实质和肾血管疾病、肾上腺皮质/

髓质病变、甲状腺病变、垂体病变和主动脉狭窄等^{3,12}。继发性HTN病人择期手术前一般由专科医生诊治以控制血压和疾病导致的其他异常。如需紧急手术，除在麻醉期间静脉使用短效降压药控制HTN外，还需治疗血流动力学异常、电解质、酸碱平衡、液体和肾功能等紊乱^{3,5,13}。

血压测量、分类和意义

HTN的诊断应在患者清醒，安静且没有疼痛的情况下进行，至少2次就诊和2次以上的测定来获得血压平均值。有时在不同地点测定的血压会得到不同的测定值。根据地点不同，HTN可以分为3种不同的表现形式：持续性，隐匿性和“白衣”HTN。持续性HTN无论地点所在其血压测定值都持续增高。隐匿性HTN的特征是在诊所内测量正常，但诊所外血压值始终高于正常。与之相反的“白衣”HTN是诊所内血压升高但诊所外的血压正常。隐匿性HTN患者所致CVD发生率、器官受损和死亡率的风险与持续性HTN相似，而“白衣”HTN患者中CVD并发症或死亡率的风险最小^{3,6,14}。

围术期HTN的常见原因

围术期HTN患者十分常见。25%接受非心脏手术以及80%进行心脏手术的病人患有HTN。围术期各种并发症危险与HTN的严重程度有关³。控制不当的HTN与手术期出血、心肌梗塞、心衰、其他心血管疾病、脑血管意外（CVA）和死亡的风险增加有关。其他诱导HTN的因素有术前停用抗HTN药、麻醉诱导、气管插管、手术刺激、麻醉过浅、静脉容量、疼痛、低氧状态、膀胱扩张、苏醒期和气管拔管等^{5,15}。

手术延期还是如期进行？

如上所述，慢性高血压的严重程度与重要器官功能受损直接相关。直至目前为止控制不当的HTN仍是推迟或取消择期手术的主要原因。比较公认的原因一是慢性持续性HTN > 180/110 mmHg；二是HTN患者伴有未经治疗或改善的心、脑、肾功能受损；三是未知病因的疑似继发性HTN患者，对于这些患者最好推迟麻醉和择期手术以查明病因，改善临床症状和体征^{3,9,14,16}。然而，一些研究人员比较了两组HTN患者：一组在术前即刻给与降压药，一组推迟手术以便降低血压至dBP < 110 mmHg。其后发现两组心、脑并发症并无明显差异^{5,9,17}。所以，如围术期心、脑、肾功能稳定，研究结果并不支持延期麻醉和手术以治疗HTN。

其他研究也发现，HTN患者如血压低于180/110 mmHg而无重要器官受损其围手术期不良预后并未增加，因此延期或取消择期手术几乎无必要^{5,14-15,18}。作为麻醉医生来说应更多地关注重要器官是否受损而非仅仅HTN本身¹⁴。

术前麻醉医生应仔细询问患者的详细病史和进行全面体检，以区分慢性持续性，“白衣”或隐匿性HTN。麻醉医生需认识这些HTN的不同临床过程，并判断其对围术期可能的影响，以便更有效地治疗这些HTN患者和确定是否如期手术^{12,14}。

术中血压变化的意义

术中血压监测十分重要。麻醉和手术中血液动力学变化非常普遍，而控制不当的HTN患者相较于其他病人其血压的波动度更大。

尽管慢性持续性HTN会增加重要器官功能受损的风险和死亡率，但一些回顾性研究显示术中低血压与30天死亡率之间密切相关。心动过速和低血压似乎比HTN更为有害，导致更多的并发症和死亡率，对非心脏手术老年患者的心肌和肾脏损伤尤为显著^{1,16,19}。手术并发症与术中低血压的持续时间

和程度相关⁵。术中低血压的常见危险因素多见于老年病患、长期服用降压药、血容量不足、失血过多、手术、麻醉药作用和肾上腺功能不全的病人^{1, 5, 16, 20}。

最近的随机研究结果认为具体病人术中血压的管控应根据手术类型、患者的基础血压值、高、低血压导致出血或重要器官缺血危险性大小等评估做“个性化”的治疗和调整。对于心脏手术患者，最好将平均动脉压（MAP）维持在70至100 mmHg之间，以维持较高的血液灌流量。对于非心脏手术可通过个性化调整血压波动，以降低围术期并发症和术后器官功能障碍。麻醉期间，对平时基础血压较低的病患MAP应维持在65 mmHg以上；术前正常血压和高血压的病人其血压变化应分别在基础值的10%和20%之间波动较好，这样的血压波动范围可以维持重要器官的适当灌流量。当器官缺血的风险较高时，血压应维持在允许范围的较高值，反之，当出血风险大时，血压可维持在较低的允许范围内以防血压增高引起的出血危险^{5, 9, 16, 21}。老年高血压患者中许多人由于动脉弹性下降，舒张期血压偏低和脉压差增大而常见单纯收缩期高血压。这些变化使患者在手术和麻醉期间血压维持较为棘手，通常将sBP降低至正常范围时可能会导致舒张期低血压和器官灌流量下降所致的缺血危险增加⁹。

术前和术中如何使用降压药？

临床上可见许多严重无症状高血压患者（血压 $\geq 180/110$ mmHg）而无急性重要器官功能受损。但是那些有临床症状或体征并显示急性器官受损的高血压患者为高血压急症，应立即开始治疗和改善严重的围术期HTN的临床表现⁵。其主要治疗目的是降低血压并减少围术期可能的并发症。再次强调麻醉医生的工作重点在于关注高血压患者的心血管风险，而不仅仅只考虑到血压升高^{6, 15}。

大部分慢性持续性高血压患者应继续服用降压药至手术当日，以免突然停药诱发的高血压反弹，术后应恢复使用这些药物^{5, 8}。

长期服用 β 受体阻滞剂且耐受较好的慢性高血压患者术前应继续用药，尤其是那些患有心肌缺血或心衰的患者^{8, 8-9, 15, 16, 22}。从未服用过 β 受体阻滞剂的高血压患者不建议术前临时使用 β 受体阻滞剂降血压，因有证据表明新近使用 β 受体阻滞剂增加脑血管意外和死亡发生率，尤其是老年HTN患者^{3, 15, 23}。

多个研究发现，1/3服用ACEI/ABRs的高血压患者术中常有难扭转性低血压。大多数学者发现高血压患者在非心脏手术前24小时如停用ACEI或ABRs，其心肌受损、脑血管意外、死亡率和术中低血压的发生率均低于术前持续使用这些降压药的患者^{5-6, 16, 24}。

外科手术过程中病人血压波动十分常见，高血压患者尤为如此。术中血压维持用药最好使用易于调节的短效血管活性药治疗高血压或低血压以避免血压明显的上下波动而增加并发症⁵。

术后血压监测与治疗

血压的监测应从术前持续到术后，直至确定患者心血管和病情稳定为止。术后低血压和高血压都可增加各种并发症^{16, 25}。因此高血压或低血压的监测与是否术后疼痛、呼吸道通气不足、肌松药逆转适当、出血、或严重的心肌缺血/梗塞同样重要。

术后病人在监护病房内（PACU）如血压 $> 180/110$ mmHg一般需要药物降压，发现并治疗引起HTN的各种原因⁵。降压药从小剂量开始直至血压接近患者基础血压值为止，例如labetalol, metoprolol, hydralazine等。如果没有禁忌症，应在术后48小时内恢复患者长期使用的降压药。研究

发现术后48小时后恢复使用患者长期服用的ACEI和ARBs等降压药,其术后并发症的发生率和死亡率增加^{6,8,16}。

PACU内如患者血压偏低(血压<90 mmHg, MAP <62 mmHg或血压<基础值的20%)就有可能增加心肌受损,脑血管意外和死亡率¹⁶。除探查诱发低血压的因素外,快速静脉给液和给予适当的血管加压药以尽快恢复或接近至患者血压基础值。

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The Journal of Biomedical Research, 2019 33(6) 430-434

Brief Report

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Multi-outcome predictive modelling of anesthesia patients

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Abstract

Conjunctive use of anesthetic agents results in drug interactions which can alter or influence multiple patient outcomes such as anesthesia depth, and cardiorespiratory parameters which can also be altered by patient conditions and surgical procedures. Using artificial intelligence technology to continuously gather data of drug infusion and patient outcomes, we can generate reliable computer models individualized for a patient during specific stages of particular surgical procedures. This data can then be used to extend the current anesthesia monitoring functions to include future impact prediction, drug administration planning, and anesthesia decisions.

Keywords: anesthesiology monitoring, anesthesia depth, patient model, outcome prediction, computer-assisted decision

Introduction

Anesthesia decisions during surgery involve controlling and maintaining a patient's anesthetic depth, blood pressures and heart rate, among many other conditions. This decision process relies on sound experience of estimating the impact of the drug inputs on the patient outcomes. Accurate estimation of such drug impacts is difficult due to several factors^[1] typically, an anesthesia drug can affect multiple outcomes, the same drug can have differing impacts on different patients, the impacts can be altered by surgical types, procedures, stages, and patient conditions, drug-to-drug interactions can influence patient outcomes. For anesthesiologists, management of such parameters on daily basis with accuracy and safety significantly depends on training and experience. Based on our increasing knowledge of

drug interactions, it is essential to identify measurable relationships between drug administration and corresponding patient outcomes in a more accurate, objective, and reliable format^[2].

Advanced information processing technology can be of great value in this pursuit. For instance, mathematical models can be developed and embedded into anesthesia monitoring systems so that in addition to "monitoring" the current status of a patient, they also can provide a prediction of the patient outcomes in the near-future. Artificial intelligence (AI) techniques and machine learning are also highly suitable in this application since they can use real-time observed data to modify models so that the models can become individualized to the specific patient, and the given type and stage of the surgery.

We report here an effort in developing such a new technology. The core of this technology is a data-

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Received 15 September 2018, Revised 01 December 2018, Accepted 08 December 2018, Epub 19 February 2019

CLC number: R614.2, Document code: B

The authors reported no conflict of interest.

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based mathematics function model that relates multiple drugs and their interactions to several essential predictive outcomes of surgical patients in the near-future. This predictive capability can then be employed to display the patient's current status along with predictive near-future outcome trajectories. When a drug infusion rate is modified, its estimated impact can be immediately displayed. As a result, if a specifically targeted anaesthesia depth or blood pressure level is required, this function can be used to display a computer-assisted "trial" on the system to ensure that the targeted factors can be achieved within required timeframes before the actual drug is administered to the patient.

It is noted that the importance of outcome prediction has been recognized in many procedures in anaesthesiology and several scoring methods were employed, including Surgical Apgar^[4], Risk Stratification Tools for predicting morbidity and mortality^[5], and Preoperative Score for predicting postoperative mortality^[6]. Computer-assisted outcome prediction and decision assistance are more challenging, and have attracted more attention. Trauma resuscitation errors and their corrections were investigated with AI technology^[7]. General discussions on feasibility of AI technology for automated anaesthesia drug delivery were reported^[8]. These studies have different focuses, use different methods, and report different results in this paper.

Methods

Human subjects

The study was approved by the appropriate Institutional Review Board and written informed consents were obtained from all subjects^[9]. We selected a patient population between 20 and 70 years of age ($n=7$), undergoing upper extremity arteriovenous fistula placement or thrombectomy, under intravenous unconscious sedation. Prior to surgery each patient was given 1 mg of Midazolam IV, taken to the operating room, and equipped with a bispectral (BIS) monitor (Aspect Medical Devices, Inc.), noninvasive blood pressure (BP) cuff, and pulse oximeter. BIS (streamed continuously) and BP (measured every three minutes) data were used in this study. As the interaction between BIS depth and BP are commonly observed patient data in anaesthesia administration, we selected these two parameters as a suitable platform to start and to potentially expand to include others such as heart rate, *etc.* The data from each patient is divided into two time segments with the first time interval a duration of 30%–50% of the

entire data collection time. The first segment is used to establish the model, namely determining the model parameters. The second time segment serves as an independent data for validation. The model fitness is evaluated by comparing the data and the model output for the entire time interval.

The patient was given 1–2 $\mu\text{g}/\text{kg}$ of bolus IV fentanyl at the beginning of the surgery and a 1 $\mu\text{g}/\text{kg}$ bolus during the surgery, if required. The patient started on intravenous propofol pump at a rate of 50 $\mu\text{g}/(\text{kg}\cdot\text{minute})$ and titrated as required during the surgery. A BIS sensor was placed on the patient's forehead before administering anaesthesia to the patient. The sensor is connected to the BIS monitor, which in turn was connected to a computer to allow continuous recording and saving of the BIS values. A baseline BIS value of at least 90 is recorded before the administration of anaesthesia. All measured heart rates and blood pressures values were entered and saved manually into the computer every three minutes and following any bolus administration. The propofol rate, any changes made to the propofol rate, and any propofol or fentanyl bolus given are also transmitted to the computer model. Data from seven patients were recorded. The BIS range from 0 (no or minimal brain activity) to 100 (patient fully awake and aware), is set by the device manufacturer. As a data collection system, the internal BP limits in the computer system is set on a wide range so as not to disturb or affect data entry. Data for each patient were reviewed by an experienced anaesthesiologist for any possible anomalies or errors.

Computer modelling and AI

The core function of this new monitoring technology is framed in establishing reliable embedded computer modelling that can directly correlate the drug or procedure inputs to outcomes in a surgery or procedure. The model structure must be capable of capturing the essential features of a patient's response to the drugs in such a manner that it is able to calculate how the past and current drug infusion rates will result in outcome changes in the immediate future. The model must be tunable to fit specific patient parameters into a varied range of surgical procedures. Here the capability of "AI" is used in the broad sense in which the model parameters are learned from data by certain identification or learning algorithms.

The function modules of this technology are depicted in **Fig. 1**. The drug infusion data and patient outcomes were measured by the medical devices, and streamed to the computer for processing. The

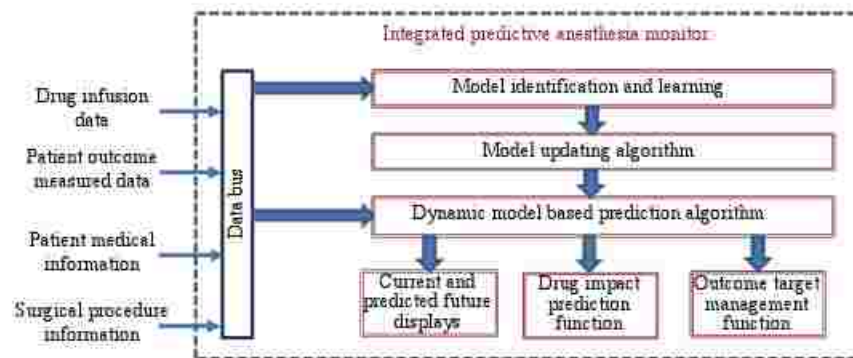


Fig. 1 The function modules of the integrated predictive anesthesia monitor where drug infusion data and patient outcomes are measured and streamed to the computer for processing. The computer model inputs further patient and surgical information to develop short-term predictive outcomes. The display module shows both the current status and predicted outcomes on the screen with both numerical values and graphical trend curves.

computer model inputs further patient and surgical information to develop short-term predictive outcomes. The display module shows both the current status and predicted outcomes on the screen with both numerical values and graphical trend curves. Fig. 2 is a collaborative display of anesthesia depth (BIS) and blood pressure. The system additionally contains a decision-assistant function module that allows the anesthesiologist to enter planned drug modifications and the system to generate a predicted impact of such changes. Tuning such modifications can allow the anesthesiologist to develop suitable scenarios to have patient outcomes designed to achieve desired target values at specific times.

To make the model account for patient uniqueness, the learning function uses the observed data to tune the model parameters, leading to a data-based learning capability. In our early work^[2], a specially designed computer monitoring system was developed to record multi-drug-multiple-outcome data. The data observed a clear correlated outcome response to propofol titration, bolus injection and fentanyl injection: the

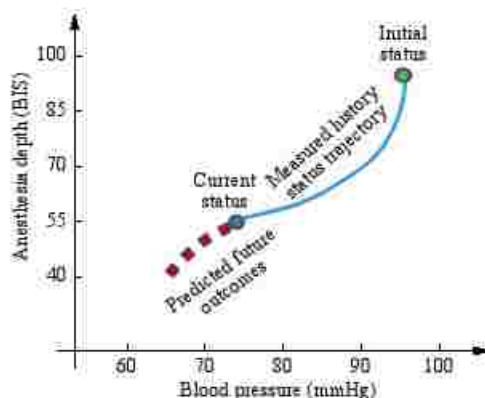


Fig. 2 Graphical illustration on how the integrated predictive anesthesia monitor can collaboratively display anesthesia depth (BIS) and blood pressure (BP).

anesthesia drugs lower the patient BIS values, depress blood pressure, and result in higher heart rate fluctuations.

To capture such dynamic relationships, we are developing an enhanced modelling technique which involves the following function modules: (1) The drug input function module to represent the drug-administering system, injection pathway, and propagation to the blood; (2) The dynamic system module to capture the common feature of initial delay and gradual impact of the drug on outcomes; (3) The multi-output function module to model the impact of the drug on each considered outcome.

The basic model structure is called a "Wiener Model"^[3,9], which relates an input to an output and contains three generic blocks: time delay, dynamic delay, and sensitivity function. It can be used for different inputs and outputs such as propofol-to-BIS relationship. For each application, the parameters will be different in different patients, which are estimated by data.

This model structure was further expanded to include multiple inputs and multiple outputs, and called a multi-input-multi-output Hammerstein-Wiener model in engineering. It extends our previous work of using single-input-single-output Wiener models^[3,9-10] which do not involve the drug input function, to the multi-drug-multi-outcome framework here. By using the simplified but representative dynamics and functions to represent these relationships, we ensure that the model contains only a relatively small set of parameters that can be updated and learned in real time during a surgery.

Our approach for determining the parameter values is data-based learning and system identification. In our early work^[2], we used a special identification algorithm to learn model parameters. In this approach, we first use the patient condition and population-based

model as the initial parameter values. After the drug administration is performed, the system starts to receive data on the drug infusion and the patient outcomes, which are used to modify the parameter values. The algorithms used to perform this task are called system identification algorithms.

The distinct advantages and contributions of our approach are in the following aspects: (1) Since simplified dynamic and function models are used, less data is required to update the parameters so that the model can more rapidly capture the salient characteristics of a specific patient, under a specific surgery, at a specific time. (2) By including the drug input functions, our model can capture data from diversified medical devices by multiple manufacturers with multiple differing device features. (3) By including multiple drugs and multiple outcomes in a unified model, we can represent interactions of drugs and their correlated impact on patient outcomes under a unified monitor system.

Results

In our study, we used a simple-structured dynamic model that mainly captured the drug impact in the following aspects: the effects of drug changes on the BIS and BP, the time delay before the initial visible response, and the response speed of the drug effect on the BIS and BP. Mathematically, this can be written as a three-component cascaded system: a time delay of τ

seconds written as e^{-Ts} , a first-order dynamics of time constant T written as $\frac{1}{1+Ts}$, and a nonlinear sensitivity function $f(x)$ where x is the drug infusion rate. For convenience of implementation, $f(x)$ can be a simple polynomial whose coefficients must be learned from data. Also, each model channel was modeled differently. For example, the channels from the fentanyl bolus injection, the propofol bolus injection, and the propofol titration to the BIS and BP, were collected on separate channels. After selecting the model structure, the data were then used to identify or learn model parameters. The model's usefulness was evaluated by its predictive capability on the measured BIS and BP values.

As shown in *Fig. 3*, with recorded data and our system's predicted outcome values, BIS values can be affected by many unknown factors, such as surgery stimulation, and body movement, among many others. The system's capability was reflected by its prediction of the main trend of BIS values as responses to drug administration. The curves showed desirable features of the system. The BP data were collected every three minutes. The curves outline that propofol affected the BP, but with slightly less impact than the fentanyl injection.

Discussion

There have been extensive efforts in studying automated anesthesia administration by using

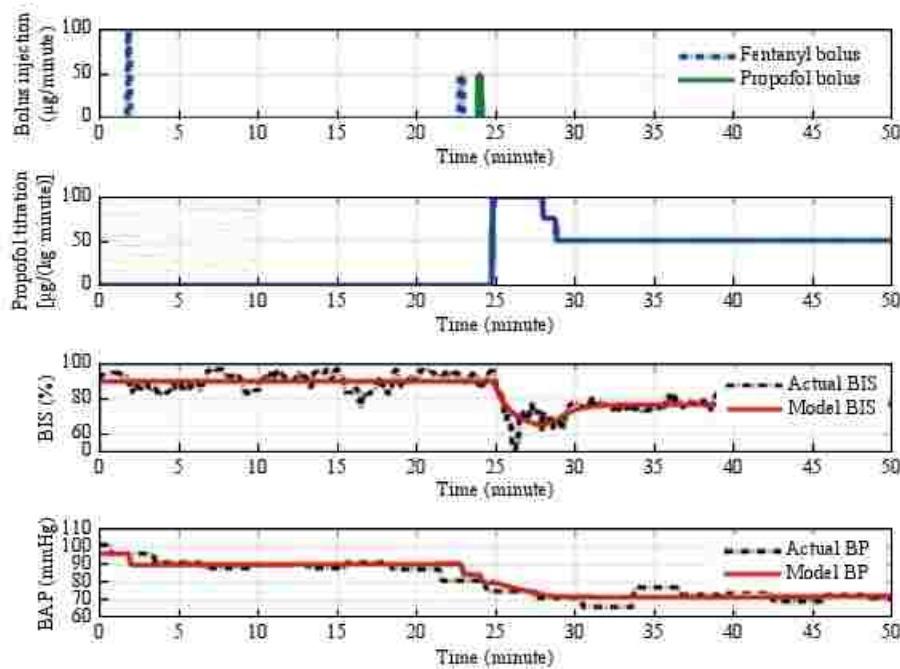


Fig. 3 The recorded data and predicted outcome values from the integrated predictive anesthesia monitor system.

feedback control techniques^[12-18]. These population-based models lack the ability of "learning" in real time to generate patient-specific models. The multi-outcome predictive monitoring technique described here is a fundamental improvement on the current anesthesia monitoring technology by providing critical future-impact information, manageable reliability, and useful decision assistance. The main ideas of using mathematics models, signal processing, and individualized management to improve anesthesia care have been used in other related areas of anesthesiology^[19-21]. This report highlights a promising approach to addressing several critical requirements for such a new technology: simple and reliable models, data-based and individualized patient outcome monitoring and prediction, and learning capability.

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国际麻醉学交流

朝着标竿直跑，实现国际标准

——广州和睦家医院的工作体会

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我是一名麻醉医生，在国内一流的大学医院的医教研岗位上工作了超过18年。我热爱我的工作，但发现自己的职业生涯进入了一种停滞的状态，开始产生职业倦怠。我自觉有点不甘于这种现状，特别不愿意从现在起就处于自己往后10年甚至一直到退休都保持相同的工作生活模式。因此，2018年5月，出于种种因缘际会，我离开了原来的医院，加入一家民营医院——广州和睦家医院。

和睦家医疗集团按照在北京、上海、天津、青岛和广州均设有医院诊所并具有JCI认证，有超过400位全职医生，来自超过25个国家和地区。很多人对和睦家的第一印象就是收费贵，同时也顺理成章地将和睦家的“高端”与收费标准划等号。在这里工作了大半年，才逐渐感觉到，医疗其实并无高端低端之分，只有对医疗质量与安全的追求以及人文关怀能力上的不同。



一、医疗质量与安全制度

在中国医患关系紧张的环境下，医疗质量与安全是我一直想深入学习的东西，直到来到和睦家才开始有所体会。对此，首先我们应该明白安全制度是既保护病人也保护医务人员的。对外，发生医疗差错与事故时，医院有客服部（Patient service）出面沟通处理；需要进行医疗诉讼时由法务部门介入处理。不应该由医生自行去跟患者/家属协调。医院并不允许患方随意破坏医院的医疗秩序。

对内，和睦家不会轻易放过每个不良事件（Event）或者潜在不良事件（Near miss event）。医院每天有早交班（Morning huddle），各个部门的主管和部分一线员工通过短短30分钟能了解到昨天医院发生的重大事件和特殊病例。院内电脑上有一套比较完善的不良事件上报系统（RiskMan event report system），员工可以实名或匿名进行上报。其核心目的是提高医疗质量，从错误中学习，避免同样的问题再次发生。质量与安全部门每年还会向这些有上报行为的员工进行一些奖励，表示一种感谢与鼓励。但对于敷衍塞责、隐瞒不报、出于利益而过度医疗造成不良事件的医生，医院是严惩不贷的。

二、安全文化

要真正贯彻安全制度，安全文化是基础。制度是死的，人是活的。和睦家能走到今天，坚守医疗品质所依靠的不是一个个制度文档和网络程序，而是每个和睦家人在一步一个脚印的工作中建立起的安全文化。然而什么是安全文化呢？主要包括两方面：一是内部的心理安全文化，团队成员彼此接受和尊重，能公开表达意见和想法，却不会有任何风险。二是“人人有责，从我做起”。和睦家让每一位员工都将自己的工作上升至医疗安全的高度。例如保洁员们，都明白自己拖地必须随时放标记牌并立即擦干，目的在于避免发生滑倒事件。又例如医院希望在最大限度降低院内感染率，关键在于提高医护人员洗手率。医院里每个洗手池的纸盒都贴着标语“请问我是否洗过手！”医生在病人面前不洗手的话，自己都会不好意思。

三、领导力

然而，医院里安全文化是否能建立和贯彻，跟医院管理者的领导力(Leadership)息息相关。由于以前并没有系统学习过，我只能这么来描述它：一个人能带领/影响团队向某个方向前进的能力。对真正的领导者而言，他们带领团队的做法直接会影响到每个成员的态度与处事方式。《圣经》上有一个小故事：耶稣的门徒们有一天为了谁能成为门徒中的首领而争论不休，耶稣平静地告诉他们：你们中谁愿为首，必先做众人的仆人，正如我来，不是要受人服侍，而是要服侍人。当时门徒很不理解。另一个晚上，耶稣亲自打水，为他们每一个人洗脚，用自己的行动展示了这种“主仆颠倒”的观念，也成了后世对领导力一种有力诠释。当今世界随着工业化和网络的高度普及，任何集体都很难依靠“命令与控制”的方式来运作。领导者们不可能再简单地采用家长式命令来控制员工的行为。他们可以做的，是通过自己的言行表率来带动整个集体，从而鼓励改进和创新。和睦家与宗教无关，但我能从这里许多领导者的工作态度中清晰看到这种为众人服务的精神，这是安全制度得以贯彻的一个关键原因。

四、围术期麻醉安全的工作条件

广州和睦家的手术室和胃镜室中全部配备了GE的麻醉机和Phillip的监护仪。麻醉医生们去胃镜室做无痛胃肠镜时，不需要像“临时工”一样背着箱子带上各种药品和急救物品。全科护士会把麻醉药品包括标签以及相应耗材还有抢救车都为麻醉医生准备好。同样地，麻醉医生们去产房做分娩镇痛，设备药品耗材都在产房里由助产士们预备好。

为保障医疗安全，和睦家每一个医疗单元包括手术室、门急诊、影像科，每个病区都配备有一台功能完备的抢救车。它是按照成人/儿童高级生命支持(ACLS和PALS)的抢救流程而设计，台上有除颤仪和从成人到新生儿的各种面罩、呼吸囊和气管插管工具。抽屉里面有各种供氧和输液需要的管路、穿刺针和全套气管插管。车身边挂有氧气罐，背后是做心脏按压需要垫上的背板。出于监测自主循环恢复的需要，除颤仪还具备EtCO₂监测功能。

除此之外，麻醉科还配备困难气道工具车。它根据英国困难气道学会DAS的非预期困难气道指南而设计。按照气道工具选择的次序分为：Plan A—可视喉镜；Plan B—可插管喉罩和电子软镜；Plan C—声门下通气和有创气道。

五、不断学习提高，向国际化标准看齐

和睦家的全体医护人员都必须具有美国心脏学会AHA的BLS（基础生命支持）provider certificate（证书）。对麻醉医生要求最高，医院要求他们具有BLS、ACLS（高级心脏生命支持）、PALS（儿童高级生命支持）和NRP（新生儿复苏）的证书，因为麻醉医生们面向患者的年龄范围是最广的。



和睦家医院工作日内每天都有内部的继续教育讲座。医院的内部网有Uptodate、Clinical key这些数据库可供医生们免费查阅。值得一提的是，我上周还有幸在上海和睦家医院参加了国内第一次的创伤高级生命支持

（Advance trauma life support, ATLS）培训。这次培训的导师们是来自美国与英国的急诊医生与骨科医生。三日的培训让每位学员都对国际标准的创伤急救的工作方式有了深入的认识，更懂得将课程提倡的理念应用在临床实践中。

六、围术期医学实践

和睦家深知麻醉科对医疗安全和舒适化管理的重要性，对麻醉科给予大力支持。这让麻醉科从开业起就能承担手术麻醉、分娩镇痛、无痛胃肠镜、小儿影像检查镇静和牙科镇静/麻醉等一系列业务。

疼痛管理在和睦家医院永远是工作重点，术后早期疼痛评分是评价麻醉医生工作的一个核心质控指标（除此以外还有术后早期的体温和氧饱和度）。和睦家有一套专门的多模式镇痛方案：通过局部浸润、NSAID和弱阿片类药物的联合使用，同时考虑到疼痛加剧时的备选方案；必要时，麻醉医生还会使用超声引导神经阻滞镇痛，从躯干不同部位到四肢的神经阻滞，他们都能靠超声引导轻松完成。

在积极有效的多模式疼痛管理基础上，和睦家医院的麻醉科、外科和妇产科都会密切合作，贯彻ERAS的理念来做好每位患者的围术期管理。从禁食、是否使用胃管尿管、术中体温管理、目标导向容量治疗和预防恶心呕吐、术后早期恢复进食与活动等方面，我们都按照国际指南结合患者的病情来做好。另外，为了缩短住院天数和提高效率，麻醉医生们都在门诊完成术前访视和麻醉同意书的签署。与以往不同的是，和睦家医院的麻醉科医生很重视通过友善耐心的沟通来获得患者的信任。麻醉医生详细地讲解术前术后将发生的事以及患者可能体验的各种感觉，其抗焦虑的作用比术前使用镇静催眠药物更为有效。

七、结语

不同于北京和上海已经有不少与和睦家类似的国际化民营医院，广州和睦家医院是对国际化医疗模式在广东扎根发展、与本土文化相融合的一种新探索。广州和睦家麻醉医生们作为医院里舒适化医疗的提供者和围术期医疗安全的守护者，他们正努力地提高自己，来适应这个全新的国际化医疗平台。随着国家改革开放的继续深入，可以期待广东必定能兴起更多重视医疗质量与安全的国际化医院。衷心希望更多的麻醉同行能预备好自己，一同加入到这股医改潮流中来！

麻醉人生活

手术室的故事——医生，谢谢你！

韩瑛

话说某天早上，我在等待室对一位女病人N做术前检查，她四十出头，因为乳腺癌，要做乳腺切除术。我到达时，她正在无声地抹眼泪儿。说实话，我不是一个善于安慰别人的人，插科打诨我比较擅长，但这种时候则是不适宜的。于是我努力假装没看见，免得她难堪，只是用尽量轻松的语气问着常规的问题，希望将病人的注意力引开，别再哭了。哪想到当我问她对什么药物过敏时，她却干脆抽抽搭搭地哭了起来。这让我变得不知所措，心想，啥时候“药物过敏”这词儿变得如此令人伤心？

我只好硬着头皮问病人N，“能告诉我我说错什么了吗？如果我说错什么，我道歉”。这位女士一只手抹去眼泪，另一只手摆了摆说道，“我先生不久前过世了，就是因为对药物过敏造成的”，说罢大颗大颗的眼泪又落了下来。我赶紧给她拿了一盒纸巾，然后坐在她床边，握住她的手说，“对不起，很抱歉勾起了你的伤心事。可不可以将伤心事说出来，别憋在心里，我们不带着眼泪进手术室，好不好？”

她听了我的话，似乎平静了一些，但还是显得惴惴不安，轻声地道来。原来她的丈夫两周前感冒了，吃了一种非处方的感冒药，不成想里面含有他过敏的药物成分，吃了之后很快就发生了过敏，导致喉头水肿。当时他独自在家，拨打911后却已然说不了话了。他强撑着敲开邻居的门，邻居大惊，也立刻拨打911。无奈何他的过敏反应发展太快了，在救护车到达前就产生窒息，当救护车到达后，虽然实施抢救，却依然回天乏力，就这样在四十几岁的壮年之际，撒手人寰了。

这位病人N在失去丈夫不久，又要面对今天的癌症手术，各种道听途说、无限夸大的麻醉事故，令她觉得她完全无法挺过去了。这些日子她愈想愈觉压抑和灰暗，可又无法自我控制。用她的话说，“我知道不对，可我就是无法不往坏处想，一想就觉得胸口犹如压了块大石头，整个房间都向我压下来，我只好跑到室外去待着，不然喘不上气来，一待就是几个小时。一到天黑，我就心慌得不行，我恐慌，我受不了，夜里更睡不着觉，要一宿开着灯才行。如果不是癌症，我是绝对不会做这个手术了。可做了手术又怎样，我觉得活着一点意思都没有，还不如死了呢！即使是现在，和你说着这些，我也不停地有种冲动想穿上衣服回家！”

听了她的诉说，我明白了，她因着生活的不幸遭遇和身体的疾病，已经产生了心理上的障碍，她需要的不仅仅是普通的安慰，她需要心理医生的指导和治疗！然而现在，在术前等待室，这些自然是无法达成的。现在我能做的是最大程度上的言语宽慰和短效镇静剂的治疗。

我给了她一个拥抱，说到，“亲爱的，我想你知道，你的先生一定希望你得到最好的治疗，对不对？他现在在天上守护着你，会保佑你和我一起合作，有一个顺利的麻醉结果的。你做完手术之后，一定要去看心理医生，亲爱的，你需要专业人士的帮助。相信我，所有这些都是可以治愈的，你会渡

过这些难关的”。她听了我的话，抬起婆婆泪眼望向我，问道，“真的吗？”我的答案自是无比的肯定。“你现在需要一点能让你放松的药，我们要平平静静地进手术室，才能有最好的结果，相信我”。给了病人一点镇静剂之后，她慢慢地进入浅眠。

离开等待室，我立刻给外科医生打了电话，将病人N堪忧的精神状态告知，并建议他给病人找一位精神科医生会诊。他喃喃咕咕了一阵，大意就是他只是外科医生，需要让病人管床的内科医生给她找精神科会诊，他会提建议的。

手术和麻醉一切顺利，我再次见到清醒的病人N，已是手术转天了。在病房再次见到她时，她完全没有手术成功的喜悦，仍然是凄凄艾艾的。我找到了她的护士询问，护士告诉我病人N一直是偷偷哭泣，可护士问她哪里不舒服时，她给的都是否定的答案。我将昨天的情况简要地说了一下，问护士病人N的主管医生有没有为她找精神科会诊，得到的答案却是否定的。我俩又仔细翻看了医嘱，确认没有人写过请精神科医生会诊的医嘱。

我知道很多时候不同科别的医生之间不想“step on the other people's toe”，也就是说别给别人“指手画脚”。可面对病人N的精神状态，我觉得我必须要与她的主管医生直言我的想法，管他谁的toe。抄起电话打过去，直接进了语音箱，别无他法，只好留言。

一天在忙碌中过去了，下午三点快下班时，我仍然没有接到病人N管床医生的回电。好管闲事的毛病是我一辈子都无法克服的问题，琢磨一下，也不差再多管这一件，于是我又去了病房。找到护士之后，我俩又将病历、医嘱梳理一遍，确定不是出现疏漏，是仍然没有人请会诊，于是我便又拿起了电话打给主管医生，又留了一遍相同的留言。我从病历里找到病人N自己家庭医生的电话打了过去，那位医生听了我讲的情况后也非常担忧，她说上次见到病人N还是在发现乳腺癌的时候，然后病人N就转去看外科医生了，她不了解病人家里的不幸遭遇，更不了解她现在的精神状态，那位医生非常同意我的观点。她认为应该乘病人在医院时就让精神医生去做诊治，因为有时病人精神状态异常，你给他们订了预约他们也不去看。

病人N的这种手术一般如果一切顺利的话，术后两天就能出院了，思及此，明天再请会诊会不会赶不上？我不禁很担忧。当天值班的正是我们主任，于是我便向他请教我是否可以写会诊医嘱。我们那时的主任是一个有着狐狸特质的人——说话做事滴水不漏，对医院任何章程都烂熟于心，也能够与任何人聊成朋友。他听了之后告诉我，医院有规定，任何有明显精神状态问题的人都不可以不经会诊就放出院，否则万一病人出事了，是可以追责任的。并且告诉我，想叫会诊就写医嘱，谁有意见他担着！对了忘说了，偶尔我们主任还有点讲义气。

我一听这话，立马觉得底气那叫一个足，写医嘱的字迹都力穿纸背！哇，咱也是有人撑腰的人，感觉真的不要太好。护士妹子见我这一天“无事忙”的样子也受到感染，保证立即给精神科打电话。好在那会还不是电子病历系统，啥事都要打电话，能够找到“活人”沟通的年代真令人安心。

后边的事就毫无悬念了，精神科医生说病人N有严重焦虑、轻中度抑郁，发现及时，给一些药物治疗、心理疏导，痊愈指日可待。内科医生后来也打来电话，一通抱歉，说是电话有了问题，他正纳闷咋一天这么清净呢，才后知后觉发现电话坏了。他坚决同意精神医生的意见和治疗方案，感谢我没让任何“病鱼”漏网，云云。

日子一如往常的过去，我也将这件事忘得透透儿了。一天俺们主任把俺叫到他办公室，辅一进去就见到医生总主任也在，他站起身来对我说，“谢谢你呀苏医生，病人给医院寄来一封感谢信！谢谢你对工作的认真，对病人的尽心！”原来是病人N！她给医院写来一封信，感谢我们为及时诊治她的精神健康问题做出的努力，其中还提到了我，只是遗憾地将我写成 Dr. Chen 了，不过麻醉就一个女医生，就一个亚裔医生，就这性别和族裔，想找错人都难。（这也是我为什么平时都夹着尾巴做人，因为一旦出了麻烦，目标太容易暴露）。

其实做为医生，我们真的没有“生死人，肉白骨”的本事，能够做的，不过是保留一点“好奇心”，保有一点“好事心”而已。莫以事小而不为，再小的问题，注意到了，就别让它溜掉，直究到底。就算证明我们错了，“丢面子了”，可与病人的安危一比，孰重孰轻自然分明。过去工厂总说“安全无小事”，套成医院就是“病人无小事”！

许多年过去了，希望病人N已经走出了生活中的不幸，快乐的生活着。

（故事情节完全虚构，如有雷同纯属巧合）

临床点滴話当年

余大为 DAVID SHEA MD

社会进步,往事依稀。1975年七月我初到纽约做住院医师,每听到呼叫就发狂地飞奔而至,因为我就是DR. SHEA,人人称赞。

美国医生做事有高度责任感,我值夜班有病患因为前列腺术后大出血,但我已经及时处理好,便不call主治好让他多睡一会是中国式的温情,他却责怪我不通知他,真是“狗咬吕洞宾”。

当初毕业在小医院的麻醉科只有三人,其中一人无麻醉训练,(当时合法)。我要从早产儿的气管插管到颅内手术等独自全包。麻醉科本身并无病人像雇工,听令於外科。我来到前无人懂用硬外止痛,有个资深产科医生按他的老规矩,命令我在产妇临盘前的一刹那用吸入N2O加Pentothal IVP,我告诉他那样做会呕,我就是Dr. Shea,呕吐而引至吸入性肺炎。他说只有三百份一机会,但都没有死亡,你不做我找别人做。那该怎么办?



我曾在印第安人保留区Eagle Butte在South Dakota的小医院服务过。各部落都是吃閒饭的居民,病人多因是醉酒和性病,其他稍严重的病患都转送到附近医院。医護小组每日派往较远的部落做门诊。原住民18岁便能领到联邦政府赔偿的土地补贴,1983年是\$3000/人,优惠至八份之一血统。

四十年前针刺麻醉镇痛誉满国际,美国总统尼克松也亲眼见证。当年的春节团拜在中国大使馆举行,大使柴泽民对我说,做麻醉镇痛用针刺才最高级。我工作的社区疯传有一个由中国来的医生懂针麻神技,给痛症病人点燃了新希望,甚致抬着来求:医生救命!我无法推辞只好尽力而为。有老太太倦曲着身子,严重气喘及全身都痛,我真怕她死在我手上但还是做了针刺,居然立即“龙精虎猛”,叛若两人。每两星期一次治疗,最后一次因不能行动便去她家出诊(当时有出诊服务),后来她的女儿谢我说:她很安详地离去。有人左手乏力,针刺复原。有三例用耳针戒烟成功。其他的效果差别极大。因为能够神奇地让残疾病人善终的事例,疯传社区,给享誉国际的中华宝堯再打一次强心剂。

后来我转到创伤医院中心工作,那里有个大产科,二十年來估计我做了近两万个硬外病例,Wet tap少于1%,没有过其他併发症。产妇多巨型超重全凭临床经验。当年只能用Marcaine,为达到令病人无痛的要求,由0.25%提高到0.5%,又用大剂量引至子宫收缩力减弱及产后双腿麻痺等问题,得到各方面谅解。

凭经验做腰麻无论任何原因,正中位置无法进针时,试用侧位约45度倾斜朝上盲插,屡见奇效。

最难忘的是人工流产,当病人一失去知觉,产科医生便在病人还在挣扎的情况下三扒两拨地快速完成手术。麻醉由诱导至复苏需要更长时间,我为著配合,只好制出有危险性的快速奇招。下班出门时被反堕胎的愤怒人群打量:张眼望望,人工流产虽然合法,为避免引发尴尬,早该由后门遁。

我在创伤中心工作时负责OR的程序安排,有人因急需做手术,要跨越OR的程序,理由五花八门,争

不到便兜神惡煞,被推后就暴跳如雷,无论我怎样决定都是豬八戒照鏡子:里外不是人。我只好堅持原則:有人硬闯,我叫保安,类似情况,历二十年。侥幸有階級斗争的真传,还算应付得绰绰有餘。

创伤麻醉的问题难在补液,常見大量出血,用大口径IV,放A.line,置血泵,装加温,及時 Order 冷冻血漿和血小板(直升專机運到)等一气呵成要有三头六臂。输血常以十单位计,見到DIC七窍流血時心里就涼了一截,术后檢討时常遭到嫁禍,說Prince George's Hospital Center是创伤中心,麻醉补液不足,死不承认因外科操作不当,撕裂肝臟(常犯)至流血不止。这时就要摆事实,讲证据,作斗争,才不至被冤枉。斗争虽然容易,但解释就很困难,你猜由学俄语的写英语报告结果会怎样?



美国现实,少查原因,多看效果。我做学生时是工农兵佔領讲台的時代,畜牧耕耘,兼做兽医。虽然荒废了学业,却熟练了操作,做起气管插管和扎针等就很利落,应揀了当年“把坏事变成好事”的政治口号。因此常常有人指定由我服务,平白多了許多額外的工,难应付,好事又变成坏事。但全凭这些技术有利临床而得到几位资深医生頂力支持,才能死撑到退休,坏事和好事又互相调换了。

这个民主国家做官的是否有特权?有!麻醉科有人要求加薪,加了。但我沒有加薪因无要求,到我提出要求时就诸多留难,要调查。恰巧有高官女儿分娩,全院紧张,因她喜欢我的服务就迎刃而解。经历过抗美援朝时期的同道来到美国不再年轻,而且英语差(学俄语的更差),职位难得又易失。一旦失去医院合同,背景差的先下岗,再求他职要有人推荐,下了岗求人采你都俊,就死给你看。

麻醉服务有单干和承包。拿到医院的承包合同雇用医生工作,賺剩餘价值就发大財,麻醉護士更像奴工。记得1983年我初受雇,年薪大约八万,单干的收入可能超过一倍多。刚毕业的CRNA只有大约二万(和OR護士差不多),却承担主要麻醉工作。经过不断磨練,以至知识和工作能力几乎赶上医生,有了他们,医生就高收入又清閒。现在有些州的CRNA能自立門戶,苦尽甘來,是拜麻醉医生之賜。

诉讼是美国医生的惡梦。法庭上往往因一句话定輸赢。病历記錄極重要,包括護士写的在內,那是原告律師要找的重点,就怕乱写,因此人事关系要好。原告律師善长误导陪審团和玩弄被告和証人,不可一世。对策是要淡定。例如有原告律師站在我后面老远发问,我要扭着身子回答,失尊严又听不清楚。对策是说:请你站在我面前说话,丑化形像和杀他的威风。他又问:类鴉片是否能杀人?你只能答yes或no!我对法官说这个愚蠢的问题可否不回答?因为类鴉片救人或杀人视剂量,结果是扯平。但医生永远是輸家,因为陪審团善良好歹都同情病人,认为病人可怜,医生富有,怎么也咬你一口。都是钱作怪,多数庭外和解。有一要诀:如有问题不想回答或不知道怎样回答就说:“我记不起”。记忆可以随时恢复,说错了就不能扳回来。靠替辩护律師的暗示多难领会。

來到美国就凭着一股热情,使尽吃奶的力和十八般武艺,还是困难重重,險象环生,侥幸老來能全身而退。后輩们是精英,水准高,风险低,可喜可贺。可知道前輩们走过的是一条布满荆棘的道路?



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CASA Bulletin of Anesthesiology
is an official publication of
Chinese American Society of Anesthesiology (CASA)

ISSN 2471-0733

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