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CASA 2022 Annual Report

Cathy Cao, MD, FASA
President of CASA

CASA/ICAA with ASA President-elect Dr. Ronald Harter in New Orleans, on 10/22/2022

Happy Holidays!

"一年好景君须记，最是橙黄橘绿时。"回首 2022 年 CASA 旅程，我首先代表 CASA 理事会感谢 CASA 会员们对我们的信任和始终如一的鼓励支持。衷心感谢大家在与新冠疫情共存的第三年能克服各种困难为 CASA 无私奉献，积极踊跃地参加各种 in-person 活动或 Zoom 会议，勤奋执着地为 CASA Bulletin 撰稿组稿，不辞辛苦地发展终身会员。CASA 的凝聚力和影响力也日益增强，CASA 因为有每一位会员而精彩，因为每一个人的贡献而不断壮大。

2022 CASA 理事会

2022 CASA 基金会

2022 CASA 董事会

2023 CASA 理事会新成员


CASA Lifetime
Achievement Award


CONGRATULATIONS


for all you do
We Appreciate You!


CASA Bulletin


2022 CASA Honorary Members


Congratulations


CASA
ASA-CASA
Collaboration Award
Beverly K. Philip, M.D.,
FACA, FASA
Immediate Past President of ASA
American Society of
Anesthesiologists


2022 Mission near Accomplished
一年来大家携手并肩，精诚协作，我们坚持不懈地朝着定的目标努力，不断发展壮大 CASA 的核心力量。今年初我提出 CASA 今年的使命是 1）庆祝 CASA 诞生 20 周年，纪念前任会长王海明医师仙逝三周年；2）每位会员发展一名新的终身会员，协助会员加能。
虽然青年初的终身会员加倍还有一定差距，但我们非常高兴今年恢复了疫情前的会员聚会活动，老朋友们经过新冠的封锁后更加珍惜生命和友谊。王海明会长的事迹激励我们更加坚定不移地团结奋斗！
"Celebrate Life of Dr. Haiming Wang, CASA's founding President." Kingston, New York on August 13, 2022
2022 CASA Activities
2022 CASA Core Mission
2022
规划 CASA 长期目标
Recruiting members

CASA-新青年麻醉论坛 Mental Health 公益讲座系列

王瑞指导领导的 CASA 身心健康委员会成员名单

疫情期间邀请精神科医师指导

Add caption here

为 CASA 年轻一代举办的职业发展和领导力发展的 Zoom 讲座

International collaboration

CASA Awards

Lifetime Achievement Award
Jefferey Huang, MD, FASA
Distinguished Service Award
Ning Miao, MD, FASA
International Wellness Award
Yong G. Peng; Amy Mi Wang; Hong Wang and Abigail Wang; Tina Leung and Carmen Leung
Organization Service Award
John Zhong; Yongjian Lin; Honghui Feng; Changzhen Wang; Henry Zhou; David Yue Tang.
Leadership Award
Henry Liu; Jinlei Li; Yong G. Peng; Zhao Yang; Xiaowei Lu; Haobo Ma; Wei Pan; Jiapeng Huang; Hong Wang.
Contribution Award
Yanqin Lou; Weidong Gao; Jingping Wang; Shaofeng Zhou; Lingqun Hu; Fenghua Li; Yuyan Liu; Shan Zhang.
Foundation Award
Yunping Li; Hong Wang.
Young Physician Award
Yang Zhang
Presidential Resident Award
1st Prize: Yunjia Zhang
2nd Prize: Wei Chen
3rd Prize Andrew Ting

篇后鸣谢长沙迈吉尔科技公司赞助 2022 年 CASA 多项活动。

主编之言

神经外科麻醉和气道通气管理的麻醉进展

苗宁， MD

神经外科手术麻醉主要指颅脑和脊髓手术的麻醉， 颅腔内的脑容积和脊髓血流丰富，围术期氧供需平衡，血流动力学，颅内压和液体的管控对麻醉医生十分重要。神经外科学的发展与神经影像学、神经解剖学，神经生理学、神经病理学和神经麻醉学等相关学科的发展密不可分。

神经外科学经历了经典神经外科，显微神经外科，微创神经外科，清醒神经外科，机器人辅助神经外科，放射科介入神经外科等等，宗旨在于切除病灶，血管和创伤修复的同时最大限度地保护脑功能。围手术期管理、药物应用以及麻醉方法对脑肿瘤手术麻醉、脑血管病手术和颅脑创伤手术麻醉的不断地进展极大的改善了患者神经系统的预后和生活的质量。外科医生和麻醉医生在神经外科手术中的相互依赖是保证手术成功的不二之选，尤其是在复杂神经外科患者的手术治疗期间。

随着麻醉学的迅速发展，大量过去被认为是禁忌的疑难、危重病患者得到了及时的手术治疗，麻醉期间对生命功能的监测与调控，手术后镇痛等不断普及，更在无形中推动了神经外科学的发展。

与神经外科手术和麻醉从小到大，从弱到强，从大体到精细的过程相似，麻醉界对呼吸道管理的重视也与日俱增。麻醉医生极大的认识到呼吸道管理是临床麻醉、重症监护和急救治疗的重要工作，许多与呼吸道插管、气道管理有关的医疗器械被研发并广泛使用。尽管如此，困难气道仍是麻醉医师常面临的挑战，是围手术期麻醉相关不良事件发生的主要原因。

除麻醉医师最熟悉且能熟练使用的喉镜片、鼻咽，口咽通气道。视频喉镜 Glidescope、可视管芯、可视插管型喉罩、纤维支气管镜、以及紧急外科环甲膜穿刺建立气道外，气道肿瘤麻醉或紧急困难气道管理时，喷射通气已被证明是一种可以有效维持氧合和通气的技术。

宾西法尼亚大学医院麻醉科的魏华峰教授自研究生起几十年来一直致力于喷射通气的研究，改进和完善"魏氏" 鼻咽喷射通气导管，用以提供声门上喷射供氧和通气，可防止丙泊酚镇静麻醉下胃镜检查时的低氧血症， 在紧急或非紧急困难气管插管时保持有效供氧和通气， 及为气管肿瘤的切除提供有效的供氧和通气，显著降低困难气道管理过程中因低氧血症导致并发症。他的这些成就取得了国际上的公认和推广应用。

这期期刊大家可以阅读神经麻醉和气道管理麻醉两方面的研究文章。希望对大家的麻醉日常工作有所启发和借鉴作用。

本期专题

Anesthetic consideration and management of awake craniotomy

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Awake craniotomy refers to an intracranial surgery performed while the patient is in a state of awareness allowing for cooperation with functional testing of the cortex. This technique is a gold standard of care for neurosurgical interventions requiring tissue resection within or close to the eloquent brain areas involved in motor, visual, language function or short-term memory [1]. The cortical mapping during awake craniotomy enables the identification of cortical and subcortical networks responsible for individual patient's neurological functions and allows maximal removal of lesions while preserving neurological and cognitive function [2]. Awake craniotomy has been originally adopted for the surgical treatment of intractable epilepsy, and in recent decades has been widely carried out for both low-grade and high-grade gliomas resection [3] and for other lesions close to eloquent brain areas (e.g., cerebral aneurysm [4], vestibular schwannomas [5]). Compared with craniotomy under general anesthesia (GA), awake craniotomy is associated with greater extent of tumor resection, lower incidence of postoperative neurological deficit [6], shorter hospital stays, and longer survival after brain tumor resection [7]. Aside from the surgical benefits, awake craniotomy is also associated with less exposure to GA, less hemodynamic and physiological disturbances, less postoperative nausea and vomiting and lower postoperative pain scores despite reduced narcotic use [8]. Recently, awake craniotomy has been studied as a potential outpatient procedure and some reports showed it is a feasible option in carefully selected patients undergoing supratentorial tumor surgery on an outpatient basis [9, 10].

Preoperative patient selection and preparation

Appropriate patient selection and preparation are crucial to procedural success. The absolute contraindications for awake craniotomy are patient refusal [11] and inability to cooperate (e.g., decreased level of consciousness) [12]. Some medical conditions may make this surgery challenging, including obesity, OSA, difficult airway, seizure history, psychiatric disorders, chronic cough, severe GERD, pregnancy, hearing or language barrier, pediatric population, and challenging tumor pathology (e.g., large and deep-seated tumors, highly vascular lesions). Strategic anesthetic planning tailored to each individual patient and a skilled multidisciplinary team are essential for the procedural success.

Awake craniotomy requires a highly motivated and cooperative patient. Preoperative preparation is of utmost importance. Approximately one quarter of patients report significant anxiety prior to awake brain surgery. This can be mitigated by providing comprehensive perioperative information and support, which should begin as soon as the patient is scheduled for awake craniotomy [11]. During the preanesthetic visit, an anesthesiologist should take this opportunity to establish good rapport with the patient, outline the procedure in detail (positioning, scalp nerve block, airway management, and motor and language testing), counsel

the patient regarding the discomfort encountered during surgery, seek the opportunity for coping method (e.g., preferred music), address their concerns and provide reassurances. Since an anesthesiologist is in hearing range and visible to the patient at all times during the procedure, patients often rely on the anesthesiologist at times of stress during surgery. A good patient-anesthesiologist rapport is, therefore, crucial to the success of awake craniotomy [11]. In addition, participation of the neuropsychologist responsible for intraoperative testing is very important even at this stage of care [13]. Comprehensive multicomponent psychological preparation and the establishment of a trusting relationship between the patient and surgical team in most cases allow us to avoid or minimize the use of sedative premedication [1].

Preoperative anxiolytics for patients with significant anxiety should be added judiciously. Benzodiazepines (esp. midazolam) are common choices. The addition of these medications should be balanced against the risk of altered mental status or failure to arouse for intraoperative testing, and respiratory insufficiency leading to hypercapnia and raised ICP. Some centers report using no sedation at all, some centers start the loading infusion of dexmedetomidine upon entry to the operating room [14]. Oral Tylenol may be taken preoperatively to alleviate intraoperative headache.

Intraoperative anesthetic management

Goals

The essential goals of anesthetic management for a successful awake craniotomy include maximizing a patient's comfort and tolerance of the procedure, ensuring adequate brain relaxation and hemodynamic stability, and ensuring a rapid and smooth emergence for intraoperative speech, memory or motor testing.

Common anesthetic approaches

Two dominant anesthetic approaches, conscious sedation (CS) and asleep–awake–asleep (AAA), are widely used in awake craniotomy with no evidence that one technique is superior to the other [11]. With CS approach, patients are sedated but readily arousable and able to maintain spontaneous breathing before and after neurological testing. With AAA approach, patients are unconscious under GA with or without mechanical ventilation (LMA or ETT) before and after neurological testing. The advantages of CS approach include stable hemodynamics, less delirium and agitation upon emergence for testing, less coughing due to absence of a LMA or ETT. However, there are risks of pain and anxiety, sudden movement, airway obstruction, elevated ICP due to respiratory insufficiency with CS approach. The advantages of AAA approach with intubation (LMA or ETT) include better patient comfort, no patient movement, controlled airway, ability to hyperventilate and less brain swelling. However, there are risks of hemodynamic fluctuations, delirium and agitation upon emergence for testing, shivering, coughing and scalp laceration from head pins upon extubation, drowsiness from residual anesthetics, and nausea and vomiting. The AAA approach without airway intubation (e.g., nasal cannula, oxygen mask) carries higher risks of airway obstruction and elevated ICP than CS approach due to higher level of sedation.

Anesthetic management

Two large-bore IVs, arterial line and urinary catheter are usually placed after the patient is sedated. A comprehensive plan for supporting or securing the airway emergently should be in place. Patients who are allowed to breathe spontaneously with supplemental oxygen need to be watched for airway obstruction. High-flow nasal cannula is an air oxygen blender supplying humidified air and oxygen mixture with control of FiO_2 from 0.2 to 1.0. It has recently been reported to facilitate awake craniotomy in the morbid obese patients [15, 16]. Nasopharyngeal or oropharyngeal airway may be inserted to alleviate airway obstruction, however, the risks of nose bleeding, coughing and increased airway secretion should be kept in mind. Respiratory insufficiency and hypercapnia may lead to elevated ICP and cerebral edema. If airway obstruction aggravates rapidly to critical situation, assisted ventilation with an LMA or ETT insertion will be indicated. Advanced airway equipment (video laryngoscope, fiberoptic bronchoscope) should be readily available to assist emergent intubation in a patient whose head is pinned and turned in semi-lateral position.

Awake craniotomy performed in the interventional MRI suite (IMRIS) allows identification of residual tumor by repeated imaging during surgery. The combination of awake craniotomy and intraoperative MRI facilitates the dual goals of maximal tumor removal with minimal functional consequences [17, 18]. In many centers, an LMA is placed before each intraoperative MRI scanning, since a patient's head will be covered by the sterile drape and his or her airway will become invisible and inaccessible after the he or she is in the MRI scanner.

The mainstay of analgesia for awake craniotomy is a regional block. Incisional pain can be managed with local anesthetics infiltration along the incision line and the pin sites. Many centers use scalp blocks to more efficiently block the six nerves which provide sensory innervation to the scalp (the greater and lesser occipital nerves, great auricular, auriculotemporal, zygomaticotemporal, supratrochlear and supraorbital nerves) [19]. However, even with successful scalp blocks, patients often experience pain during surgical resection. Usually, these sensations are associated with manipulations of the skull-base structures or traction of pain-sensitive structures [20]. During surgical resection, the surgeons may infiltrate the areas close to inflections of the dura and major arteries (the dura mater of the skull base, the falx cerebri, and the leptomeninges of the lateral fissure and neighboring sulci) with local anesthetics, as those areas are sensitive to pain [14]. In addition, the surgeons need to avoid traction of pain-sensitive structures to minimize intraoperative pain and improve a patient's satisfaction.

Besides the surgical manipulation, there are other resources of discomfort or irritation that an anesthesiologist must keep in mind and attempt to alleviate as much as possible to facilitate a patient's cooperation. These include thirst, cold temperature, positioning discomfort, irritation from urinary catheter, lines (arterial line, IVs), tight-fitting oxygen mask or nasal trumpet, inability to see the surroundings. It would be helpful to provide mouth moisture swab, warm blanket, adequate padding to pressure points, face tent (instead of tight-fitting oxygen mask), numbing the nostril before insertion of nasal trumpet, and tent the drape upward from the patient for better visualization and reduce a patient's sense of claustrophobia. Patients' favorite music could be played in the operating room to help to alleviate their anxiety. Verbal guidance and reassurance should be offered throughout the awake portion during the neurological testing, he or she must be reassured that involuntary movements and speech patterns may occur as a result of cortical stimulation by the surgical team.

Before and after neurological testing, either IV sedatives or volatile agent may be used for patients under GA with controlled ventilation (LMA or ETT). Inhalational anesthetics, such as sevoflurane, has the potential to increase ICP and induce nausea and vomiting during awake stage. If the plan is to maintain a patient's spontaneous breathing with either CS or AAA approach, IV infusion of propofol solely or in combination with dexmedetomidine or remifentanil has been used with success. Careful titration of the IV sedatives to achieve the above-mentioned goals is the key. Optimal sedation level is one that renders a patient drowsy but readily arousable. It takes skill and experience to achieve this balance in the complex setting of awake craniotomies. Remifentanil may facilitate analgesia and sedation, however, risk of respiratory depression is higher [11]. Dexmedetomidine, a selective alpha 2 agonist with sedative, anxiolytic, analgesic, sympatholytic and opioid-sparing properties, has minimal impact on neuronal function and causes minimal respiratory depression when using a low dose, making it particularly suitable for sedation during awake craniotomy [11]. Although high-dose dexmedetomidine may cause bradycardia, hypotension and prolonged recovery from sedation, such doses are rarely required during awake craniotomy [11]. Propofol should be discontinued at least 15 minutes before EEG recording. Despite prompt awakening, propofol leaves a residual EEG footprint characterized by high-frequency, high-amplitude β activity that can obscure the abnormal activity that is being sought in the cortical surface EEG [21]. In order to alleviate a patient's anxiety, discomfort and movement during neurological testing, there are case reports that very low dose of dexmedetomidine or remifentanil infusion has been maintained and titrated to effective patient cooperation during the testing portion [22, 23]. There was a concern that adequate cortical stimulation could not occur with ongoing sedation but studies have shown it can be used during the testing [24].

The clinical benefits of awake craniotomy and the quality of intraoperative brain mapping highly depend on the quality of intraoperative emergence and speech interaction with the patient during the surgery. The sedation profile during the pre-awake phase (i.e., scalp incision, bone flap removal, dura opening) plays a crucial role in the quality of intraoperative emergence. With sudden movements, coughing and delirium upon emergence, patients are at risk of scalp lacerations due to pin slippage, contamination of the operation field, and other injury [25]. Anesthetic plan should be tailored to achieve a rapid and smooth emergence and make it possible to restore a patient's preoperative level of consciousness for neuropsychological testing to be run successfully.

Intraoperative complications

Although very safe in experienced hands, awake craniotomy is associated with some well recognized complications [11]. In addition to those discussed previously (airway obstruction, delirium and restlessness upon emergence, inadequate analgesia), nausea and vomiting, brain swelling [26] and seizures may occur during awake craniotomy [11]. Other rarer events, such as macroglossia [27] and accidental intracerebral injection of local anesthetics during scalp block [28], have also been reported.

Nausea or vomiting during awake craniotomy is a serious safety concern since it may lead to increased risk of aspiration and inadvertent brain swelling [12]. Administration of prophylactic antiemetics is advisable, especially if narcotics are administered in patients with multiple risk factors for PONV. Using antiemetics from different pharmacological mechanisms at the

beginning of the procedure may help achieve optimal outcome. Other measures may include gentle manipulation of the dura and limitation of narcotic usage.[12]

Although spontaneous ventilation may assist in keeping the brain relaxed due to maintenance of negative intrathoracic pressure and promotion of cerebral venous outflow, spontaneous ventilation under sedation may pose the problem of brain swelling due to hypercapnia resulting from decreased respiratory effort and airway obstruction.[29] There are a few maneuvers that may improve the conditions[14], including elevating the head, decreasing sedation to improve respiration and use of mannitol or furosemide. One should keep in mind that inserting nasopharyngeal or oropharyngeal airway or applying jaw thrust to improve respiration may trigger patient movement, coughing and straining leading to worsening brain swelling. If there is no additional need for a patient's cooperation, GA could be induced with placement of ETT or LMA to initiate hyperventilation.

During electrical cortical stimulation, an anesthesiologist should be prepared to treat grand mal seizures. The main risk factors for intraoperative seizures are history of preoperative seizures and frontal lobe tumors[30], although preoperative antiepileptic medication prophylaxis did not show benefits of seizures prevention in brain tumor resection.[31] Seizures usually stop with cessation of cortical stimulation or with irrigation of the cortex with cold saline. When seizures are not self-limited, pharmacologic intervention (e.g., with propofol in increments of 0.5-1.0 mg/kg) may be warranted. However, propofol should be withheld briefly until it is clear that the seizure is not going to terminate spontaneously because it may interfere with subsequent EEG localization for a while.[32] Other anticonvulsants, such as benzodiazepam, may not be optimal due to slower clearance and possible interference with further functional testing. Postictal drowsiness, respiratory depression, and hypotension may occur. Be prepared to convert to GA and secure the airway with ETT or LMA if necessary.

Conclusion

Appropriate patient selection and preparation are crucial to the procedural success. Every effort should be made to alleviate a patient's discomfort to facilitate his or her cooperation and tolerance of the procedure. Regardless of the chosen anesthetic approach, the goal is to achieve hemodynamic stability, adequate brain relaxation, and rapid and smooth emergence for neurological testing. A comprehensive plan for supporting or securing the airway emergently should be in place. Anesthesia providers should be prepared to treat intraoperative complications including brain swelling and seizures during awake craniotomy. Strategic anesthetic planning tailored to each individual patient and a skilled multidisciplinary team are essential for the success of awake craniotomy.

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The role of ICPNT in Standardization of Neuroanesthesiology Fellowships

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I) Foundation and Current Scenario of the ICPNT

With the demand for improving patient outcomes during complex neurosurgical procedures, there is an increased interest and necessity for perioperative experts in Neurocritical patient care. Neuroanesthesiologists are fellowship-trained physicians with the skills, knowledge, and experience to orchestrate the perioperative environment to optimize care and support innovations in the neurosurgery and neuroradiology operating rooms. In its current state, Neuroanesthesiology training is still heterogeneous both in the U.S. and internationally, with fellowships varying in length, curriculum, and standards. As such, the pathway unfortunately is unacceptably ambiguous, and the need for an explicit and unified standardized curriculum for interested fellows is greater than ever. This heterogeneity in neuroanesthesia education creates confusion and produces variation in the standards of care and likely adversely impacts patient outcomes. In addition, recent surveys by Swell et al. [1] in Canada, Rajan et al. [2] in the U.S., and Valero et al. [3] in Europe showed a general lack of standardized curriculums in their respective areas, with Valero's and Rajan's surveys revealing a majority approval for standardization, further supporting the urgent need for action.

Recognizing the need for an international homogenous curriculum to advocate for and improve the subspecialty, SNACC created The International Council for Perioperative Neuroscience Training (ICPNT) in 2019 [4] (icpnt.org). The ICPNT was created to serve as an entity that provides new and existing Neuroanesthesiology fellowship programs the opportunity to get accredited through a stepwise process that ensures the highest standards in the field globally. The curriculum was based on the three pillars of Neuroanesthesiology described by visionary and former SNACC president Dr. George Mashour [5]. The recommended curriculum consists of all essential elements of perioperative neuroscience and anesthesiology divided into 12 modules 4-weeks each. Figure 3 depicts a summary of the core Curricular and Cognitive Competencies in Neuroanesthesia that a fellow must be proficient in. The development of this curriculum marks a monumental moment for the subspecialty, paving the way for an official accrediting council. With 25 internationally accredited programs and a novel accreditation process, the ICPNT is setting standards for Neuroanesthesia fellowship training worldwide.

II) Mission and Goals of the ICPNT

Since its creation, the mission of the ICPNT has been "to set high-quality neuro-anesthesia educational standards globally and improve patient outcomes." To fulfill that mission, the ICPNT set forth a set of goals (Figure 1) and a clear vision to achieve. The vision of the ICPNT is:

1. To accredit and thereby ensure standardization of Neuroanesthesia education with an international spectrum and scope.

2. To promote collaboration between accredited programs leading to quality education for fellows graduating from these programs.
3. To contribute to education and research to our specialty through networking and partnerships.

Figure 1: Strategic Goals of the ICPNT

To promote communication and networking between accredited programs, the ICPNT created the Neuroanesthesia Program Relations committee (NPR), which plays an active part in educational networking between Neuroanesthesia fellowship programs to aid research and innovation.

- The committee offers webinars featuring Neuroanesthesiology experts, neuroscience researchers, and ICPNT fellows presenting interesting cases and journal clubs every month.
- During the pandemic, the committee surveyed the impact of the COVID-19 pandemic on clinical training, education, and the emotional wellness of the trainees in Neuroanesthesia and published the results in the Journal of Neurosurgical Anesthesiology.
- The NPR provides yearly workshops during the SNACC annual meeting, with the 2021 workshop on 'Perioperative Brain Function Monitoring' selling out. This indicated the need for such educational programs for Neuroanesthesiologists in practice.
- In April 2021, the committee organized a virtual PD meet and greet, with another excellent discussion between program directors regarding fellowships, accreditation, and collaboration. Everyone toasted online during a virtual wine and cocktail event.

Activities of other ICPNT committees are

- Developing and maintaining procedures for neuroanesthesiology fellowship accreditation
- Creating a bank of questions which can aid program directors in teaching and assessing fellows. This may one day form the nucleus for a summative certification examination
- Developing modules for certification of individuals in specific aspects of neuroanesthesia knowledge and practice
- Growing a network in support of neuroanesthesia research
- Assuring high quality communication of ICPNT activities

III) Novel Accreditation Process

In support of international differences in training, culture, and regulation, the ICPNT created a formal yet novel accreditation process (Figure 2). The application process is divided into two main stages. The first stage includes a Formative submission by the program for the ICPNT to provide feedback on how to improve the application based on the core curriculum competencies. The second stage is a Summative evaluation that provides the program with official accreditation if approved. As depicted in Figure 2, there are three categories of accreditation:

- A1 is 5 years - Strong program, criteria are fully met
- A2 is 3 years - Minor deficiencies are expected to be addressed to meet full criteria.
- A3 is 1 year - Deficiencies are major and can be met with significant effort

Figure 2. ICPNT Novel Accreditation Process

IV) Neuroanesthesiology Fellowship Curriculum

The fellowship should last at least one year with six mandatory adult neurosurgical operating room modules (4 weeks + 1 module), one module in interventional neuroradiology, one research and scholarship module, one critical care module, principles of neuromonitoring module, and elective modules such as pediatric neuroanesthesiology (Figure 3).[4]

Figure 3. ICPNT curriculum

Perioperative Anesthetic care includes assessment, Intraoperative and Postoperative management of Neurosurgery cases- with a special emphasis on procedures like Neuromonitoring, Transcranial dopplers, and Cerebral oximetry. In the Neurocritical care module, the fellows evaluate and manage critical neurological illnesses, perioperative morbidities in neurological injury patients, postoperative pain, and implement analgesic regimens tailored to neurological status and provide anesthetic care for various interventional neuroradiology procedures. During the Interventional Neuroradiology module, the fellows become experts at assessing MRI and providing care and intervention assisting the neuro-interventionalist. The Cognitive Module involves learning Neuroanatomy, Neurophysiology, Neuropathology, Neuropharmacology, and Neurologic injury- Classification and Grading. Educational Activities include lectures, simulation labs, research, and conferences. And finally, Educational Methodology comprises problem-based learning, weekly case presentations (formal and informal), lectures, and journal clubs.Flexibility exists such that the neuroanesthesiology education could be designed to be a continuum with additional education in research, neuromonitoring, and neurocritical care.

Ultimately ICPNT neuroanesthesiology fellows gain skills in teaching, supervising, innovation, and professionalism in preparation for becoming future educators and leaders in perioperative neuroscience. The goal is to prepare fellows to have expertise in perioperative care of patients undergoing neurosurgical interventions and independently manage complex and rare neurosurgical cases and neurological crises. The ICPNT is providing a cohesive curriculum to bridge the now-to-future gap in Neuroanesthesia training and help develop the next generation of Neuroanesthesiologists who will participate in a future practice which will require capability in adaptive innovation to facilitate advances in neurosurgery and neuroradiology.

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Anesthesia for Interventional Neuro Radiology

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Summary

This article summarizes the proliferation in endovascular interventions for neuro vascular procedures that the Anesthesiologist will commonly encounter in the neuro interventional radiology (NIR) suite. General principles applicable to most procedures are outlined as well as some special considerations for different conditions such as cerebral aneurysms, arteriovenous malformations and stroke. It is also of paramount importance that those taking care of patients in the NIR suite are aware of the two most devastating complications of cerebral ischemia due to intra- arterial thrombus formation and cerebral hemorrhage with accompanying intracranial hypertension that can happen, what can be done to minimize the risk of them occurring and how they should be managed.

Introduction

NIR is a growing specialty with a number of newer innovations in both devices and the number of conditions that can be treated. Since the introduction of coils to treat brain aneurysms in the early 1990's the indications for treatment have grown to include aneurysms with broad necks, giant aneurysms and complex aneurysms at branching points in the intracerebral circulation. This evolution has gone hand in hand with techniques such as balloon and stent assisted coiling that allow coils to be compacted within the aneurysm. Balloon assisted coiling (BAC) also has the ability to arrest flow while the coils are deployed which is particularly useful for the treatment of ruptured aneurysms. More recently the focus has shifted from coils deployed to provoke aneurysm thrombosis to now include the use of "pipeline" or "flow diverting stents" to treat the parent artery and divert blood flow away from the aneurysm and thrombosis occurs over a period of weeks due to stasis of blood within the aneurysm. Stent therapies are thrombogenic and have to be combined with dual antiplatelet therapy (DAPT) thereby relatively contraindicating their use in patients presenting with ruptured aneurysms. The newest device is a Woven Endo Bridge (WEB)™, a construct that is deployed across the neck a wide aneurysm without the need for a supporting stent device and antiplatelet agents and is being used off label to treat ruptured aneurysms. For the endovascular enthusiast there are becoming few aneurysms that cannot be treated in the NIR suite. Other conditions that are commonly encountered in the NIR suite include embolization of arteriovenous malformations (AVM's) and tumors, vasospasm following subarachnoid hemorrhage and perhaps most commonly for the generalist covering the NIR suite on call, mechanical thrombectomy for treatment of acute ischemic stroke. With this rapid growth of both conditions and treatment options over the past 30 years there is much for the Anesthesiologist to consider in the care of the patient in the NIR suite.

General considerations

NIR procedures typically take place in locations remote from the OR or increasingly in newly designed and constructed hybrid suites within the OR. The former requires anticipation of

medications and equipment that might not be immediately available for the more complex patient or procedure and both types of locations might be unfamiliar surroundings in terms of room layout and staff for the generalist providing coverage for "out of hours" procedures. These procedures expose both the patient and staff to high doses of radiation and it is important to consider the possibility of pregnancy when appropriate and for staff to wear radiation protective lead and increase their distance from the source of radiation as much as possible and particularly during times of high usage as the dose of radiation is reduced to ¼ by doubling the distance away from the source.

Mild allergic and other physiological reactions such as renal dysfunction to contrast media are quite common. Predispositions to renal injury include age greater than 75 years, pre-existing renal impairment, hypertension, diabetes mellitus (esp. with metformin use) and co-administration of nephrotoxic drugs (e.g. aminoglycosides or NSAID's). Careful attention should be made to fluid management to maintain euvolemia and during longer duration procedures it is important to consider that the interventionist may flush their catheters with 1-2 liters of crystalloid solution. Modern contrast media consist of non-ionized compounds that are either iso or low osmolality and severe anaphylactoid reactions are very rare (1/2500) and unrelated to shell fish or iodine allergy.

It is of the upmost importance that patients do not move during intracranial NIR procedures. Using digital subtraction angiography the interventionist will create a roadmap of the intracranial circulation and any movement of the patients head will cause the road map to be inaccurate. Instrumentation and manipulation of the skull base arteries with catheters, wires and devices can be uncomfortable and sufficiently stimulating to elicit reactions such as coughing and bucking provoking imprecise deployment of coils, stents and embolic materials and complications such as unwanted thrombosis, rupture or nonselective occlusion of vessels. For patient comfort and safety most centers prefer patients to have general anesthesia for endovascular intracranial interventions. For most elective procedures maintenance of physiological homeostasis is acceptable but immobility is of paramount importance. In theory that latter should be achieved with an adequate depth of anesthesia but the periods of intense stimulation can be unpredictable and at our institution we have adopted a protocol of maintaining a profound neuromuscular block. Most commonly the interventionist will access one of the femoral arteries and the side port of the catheter can be "slaved" for invasive blood pressure monitoring and blood sampling. An important consideration for interventions when larger diameter catheters are used is the need for patients to lie relaxed and flat for up to six hours after the procedure to prevent hematoma and possibly femoral artery pseudo aneurysm formation. This may necessitate the need for either post procedural intubation or sedation in patients unable to do so. We have one proceduralist whose preference is to use the radial artery which negates some of these concerns.

Specific procedure related considerations

Cerebral Aneurysms

Due to the risk of ischemic complications Endovascular interventions require the patient to be heparinized typically with an initial bolus of heparin (50-70 mcg/kg) to achieve an ACT in the range of 250-300s. Patients who are to be treated with either stent assisted coiling or flow diverting stent are at even higher risk of ischemic complications due to in-stent thrombosis are started on DAPT prior to treatment. Some patients have variable therapeutic responsiveness to

the P2Y12 platelet receptor inhibitor Clopidogrel. This may be due to either a genetic deficiency in the enzyme that converts clopidogrel to its active metabolite or co morbidities such as diabetes, renal impairment, drug interactions or tobacco use that share a common metabolic pathway. Many neuro interventionists will use the VerifyNow™ P2Y12 assay to measure the efficacy of clopidogrel activity. It measures P2Y12 reaction units (PRU) and a value <194 is deemed adequate platelet inhibition. Patients who are deemed inadequate responders can be treated with the newer generation thienopyridine class drugs prasugrel and ticaglor that have the benefit of faster onset and efficacy but the downside of increased bleeding risk, cost and twice daily dosing for ticagrelor.

When complications occur in the NIR suite successful management is dependent on effective communication between the proceduralist and the Anesthesiologist. Although intra-procedure aneurysm rupture is arguably the most feared and devastating complication of an endovascular intervention it is intra-arterial thrombus formation and the risk for ischemic complications that happens more frequently. When the proceduralist is aware of thrombus formation they will often ask for the blood pressure to be raised, more heparin to be given and sometimes glycoprotein IIb-IIIa inhibitors are given either locally intra-arterially or systemically intravenously to inhibit platelet aggregation. Patients with vasospasm after sub arachnoid may present to the NIR for possible interventions including angioplasty and possibly intra-arterial injection of calcium antagonists such as verapamil and nicardipine directly into the constricted arteries. This may cause profound hypotension and should be anticipated as these patients are at particular risk of further brain injury due to cerebral ischemia.

When an aneurysm ruptures during an endovascular intervention this will usually elicit a sudden Cushing's or hypertensive crisis in reaction to the sudden increase in intracranial pressure. The proceduralist should be immediately alerted and they will attempt to control the bleeding by occluding the artery with a balloon whilst coils are packed into the aneurysm. It will often be necessary to reverse any heparin that has been given with protamine and a platelet infusion might be necessary if the patient has received DAPT. Whilst the initial reaction to a Cushing's response will be to lower blood pressure it may become necessary to maintain a normal or slightly elevated blood pressure in the setting of a balloon artery occlusion and other maneuvers to try and lower intracranial pressure should be considered such as hyperventilation to lower $paCO_2$, hyperosmotic therapy and draining CSF (if a ventriculostomy has been placed for ruptured aneurysms prior to the procedure). It may be necessary to take the patient emergently to the OR following the procedure for a decompressive craniectomy.

Embolization Procedures

Technological advancements in both micro catheters and wires feeding arteries to both AVM's and tumors as well as fistula can be selectively embolized with "glue" like materials. Again, it is of paramount importance that the patient remains immobile so that the catheter does not migrate on injection into normal arterial branches. The proceduralist may ask for normal or lower blood pressure on injection to try and prevent embolization of embolic materials into draining veins causing some degree of venous outflow obstruction or even the pulmonary circulation which may present as post procedural hypoxemia. When an AVM is embolized relative hypotension is often necessary for up to 24hrs as blood is shunted into a chronically hypotensive vascular bed that requires time to restore its auto-regulatory capacity.

Stroke

Due to the success of mechanical thrombectomy with stent retrievers for large vessel occlusions there has been an explosion in stroke interventions over the past ten years or so. The pooled data from three randomized controlled trial has demonstrated equipoise between general anesthetic and MAC for stroke outcomes when hypotension and hypocarbia are avoided and outcomes are worse when MAC is converted to GA . The perceived benefit of MAC is a more timely intervention and less physiological disturbance but unless the patient presents in a condition compatible with successful MAC our practice and others is favoring GA for patient safety and comfort

Final thoughts

It is anticipated that with knowledge considerations of the procedures and conditions being treated in the NIR suite and good communication between the Proceduralist and Anesthesiologist the outcomes for the patient will be good and the experience satisfying for all those involved.

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Further reading

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Multimodal Analgesia for Complex Spine Surgeries

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Postoperative pain following complex spine surgery is particularly a major challenge for anesthesiologists due to the combination of extensive tissue trauma (from muscle dissection & surgical manipulation at the operative site) and the patient population who already have significant spine pain at baseline. Up to 55% of spine surgery patients struggle with chronic pain preoperatively and as many as 50% of patients are already consuming regular opioids at the time of surgery. As expected, preoperative opioid use is directly related to postoperative opioid use as well as other complications including increased hospital length of stay, healthcare costs, risk of surgical revision and hospital readmission within 90 days [1,2,3]. Severe postoperative pain can delay postoperative recovery and prolong rehabilitation. Lumbar fusion and large spinal reconstruction procedures represented the top six surgeries with the highest pain scores on the first postoperative day and 3-34% patients undergoing single-level discectomy without instrumentation experienced persistent pain in the short term (6-24 months) and 5-36% in the long term (> 24 months) postoperative period [4,5].

Postoperative pain following spine surgeries are also at high risk for progressing into chronic pain, with its frequency ranging from 5% to 75% [6,7]. In another study, it was shown that 7.2% of patients experience persistent low back pain following posterior decompression & instrumented fusion surgery. The risk factors for developing this included preoperative low back pain, surgery on the spinal segments L5-S1, and preoperative paraspinal muscle degeneration [8]. Chronic postsurgical pain (CPSP), which is defined as persistent post-surgical pain lasting longer than 2 months, is a complication that can lead to unexpected functional limitations and immense psychological distress. Unlike acute postoperative surgical pain which is primarily somatic and visceral, CPSP has a neuropathic component that is more difficult to treat. It is therefore important to identify the risk factors and develop preventative strategies to reduce the risk of developing CPSP as much as possible. The risk factors for developing CPSP includes preoperative pain, psychological factors (*ie.* anxiety), surgical site, surgical duration (greater than 3 hours), female sex and younger age. Most importantly, severe acute postoperative pain has been shown to be associated with an increased risk of developing CPSP, emphasizing the importance of adequate postoperative pain control in this population [9].

Prior investigations have shown that postoperative pain following spine surgery may involve a combination of pathways including neuropathic, inflammatory, and nociceptive pain responses [10]. In acute pain, previous studies have evaluated the role of PGE-2 and IL-6 in the induction of pain and inflammation [11]. In addition, activation N-Methyl-D-aspartate (NMDA) receptors and central sensitization with associated secondary hyperalgesia have been implicated in the development of chronic pain [12]. The growing body of evidence indicates that the combination of pharmacologic agents that simultaneously act upon multiple pain pathways can provide a synergistic effect while reducing the need for each medication and its potential side effects.

<u>NSAIDs & COX-2 inhibitors</u>

Somatic pain is due to production of inflammatory pain mediators resulting from tissue damage. NSAIDs (*ie.* ketorolac) and selective cyclooxygenase-2 inhibitors (*ie.* celecoxib) have been used to manage somatic surgical pain by inhibiting the production of these inflammatory mediators. Preoperative celecoxib use has shown to reduce postoperative morphine consumption, pain, nausea and vomiting [13]. Preemptive analgesia with COX-2 inhibitors has shown to improve postoperative pain scores and decrease opioid consumption while increasing patient satisfaction [14]. Due to the lack of COX-2 enzyme in platelets, COX-2 inhibitors do not affect platelet function or increase perioperative bleeding.

The role of COX-2 in bone resorption and healing has been demonstrated through many studies. Following bone injury, prostaglandin synthesis and COX-2 expressions are elevated during the first two weeks to promote bone healing. For this reason, there has been concerns that COX-2 inhibitors may interfere with proper bone formation following spine surgeries [15]. However, studies have shown that COX-2 inhibitors do not inhibit spinal fusion or bone healing and therefore is a safe analgesic to use following spine surgery. In fact, COX-2 inhibitors were shown to provide better analgesia compared to tramadol without compromising bone healing [16]. According to a meta-analysis done by Farii et al., the risk of nonunion was higher in patients who received NSAIDs. However, when the studies were categorized into those who received NSAIDs during the early postoperative period (less than 2 weeks) versus those who were exposed to NSAIDs for a longer period of time (longer than 4 weeks), there was no significant difference between those who received NSAIDs during the early postoperative period compared to the control group while there was found to be a significant difference between those who received NSAIDs for longer than 4 weeks compared to the control group. This study also showed that the use of indomethacin did increase the risk of nonunion. Therefore, NSAIDs, other than indomethacin, can be an excellent analgesic that can be safely used during the early postoperative period [17].

Ketorolac has been successful in controlling early surgical pain but in order to decrease postoperative opioid consumption, patients required a dose higher than 60 mg. Although effective, there are side effects of ketorolac that limits its universal use for regular use for postoperative pain such as renal impairment. Ketorolac has also been associated with nonunion and failed spinal fusion in patients with history of smoking as well [18,19].

Acetaminophen

Although the mechanism of action of acetaminophen is not entirely clear, its antipyretic and analgesic property is well established. It has been historically categorized under NSAIDs because of its ability to inhibit the cyclooxygenase pathways and provide analgesia. However unlike NSAIDs, acetaminophen has weak anti-inflammatory activity which is the hallmark of NSAIDs. Acetaminophen's analgesic properties are due to indirect central COX enzyme inhibition, increase in pain threshold and its ability to modulate the endogenous cannabinoid system, possibly by preventing COX-dependent endocannabinoid degradation [20]. The recommended therapeutic dose for acetaminophen is 4 g to avoid hepatotoxicity and liver failure as a result of glutathione depletion. Despite much debate regarding the superior efficacy of intravenous over oral acetaminophen, it has been shown that there is no difference between oral & intravenous administration when used as part of the 24-hour multimodal analgesic regimen after a total knee arthroplasty [21].

Acetaminophen continues to be a crucial part of the perioperative multimodal analgesic regimen for its analgesic and opioid-sparing properties, which has been an important consideration in the setting of rising challenges with perioperative use of opioids (such as adverse events, misuse and abuse). However, the optimal dose and route of administration of acetaminophen for preemptive analgesia remains to unclear [23].

Ketamine

Although primarily known as an anesthetic, ketamine has also been successfully used as an adjunct for perioperative pain management due to its safety profile & profound analgesic properties. Ketamine is a non-competitive NMDA antagonist derived from phencyclidine. At subanesthetic doses, ketamine can prevent central sensitization and subsequently reduce the risk of developing opioid induced hyperalgesia and opioid tolerance [22]. This can be particularly helpful in spine surgery patients, many of whom are already opioid dependent and struggle with chronic pain which confer high risk for postoperative pain.

In the setting of acute postsurgical pain, ketamine infusions have recently been gaining favor as part of a multimodal opioid sparing analgesia regimen and is the standard of care in some institutions for the management of postoperative pain in opioid tolerant patients. In patients undergoing major lumbar spine surgery, intraoperative high-dose ketamine was shown to have morphine-sparing effects and decreased pain scores postoperatively [25]. Similarly in patients undergoing scoliosis surgery, Hadi et al. reported that in combination with remifentanil, the use of ketamine resulted in lower pain scores, reduced morphine consumption, and prolonged time to first analgesic rescue [26].

In another study, perioperative ketamine with clonidine premedication has shown to potentiate the analgesic effects of opioids and reduce the consumption of morphine through patient controlled analgesia (PCA) following spine surgery [27]. In chronic pain patients, a study by Nielson et al., demonstrated that postoperative morphine consumption and sedation 24 hours following spinal fusion surgery was significantly reduced in patients who received ketamine infusions compared to placebo [24]. Ketamine has been associated with nausea, headaches and disturbing psychomimetic effects (ie hallucinations, emergence phenomenon, sedation, disorientation). However, these are transient occurrences that last less than 60 minutes following administration. For these reasons, ketamine is considered to be a safe and relatively well tolerated medication [27]. The recommended dose of ketamine infusions for pain management consists of a 0.1-1mg/kg bolus upon induction followed by an infusion ranging between 0.1-0.25 mg/kg/hr. Ketamine also has promising prospects for chronic pain patients with concurrent depression. The closely intertwined relationship between chronic pain and depression is well known and commonly seen occurring together because they are mediated by the same modulatory neural system. Central nervous system nociceptive pathways (descending, ascending pain pathways in the midbrain, brainstem – periaqueductal gray matter, nucleus raphe, locus ceruleus) and brain regions involved in mood management are both mediated by neurotransmitters such as serotonin, glutamate and norepinephrine. There are a wide variety of antidepressants that are used to treat depression with associated pain such as SNRIs, SSRIs, TCAs and although they are effective in treating neuropathic pain, it has not always been effective in treating musculoskeletal pain. Chronic pain patients with clinical depression have worse physical, mental and social functioning compared to those without depression and

ketamine, which is a psychotropic mediation with profound analgesic properties shows great promise in the treatment for chronic patients with concomitant depression [28,29]

Unlike other antidepressants, ketamine's unique NMDA antagonism and anti-depressive properties is mediated through activation of mTOR in the prefrontal cortex. The anti-depressive effects of ketamine can also be seen within a few hours to days following treatment unlike other antidepressants which takes months before beginning to see its effect [29,30]. Ketamine's rapid effect onset is particularly useful in patients with suicidal ideations who are at high risk of carrying out suicidal behaviors at any given time [31].

Lidocaine

Lidocaine infusions have opioid sparing properties and has shown to decrease opioid consumption and improve quality of life following complex spine surgeries making it an ideal adjunct for pain control in opioid dependent patients [32,33]. The mechanism of pain relief and anti-hyperalgesia is mediated by NMDA and voltage gated sodium channel inhibition [34]. Systemic lidocaine also has anti-inflammatory properties. Systemic lidocaine stimulates the release of superoxide anions and interleukin 1B that inhibits neutrophil priming, a process where leukocytes are 'primed' to produce an enhanced response to activating stimuli [35]. Other mechanisms of lidocaine include inhibition of voltage gated calcium channels, potassium channels, glycine receptors and G protein pathways.

Dexmedetomidine

Dexmedetomidine is another opioid sparing adjunct that has recently garnered much attention for its diverse effects including analgesia, anxiolysis, perioperative sympatholysis and preservation of respiratory functions. Dexmedetomidine is a $\alpha 2$ agonist with moderate analgesic properties that work on peripheral and central $\alpha 2$ receptors. Its high lipophilicity allows it to pass the blood brain barrier, get absorbed into the cerebrospinal fluid and bind to the $\alpha 2$ receptors of the spinal cord to decrease nociceptive neurotransmitters such as Substance P [35]. In a study by Hwang et al., dexmedetomidine infusion was compared with remifentanil infusion in patients undergoing posterior lumbar interbody fusion surgery. Patients who received a dexmedetomidine infusion had significantly lower pain scores at the immediate and late postoperative periods (48 hr) and had lower hydromorphone requirements for 48 hours compared to the remifentanil group [36].

Dexamethasone

Major surgeries such as complex spine surgeries cause massive release of proinflammatory cytokines and profound systemic inflammation. Glucocorticoids such as dexamethasone can suppress the production of pro-inflammatory cytokines and prostaglandin synthesis by inhibiting Phospholipase A2 and the expression of COX-2 enzymes subsequently reducing postoperative hyperalgesia secondary to central sensitization. Preoperative administration of intravenous dexamethasone has shown to reduce acute pain during mobilization up to 24 hours after primary disc surgery and glucocorticoids have also shown to have sustained postoperative opioid sparing effects up to 3 days postoperatively [37,38,39].

Mg

Magnesium (Mg) is another analgesic with NMDA antagonism. The mechanism of Mg's antinociceptive effect is primarily mediated by regulation of calcium channels that are involved in central sensitization and pain hypersensitivity. The NMDA receptor regulates flux of ions such as sodium, calcium and potassium. Inhibition of NMDA receptors by Mg will prevent calcium entering the cell which is often the first step required to initiate and maintain central sensitization. Mg therapy has also shown to be beneficial in treating neuropathic pain, which is a result of peripheral or central sensitization. Mg is also involved in a variety of enzymatic reactions and synthesis of proteins responsible for neuronal function and survival. It promotes axonal growth, neural cell proliferation and repair following neural damage [40,41]. Mg can provide neuroprotection by inhibiting 'secondary' nerve injuries. Upon stress and nerve damage, as Mg levels decrease calcium influx through NMDA receptors will increase, causing cells to swell and undergo apoptosis. This leads to degeneration of uninjured nearby nerves as well. Mg can block NMDA receptors and the neurotoxic effects of calcium [42]. Major surgeries such as complex spine surgeries cause extensive surgical tissue and surrounding nerve injuries – Intravenous Mg can be helpful for perioperative pain caused by the combination of intraoperative neural injuries and pre-existing neuropathic pain. Intravenous Mg has shown to decrease postoperative opioid consumption and postoperative pain scores both at rest and at movement. In a study by Jabbour et al., patients who received both magnesium and ketamine infusions demonstrated lower cumulative morphine consumption up to 48 hour postoperatively when compared to patients who only received a ketamine infusion. Although magnesium is not currently widely utilized for postoperative pain, it shows great potential as an adjunct to reduce acute postoperative pain [43,44].

Gabapentinoids

Gabapentin was initially developed to treat epilepsy and developed to primarily modulate GABA metabolism. However, instead, they were found to inhibit the α2δ1 subunits of voltage gated calcium channels which are abundant in the cerebellum and hippocampus and can attenuate neurotransmission. Through this mechanism, it was hypothesized that gabapentinoids could be used to control pain by reducing neuronal hyperexcitability. Gabapentinoids have successfully demonstrated its ability to treat pain and has been widely used to treat a variety of neuropathic pain conditions including painful diabetic neuropathy, post-herpetic neuralgia and neuropathic pain from traumatic spinal cord injuries.[45] Due to its efficacy in treating chronic pain conditions, gabapentinoids have also been widely used in the perioperative period and considered essential components of protocols for early recovery after surgery and multimodal analgesia including complex spine surgeries. A meta-analysis study of 281 randomized clinical trials that compared gabapentinoids to placebos and other analgesic regimens concluded that there was no statistically significant difference in acute, subacute, or chronic pain and opioid sparing effect. On the other hand, gabapentinoids were associated with less postoperative nausea and vomiting but had other side effects such as dizziness and visual disturbances [46,47]. These side effects are primarily due to the effect of gabapentinoids on the cerebellum & hippocampus where α2δ1 voltage gated calcium channel is richly expressed. Other side effects include balance disorders (ie ataxia), sedation, somnolence and cognitive impairment. Pregabalin was associated with a three times higher risk of serious adverse events (*ie.* life threatening events resulting in death, disability, or significant loss of function or causing hospital admission or prolonged hospitalization) [48].

Gabapentinoids given on the day of surgery were also associated with increased risk of postoperative complications (*ie.* respiratory failure, pneumonia, reintubation) due to respiratory depression independent of opioid use [40]. In 2019, the FDA issued a drug safety alert on serious breathing problems with gabapentin and pregabalin in patients with respiratory problems or those taking CNS depressants. Day of surgery gabapentinoids is also associated with increased risk of ICU admissions without decreasing opioid requirements or hospital length of stay [41]. The French Society of Anesthesia and Intensive Care Medicine no lonbger recommends gabapentinoids being used as part of the routine perioperative regimen. With the risks of gabapentinoid use outweighing the benefits, current evidence forces us to re-evaluate the routine use of perioperative gabapentinoid in adults.

Sufentanil

Sufentanil is a potent, central mu opioid agonist that produces analgesia. Intravenous administration is not an effective postoperative analgesic because of its rapid decline in plasma concentration following cessation. However, sublingual administration has a longer duration of action and high bioavailability. Compared to oral sufentanil which has a bioavailability of 9%, sublingual sufentanil has a bioavailability of 60%. Sufentanil is highly lipophilic and crosses the blood brain barrier easily and has a potency that is 400 times stronger than that of morphine. Sufentanil is 12 times more potent than fentanyl with similar onset of time of 6.2 min (The onset of time for fentanyl is 6.6 min). The patient-controlled dispensary system for sublingual sufentanil is similar to PCA (patient controlled analgesia) pumps and dispenses 15 ug tablets every 20 minutes. It can be continued up to 72 hours postoperatively [39].

Although IV PCAs provide excellent analgesia and high patient satisfaction, it has been associated with issues such as infection, analgesic gaps (due to tubing obstructions) and respiratory depression. Sufentanil sublingual tablet system (SSTS) has been able to address such issues. Unlike morphine whose active metabolite (Morphine-6-Glucuronide, M6G) reaches its peak concentration hours following its dose event, sufentanil lacks active metabolites, decreasing the risk of delayed respiratory depression. Sublingual administration eliminates the risks associated with administering medications intravenously (*ie.* obstruction, catheter infiltration). Studies have shown that SSTS provides higher patient & nurse satisfaction due to its faster onset of analgesia and ease of use of the device compared to morphine PCAs [31]. However, according to Kim et al., there was no difference in postoperative pain following lumbar fusion surgeries between IV fentanyl and sufentanil PCA. IV sufentanil PCA did have a lower postoperative nausea and vomiting rate compared to fentanyl [32].

Methadone

Methadone is another option that can be used for postoperative pain due to its prolonged duration of action. The elimination half-life of methadone is approximately 22 hours. However, the metabolism may vary greatly between individuals due to variation in CYP 3A4, 2B6 and 2D6 expression. It is more commonly used for chronic pain, but the potential benefits of methadone in reducing the need for PCAs postoperatively offers much potential. Methadone for postoperative analgesia can be given orally 0.2-0.3 mg/kg prior to induction or as a single intravenous bolus 0.14-0.2 mg/kg intraoperatively. 0.2 mg/kg methadone intraoperatively decreases pain scores and postoperative pain requirements by 50% up to 72 hours postoperatively. However, intraoperative methadone has been associated with side effects such

as postoperative respiratory depression, hypoxemia, re-intubation and cardiac complications including arrhythmias and prolonged QTc [53]. Patients who received methadone treatment gain the most analgesic benefit between 48-72 hours postoperatively. In addition to opioid agonism, methadone is also an NMDA antagonist that can be useful for opioid tolerance and hyperalgesia. Other mechanisms include inhibition of 5-hydroxytryptamine and norepinephrine reuptake [54].

Fentanyl

The fentanyl iontophoretic transdermal system (ITS) is another type of patient controlled analgesic system that offers similar analgesic efficacy as IV PCA without the complications associated with administering medications intravenously (*ie.* line occlusion, infections). The ITS utilizes iontophoresis to administer medications transdermally and at pre-programmed doses. The ITS eliminates the risks associated with administering medications intravenously such as line occlusion and infections. Although ITS still requires skilled nursing monitoring, it is easier to set up and trouble shoot compared to IV PCAs. Overall ITS formulation of fentanyl had less opioid related complications including hypotension, tachycardia, hypotension, pruritus and urinary retention. However, it was shown to be better than IV morphine PCAs in promoting early mobilization following surgery [55].

New therapeutic modalities for postoperative pain management continue to emerge.

TENS, Epidural Analgesia, ESPB

Transcutaneous electrical nerve stimulation (TENS) is another non-invasive technique that can be used to relieve pain by transmitting electrical pulses to areas of pain. TENS is based on the 'gate theory of pain' and uses an electrical current to compete and inhibit afferent pain impulses, thereby decreasing painful input to the central nervous system. Evidence behind the analgesic efficacy of TENS in the perioperative period for postoperative pain control is unclear but there are multiple studies demonstrating significant reduction in pain and pharmacological analgesic consumption with its use [56].

Epidural analgesia has shown to be effective for both intraoperative and postoperative analgesia in a variety of surgeries including spine surgery. Epidural analgesia can provide potential benefits including increased patient satisfaction, decreased opioid requirements, earlier mobilization and decreased risk of postoperative nausea & vomiting. In a retrospective study done at the Cleveland Clinic Foundation, epidural analgesia was shown to decrease opioid requirements and their side effects, particularly in the elderly population [57,58].

Erector spinae plane blocks (ESPB) is a paraspinal interfascial nerve block where local anesthetic is injected between the erector spinae muscles and the thoracic transverse processes to target the ventral and dorsal rami of spinal nerves. A meta-analysis of 13 studies done on patients receiving ESPB following spine surgeries have shown reduced total opioid use, better pain scores and lower risk of postoperative nausea and vomiting with the use of ESPB. However, the quality of pooled findings was judged to be low to moderate [59]. In a study done by Avis et al where 50 patients undergoing lumbar spine surgery were randomized to receive bilateral ESPB with ropivacaine versus saline showed that there was no difference between the two groups in opioid sparing effects and pain scores [60]. None of these studies investigated the effect of continuous ESPB for postoperative analgesia which is an area that may be worth exploring

Liposomal Bupivacaine

Local anesthetics have been frequently injected into surgical sites to provide postoperative analgesia. In order to prolong the duration of action, long acting local anesthetics (ie bupivacaine) has been encased in liposomes so that they would be released over a longer period of time. However, recent meta-analysis including 13 RCTs suggests that there are few, if any, benefits in switching from intraoperative infiltration with unencapsulated bupivacaine to liposomal bupivacaine [6].

Opioids

Opioids is one of the most common analgesics used in the perioperative setting but is also associated with unwanted opioid related adverse events (ORAES) which complicates dosing and management. Opioids bind non-selectively to mu receptors to activate both the G protein signaling pathway and the beta-arrestin pathway that is responsible for desired analgesic effects and ORAES (ie respiratory depression, constipation) respectively. Recent studies have led to the discovery of molecules with 'differential signaling' that can preferentially activate the G protein signaling pathway without activating the beta arrestin pathway that cause ORAES.

Biased agonism (also known as functional selectivity) refers to agonists that preferentially activate one signaling pathway over another. Oliceridine is an example of a mu-GPS modulator that is actively being developed for pain management. Oliceridine is a newly approved FDA ligand bias opioid that has the ability to differentially activate the G protein signlaing pathway and provide pain relief with a decreased side effect profile (ie respiratory depression, nausea, vomiting) compared to morphine broadening the therapeutic window while decreasing ORAEs [6]. The onset of time of Oliceridine is 1-2 minutes with a duration of action of 1-3 hours. It is up to five times more potent compared to morphine. A 1-2 mg loading dose can be given and supplemented with 1-3 mg every 1-3 hours as needed. The recommended PCA dosing regimen consists of a loading dose of 1.5 mg with 0.35 or 0.5 mg demand dose with a 6-minute lockout [6].

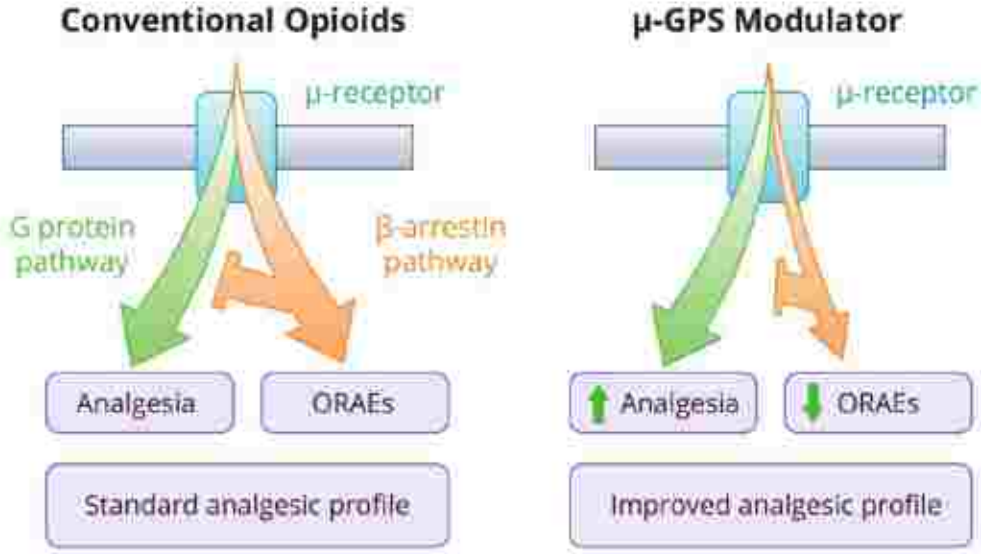

Figure 1. Mechanism of action of conventional opioids versus mu-GPS modulators[62]

Adequate postoperative pain control following complex spine surgeries is a crucial component of perioperative management for spine surgeries to accelerate postoperative recovery and promote early mobilization. Multimodal analgesia is the ideal method for perioperative pain management and starts with preoperative education and screening for risk factors. Patients who are at high risk for postoperative pain or preoperative opioid use should be referred to the perioperative pain clinic for further optimization of pain control prior to surgery. Prior to surgery, patients should be started on gabapentinoids and consider intraoperative liposomal bupivacaine infiltration at the surgical site. Postoperative pain regimen should include scheduled acetaminophen, NSAIDs, COX-2 inhibitors, oral/IV/PCA opioids, lidocaine and/or ketamine infusions. Although a specific pain regimen cannot be recommended from the literature, a multimodal approach has consistently shown to provide health benefits with fewer opioid related side effects and improved postoperative outcomes following complex spine surgeries.

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声门上喷射通气氧合在肥胖患者宫腔镜手术中的应用

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使用魏氏经鼻喷射导管（WEI Nasal Jet Tube, WNJ）进行声门上喷射通气氧合（Supraglottic jet oxygenation and ventilation, SJOV）能改善和维持麻醉状态下病理性肥胖患者困难气道的通气氧合[1]。但使用经鼻高流量给 100%氧对病理性肥胖患者麻醉诱导前预给氧却加速去氧和作用，出现肺不张[2]。可见，经 WNJ 行 SJOV 改善肥胖患者通气氧合基础在于改善气道塌陷，维持通气，提高已经下降了的功能残气量，从而改善氧合。经 WNJ 行 SJOV 同样适合生理性困难气道，因其对患者刺激较小，但却能为心肺功能脆弱的患者提供充足的氧合和通气[3]。WNJ 的呼气末二氧化碳（$ETCO_2$）监测气体采集在导管尖端，提高开放气道辅助通气时 $ETCO_2$ 监测的准确性，根据 $ETCO_2$ 监测判断和调整 WNJ 导管位置更有依据性[4]。

宫腔镜是妇科最常见的检查和手术方式，手术过程中不允许患者发生体动，以防止子宫穿孔等并发症[5]。据估计，中国每年有超过 10 万名患者接受宫腔镜检查或手术。通常是在静脉麻醉完成的，不需要气管插管或喉罩。丙泊酚/瑞芬太尼在内镜下的镇静和镇痛作用在过去 10 年显著增加[6]。肥胖患者通过托颌法或面罩加压通气进行补氧通常能缓解呼吸抑制及氧合障碍，但增加手术麻醉风险和麻醉医师工作量[6]。对拟行宫腔镜手术的肥胖患者使用经 WNJ 行 SJOV 患者临床随机对照研究发现，SpO2 <95%的发生率由 33%降至 6% (P = 0.006)；PETCO2 <10 mmHg 的发生率由 36%降至 9% (P = 0.009)；不良事件总发生率从 36%下降至 12% (P = 0.004)；经 WNJ 行 SJOV 前、后胃窦部横截面积差异无统计学意义 (P = 0.234)。无明显鼻出血、气压伤、误吸及胃胀气等严重风险。WNJ 置入深度约为 12.34 cm，相当于鼻翼到同侧耳垂的距离；WNJ 导管尖端的最佳置入位置为会厌与悬雍垂之间[6]。

总之，临床实践表明，经 WNJ 行 SJOV 可安全、有效地维持肥胖患者宫腔镜手术时静脉麻醉下的充足氧合。这种高效的氧合可能主要是由于向声门上区域提供高浓度氧，高压喷射提供了有效通气的缘故。WNJ 导管支撑肥胖患者塌陷的气道，改善通气可能起到关键性作用。没有证据显示 SJOV 增加胃胀气和误吸的风险，且无明显并发症。这可能为肥胖患者的困难气道管理提供一种新的有效方法。

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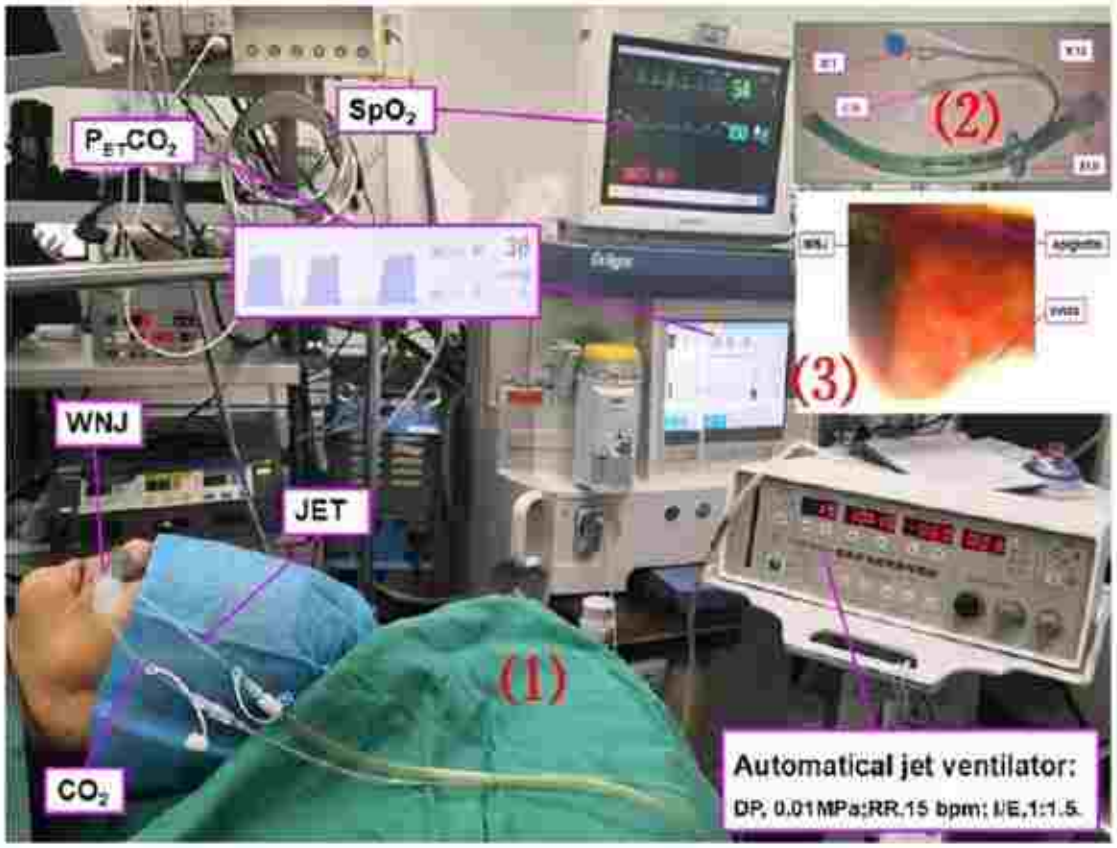

图 2：(1)通过 WNJ 的声门上喷射通气氧合(SJOV)场景，伴或不伴自主呼吸。SJOV 能保持氧饱和度和二氧化碳的呼出。PETCO2 =呼气末二氧化碳分压; SpO2 =脉搏氧饱和度，DP =驱动压力，RR =呼吸频率; I/E 比=吸入/呼出比。(2) 魏氏经鼻喷射导管 (WNJ)，在管壁内设置有两个通道，分别用于喷射通气和 CO2 监测的呼气末压力。FVD =深度固定阀。(3)WNJ 在声门上位置的纤维光镜图像。[Liang H, et al. BMC Anesthesiol. 2019 Aug 14; 19(1): 151.]

喷射通气在非紧急困难气道中的应用

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有效的气道管理是麻醉安全的基石。困难气道仍是麻醉医师常面临的挑战，是围手术期麻醉相关不良事件发生的主要原因[1]。未能快速成功地插管或通气可能会导致严重的不良后果，包括脑损伤或死亡。基于中华医学会麻醉学分会的困难气道管理指南，麻醉诱导后的困难气道根据有无困难面罩通气被区分为“非紧急气道”和“紧急气道”[2]。非紧急气道意味着患者仅有困难插管的情况，可以暂时通过面罩维持氧合。然而，插管困难和困难面罩通气是密切相关的，面罩通气困难患者中有四分之一的患者插管也困难，发展至“无法插管和无法通气（Cannot intubate and Cannot ventilate，CICV）”的状态是更大的挑战[3]。据统计，CICV 的紧急气道情况可导致高达 28%的麻醉相关死亡病例[4]。因此，当遭遇困难气道的紧急情况时，多数指南建议使用能够辅助气管插管和（或）建立人工气道的气道工具及紧急救援技术来尽快改善通气，保护患者围术期的安全。

喷射通气已被证明是一种可以有效维持氧合和通气的技术，美国麻醉医师协会的困难气道管理指南多次将其列入困难气道紧急情况下的有效处理办法[5,6]。喷射通气根据其通气频率可以分为低频、常频以及高频喷射通气。其中，以高频喷射通气（High frequency jet ventilation, HFJV）在困难气道中的应用最为广泛。HFJV 是气管切开术的可替代选择，它使用狭窄的导管输送高压、高频的氧气进入呼吸道。高压高频产生的文丘里效应使涡流的气体可以直接注入肺泡，增加了氧合并加快 CO_2 的清除[7]。其通气管的位置灵活多变，可以根据患者个体情况放置在声门上、声门下或经皮肤置入气管[8]。此外，HFJV 可以与喉镜、支气管镜、交换管、喉罩、甚至胃管、导尿管、吸痰管等多种工具结合使用，以便在困难插管期间能够更好地维持氧合。以上的众多优势使得 HFJV 已经成为困难气道管理中重要的通气方法之一。

Bouroche 等人[9]的回顾性研究发现，31 例困难插管患者在使用经气管高频喷射通气（Transtracheal high frequency jet ventilation, TTJV）后可以迅速恢复通气（SpO_2 >90%），成功率 100%。据 Anderson 等人[10]报告，TTJV 在处理困难气道方面的优势在于能够提供会厌的无障碍视野，不需要增加喉镜检查，并且在全身麻醉情况下减少气管切开的需要。然而，作为一项有创性操作所引起的气压伤、软组织肺气肿、出血等并发症也是不容忽视的，应该综合考虑安全性和有效性后合理使用。声门上喷射供氧和通气技术（Supraglottic jet oxygenation and ventilation, SJOV）是一种无创的新型通气方法，它通过使用魏氏鼻咽通气管来实现声门水平上的喷射通气。SJOV 能够在困难插管救援期间提供足够的氧合和通气，并在通过插管工具实施气管插管时，有

效延长插管时间。此外，SJOV 易于管理，由于其无创性操作的特点使得并发症较少，因此广泛使用于困难气道的患者。Liang 等人[11]报告了一名存在睡眠呼吸暂停综合征的病态肥胖患者，在可视喉镜插管多次失败后，面罩加压给氧效果欠佳，使用 SJOV 仅 1 min 后，SpO_2 上升至 100%，并顺利通过纤维支气管镜引导插管，SJOV 总时间为 7 min。Wu 等人[12]通过纳入 50 名 Cormack-Lehane ≥3 级的全身麻醉成年患者来比较 SJOV 及喉罩辅助纤维支气管镜在治疗困难气管插管方面的有效性和安全性，结果显示使用魏氏鼻咽通气管的 SJOV 在困难气道管理中能显著提高成功率并最大限度地减少低氧血症的发生。

针对非紧急或预期困难气道的患者，使用喷射通气技术来管理气道是切实可行的。可以根据患者个体情况及麻醉医师对操作的熟练程度来选择最合适的救援方法。我们建议至少将喷射通气作为一种备用技术，以管理围手术期患者气管插管期间的通气，尤其是在紧急情况下。

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声门上喷射通气在困难气道中的应用

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声门上喷射供氧和通气是一种无创通气新技术,可以避免经气管壁穿刺喷射通气的损伤和气压伤[1]。采用魏氏气管导管联合声门上喷射通气供氧, 可以在 8. 3 mi n 的时间里保持呼吸停止患者的动脉血氧饱和度在 100%, 显著延长直接喉镜气管插管的操作时间[2-3]。声门上喷射供氧和通气技术用于困难气管插管, 可辅助纤维支气管镜气管插管, 在插管过程中持续给氧, 尤其出现患者 "不能插管, 不能通气" 的危急情况时, 实施声门上喷射供氧和通气可以保证患者有效的氧气供应, 争取到宝贵的时间进行气管插管, 避免发生严重并发症。声门上喷射通气已经成功用于多种类型的难度较大的气道管理, 未发生严重的并发症[4]。Li 等[5]报道了 1 例不能插管和不能通气的困难插管患者, 采用经鼻入路声门上喷射供氧和通气技术协助插管, 帮助患者度过危机状态, 避免了灾难性结果的出现。

声门上喷射供氧和通气技术可以为窒息患者提供可靠的通气和供氧, 辅助困难气道患者气管插管, 为日间手术患者提供有效供氧和通气, 其优势明显且并发症少而轻, 是一种安全、有效、无创的供氧技术, 适合于临床呼吸抑制和通气困难的患者使用。

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喷射通气在支气管镜介入治疗中的应用

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支气管镜介入治疗已成为诊断和治疗气道病变的首选方法，通过缓解气道梗阻改善患者的生活质量[1]。不同的手术需要不同的麻醉方法和不同的气道管理[2,3]。各种氧气输送途径包括鼻导管、面罩、喉罩气道和声门上导管，如魏氏声门上喷射通气管、气管内导管和硬质支气管镜[4-6]。内窥镜面罩舒适度高，不影响支气管镜插入，是最常用的通气工具。通气模式包括常规氧疗(COT)，间歇通风，机械通气，和喷射通气，它们各有优缺点。高频喷射通气 (HFJV)是一种开放式通气技术，可用于维持紧急或困难气道的通气。然而在深度镇静麻醉下进行支气管镜介入治疗气道狭窄的患者术中，在维持氧合方面，HFJV 是否优于 COT 和常频喷射通气 (NFJV)尚不清楚。因此，我们提出了 HFJV 可以改善深度镇静麻醉下气道狭窄患者行气道介入治疗的术中 PaO_2 的假设。

患者被随机分为 3 个平行组，每组 50 例：COT 组（吸入氧分数（FiO_2 1.0,12L/min），NFJV 组（FiO_2 1.0，驱动压力 0.1MPa，呼吸频率 (RR) 15 bpm) 和 HFJV 组（FiO_2 1.0，驱动压力为 0.1MPa，RR 1200bpm）。在整个治疗过程中记录患者的平均动脉血压、心率和 SpO_2。手术开始后 15 分钟抽取动脉血并记录动脉血气指标。同时记录了三组的手术持续时间、麻醉剂剂量和支气管治疗期间的不良事件。

研究结果显示 HFJV 组患者的 PaO_2 升高至 251.7mmHg，显著高于 COT 和 NFJV 组患者的 PaO_2 ($P<0.001$)。HFJV 具有一定的 PEEP 效应，可以打开气道，减少鼻咽腔的解剖低效率，增加肺泡有效通气量[7,8]。NFJV 组患者的 PaO_2 为 192.0mmHg，高于 COT 组 (176.3mmHg)，但无统计学差异。NFJV 的作用机制与 HFJV 相似，但 NFJV 可能会导致呼吸不同步，所以氧合改善不如 HFJV 显著。除了 PaO_2，另一个关注点是患者的 $PaCO_2$。之前的综述证明，NFJV 比 HFJV 更适合气道介入麻醉，因为喷射频率高于 150/min 后可能会导致 CO_2 积累[9]。本研究中 COT、NFJV 和 HFJV 组患者的 $PaCO_2$ 值分别为 59.2mmHg、59.8mmHg 和 59.6mmHg，三者之间无显著差异。尽管 $PaCO_2$ 值高于正常值的上限，但均未发生延迟苏醒。患者的术中氧合可能受多种因素影响，本研究中多元线性回归显示只有体重指数 (BMI)和手术时间是 PaO_2 的独立影响因素，没有 $PaCO_2$ 的独立影响因素。

气道介入麻醉的关键是如何维持患者开放气道的氧合功能，保证手术的可行性。病理性气道常引起限制性通气功能障碍，导致呼吸功能下降、弹性阻力增加、肺泡顺应性下降，这些都是影响 PaO_2 的重要因素。病变的范围、位置和病变程度，以及开放气道是否加重其对 PaO_2 的影响，

都是值得解决的问题。在本研究中，气道病变的位置和气道狭窄的严重程度被推测是与 PaO_2 相关的重要因素，但 Pearson 分析表明，两者都不是影响 PaO_2 的重要因素。

总之，HFJV 可有效、安全地改善气道介入治疗期间气道狭窄患者的术中 PaO_2，且不增加术中高碳酸血症的风险。PaO_2 与通气模式、BMI 和手术持续时间相关，但只有 BMI 和手术时间是术中 PaO_2 的独立影响因素。$PaCO_2$ 与任何术前因素无关。

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声门上喷射通气氧合在喉显微手术中的应用

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全麻下显微喉镜手术常用于声带肿物切除术。由于外科医生和麻醉医生共用气道，因此需要手术团队之间的沟通协作。理想的麻醉技术包括维持足够的氧合、气体交换；充分的术野暴露；相对静止的咽喉部空间以及防止组织碎块或血液污染气道。

有多种气道技术可以用于显微喉镜手术，其安全性和术野暴露各有优缺点[1]。通常情况下，全麻下肌松的患者会用小号气管导管来控制气道和通气，然而导管会影响术野和声带占位暴露，特别是出于声门后方以及声门下的小占位。为了增加术野暴露可以采用"无导管"（No-Tube）技术控制气道，即间断通过气管导管或面罩通气，手术操作则在拔除导管或移开面罩时的无通气状态下进行，其缺点就是需要根据患者耐受缺氧的程度，频繁中断手术操作。在全凭静脉麻醉下保留患者自主呼吸也可以达到术野完全不被遮挡的目的，然而在保留自主呼吸的条件下，仍然需要有一定麻醉深度以应对悬吊喉镜的操作刺激，该技术需要足够的临床经验[2]。和小号气管导管通气类似，还可以放置特殊设计的导管（喉显微导管、Ben 喷射导管、Hunsaker Mon 喷射导管等）至声门下进行声门下喷射通气，但要注意在喷射通气期间不要使气道完全密闭，避免导致气压伤。

声门上喷射通气氧合作为一项无创的通气方式，通常经鼻放置喷射通气导管至声门上，最好使喷射气流正对声门[2]。相对于声门下喷射通气，其气压伤的风险较低。魏氏喷射通气导管（WNJ；维力医疗有限公司，广州，中国）是目前较新的实施声门上喷射通气的工具。经鼻放置的 WNJ，在导管前端以及中间各有一个通道，分别用于连接喷射通气装置以及测量呼气末二氧化碳浓度[3]。

进行声门上喷射通气用于显微喉镜手术的主要优势在于无遮挡的手术视野。而麻醉相关的主要顾虑在于患者是否能维持氧合，有没有二氧化碳潴留以及组织碎片和血液是否会污染气道。复旦大学附属眼耳鼻喉科医院的一项临床研究[4]，比较了声门上喷射通气和常规小型号气管导管作为显微喉镜手术气道管理技术的优劣。由于更好的视野暴露（外科医生主观视野评分，满分 10 分，9.7±0.5 vs 7.7±1.1），进行声门上喷射通气的手术时间更短（12.4±4.6 min vs 15.5±4.0 min）；最低氧饱和度低于气管插管组（95.7±5.1 % vs 99.2±0.5 %）；虽然术毕呼气末二氧化碳更高（52.0±7.3 mmHg vs 43.0±2.3 mmHg），然而仍在临床可接受范围。

在临床实践中的注意点包括，对于易出血的占位以及怀疑肿瘤的占位，考虑出血污染以及肿瘤种植的风险，带套囊的气管导管能更好的保护气道；如果外科医生预计手术时间较长，要警惕高碳酸血症的可能；支撑喉镜的胸部支架会影响喷射通气期间观察患者的胸部起伏，WNJ 的优势

在于可以通过到位的导管测量患者呼气末二氧化碳；如果外科医生需要使用激光操作，可以停止纯氧喷射供应，并用 WNJ 连接呼吸机进行低浓度氧冲洗术野。

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绿荷舒卷凉风晓，　红萼开蒸紫茹重。　　唐. 李绅

摄影：汪红 MD　　CASA 华人麻醉医学会

2022 年 ASA 年会

现代科技重在以人为本—记 2022 美国麻醉年会主讲嘉宾—Mick Ebeling

陈文，MD

北美健康圈

北美健康圈通过北美华人医生们的笔，为大众普及医学健康新知识，也为医人们发挥个人才艺提供平台空间，达到医学与艺术的圆满结合。

158 篇原创内容
公众号

2022 ASA 美国麻醉年会在南部路易斯安娜州的新奥尔良举行。新奥尔良是美国爵士乐的发源地，美国爵士乐之父 Luis Armstrong （图一）就是在这里出生的。为了纪念这位伟大的黑人音乐家对爵士乐的杰出贡献，新奥尔良国际机场以 Luis Amstrong 的名字命名。

图一 美国爵士乐之父 Luis Armstrong

有趣的是，继去年 ASA 邀请美国著名总统传记作家 Doris Kearnes GoodWin 博士做为主讲嘉宾之后，ASA 今年再次邀请了非医学专业人士做为大会的主讲嘉宾。这次请到的是 Not impossible Labs 的 CEO Mick Ebeling （图二）。

现年 52 岁的 Mick Ebeling 毕业于 UC Santa Barbara 政治学系，Ebeling 是美国著名的发明家，企业家，作家，演说家和慈善家。他的公司 Not Impossible Labs 致力于研究以人为本的突破性发明，目的是把一些看似不可能的设想，变为可能。Mick Ebeling 曾经获奖无数（图三），其中包括默罕默德阿里人类贡献奖（Muhammad Ali humanitarian the year award），他也被财富杂志评为五十个最有创意的人之一。同时，他又是时代杂志唯一一个两次获得最有创意发明奖的人，获奖项目是 2010 年的 EyeWriter （图四）和 2021 年的 Bento（图五）

图五 Bento

EyeWriter 的最初创意， 是希望能够帮助一位患有肯髓侧索硬化（Amyotrophic lateral sclerosis ，ALS) 涂鸦艺术家 Tempt one 恢复同家人交流的能力。大家都知道患有 ALS 的患者会逐步瘫痪甚至失去发音和呼吸的能力。但是病人意识是清楚的，并可以看得见和听得见。EyeWriter 这个项目，通过给 Tempt one 设计一个特别的眼镜，通过眼镜上的特殊传感器，记录病人眼球的活动，帮助病人跟家人交流。不仅如此， Tempt one 在瘫痪七年之后还第一次用 EyeWriter 画了第一幅画（图六）。Mick Ebeling 和他的团队的这个 Eyewriter， 已经被纽约现代艺术博物馆 MoMA 做为永久性的收藏。

图六 Tempt one 第一次用 EyeWriter 画画

Mick Ebeling 的 Not impossible Labs 的另一个以人为本的创意是 3D 打印塑形手臂（3D-printable prosthetic arm）。Ebeling 得知苏丹的一个十四岁的孩子 Daniel，因为爆炸失去了双臂，当 Daniel 苏醒过来的时候，他告诉周围的人他宁愿死去，也不愿意因为失去双臂成为家庭的负担。Ebeling 听到这个故事以后感到非常难过，他设立了一个叫做 "Project Daniel "的项目，并于 2013 年十一月飞到南部苏丹，建立了当地的第一个 3D 打印塑形手臂实验室。"Project Daniel " 帮助 Daniel 拥有了自己的功能性手臂（图七），也为 Not impossible labs 赢得了很多世界级的奖项。

图七 Project Daniel

Not impossible Labs 的另一个看似疯狂的项目叫做 "Music: not impossible "，团队设计了一种可以穿在身上的震动感应技术，可以把音乐转化成震动信号，让聋哑人 "听到" 音乐的美妙。（图八）


图八 Music : not impossible

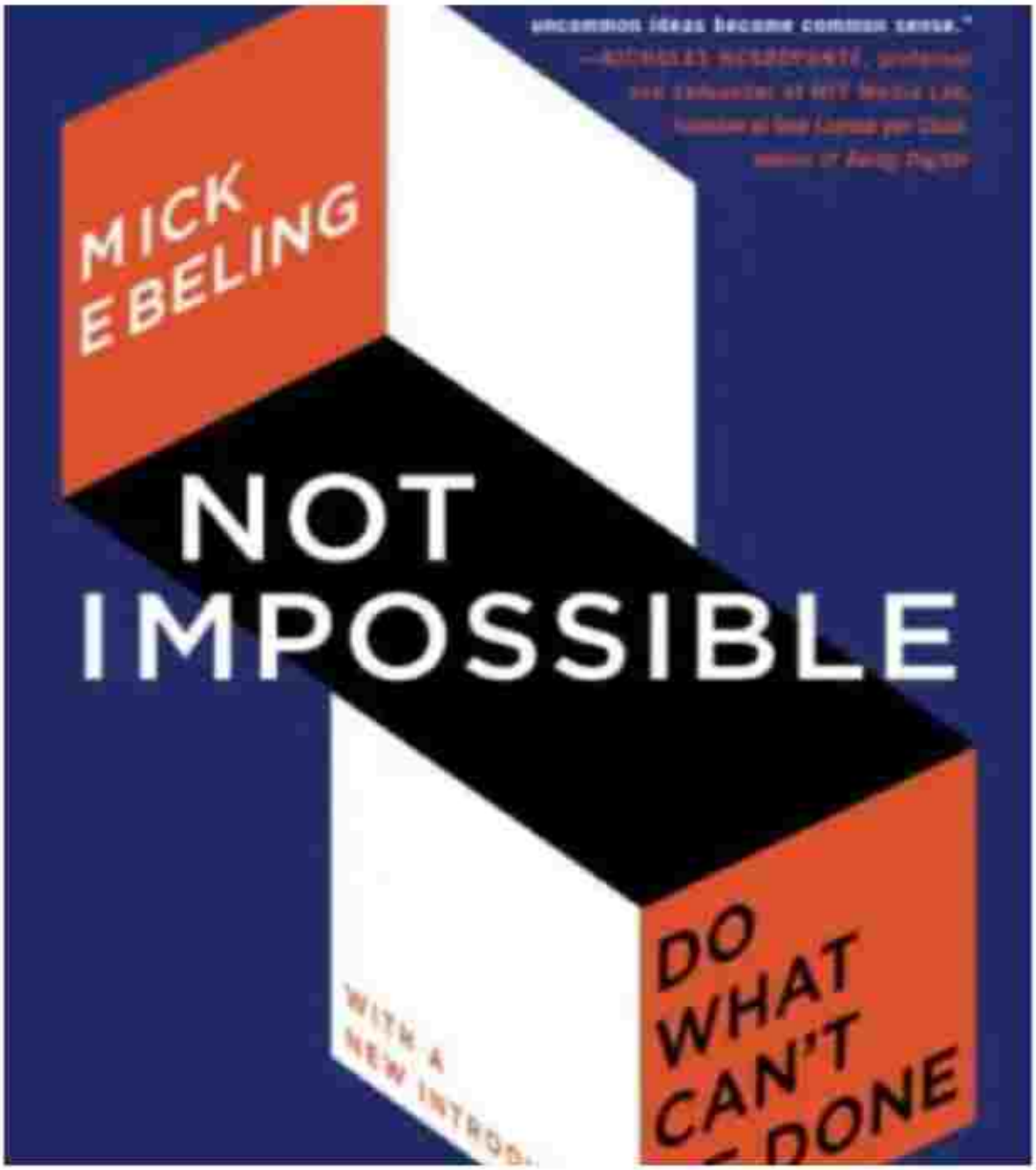
Ebeling 了解到美国还有很多人处于饥饿的状态，但实际上美国又有很多地方可以提供食品；关键在于如何把需要食品的人，和可以提供食品的机构联系起来。Ebeling 建立了一个旨在帮助穷人不再挨饿的短信系统，叫做 "Bento" 项目。这个简单的短信链接系统，却帮助了很多挨饿的人们不再担心吃饭问题。

最近， Not impossible labs 还在研制其他的项目，比如帮助帕金森病人恢复一些操作性功能的项目，虽然这个项目还没有得到 FDA 的批准，但是前景似乎很乐观（图九）。Ebeling 最近还不顾危险，飞到了战火纷飞的乌克兰，他们的团队也希望可以帮助到那里受战争煎熬的人们。

2015 年，Ebeling 出版了自己的记实体材的书 "Not Impossible" （图十）书中，Ebeling 分享了自己的创业体验。把看似不可思议的事情变为现实，变不可能为可能，是他的以人为本的创

意公司（Not impossible labs）的宗旨。Ebeling 做到了，那么也许你也可以做到，你也可以碰巧成为那个改变世界的人。世界需要以人为本的科技，让我们共同努力把这个世界变得更美好。

图十. Mick Ebeling's book



麻醉学年会有感

田穗荣， 刘恒意， MD

2022年10月下旬，来自世界79个国家的11,000位麻醉界同行齐聚美国南方路易斯安纳州最大的城市新奥尔良， 参加在此进行的美国一年一度的麻醉学年会。诸多涉及麻醉学亚专科的讲座让与会者受益匪浅，专家们解说最新麻醉指南以及正在进行中麻醉学相关的医学研究，麻醉实践的新趋势等等，更是让人耳目一新。

对新奥尔良的第一印象来自于美国著名的作家玛格丽特·米切尔创作的长篇小说《飘》，这本书获得1937年普利策文学奖。书中的女主角斯嘉丽是亚特兰大地区的一个富有的农场主家的女孩。 在19世纪初中期，尽管亚特兰大也是颇具规模的城市，然而却是内陆城市。

当年纽约、巴尔的摩和新奥尔良三个城市齐名，因为它们有港口，是商业中心，许多高档商品，如时尚的欧洲服饰、帽子，罗马/希腊风格的建筑材料等等，都会来到这三个港口城市。 对比这三个口岸城市的时尚生活方式，斯嘉丽就像乡下姑娘。当白瑞德告诉斯嘉丽要带她去新奥尔良时，斯嘉丽那高兴劲溢于言表，充满了对未来美好生活的憧憬。后来他们来到新奥尔良生活，白瑞德给斯嘉丽买她喜欢的时装，住欧洲风格的豪宅，享受可能比欧洲贵族更富裕的生活，衣着时尚堪比法国模特儿，斯嘉丽娘家的土豪乡村生活相形见绌。

100多年过去了，现在新奥尔良仍然是重要的港口、石油城市和商业中心，但只有不到100万人口， 比今天的亚特兰大规模小多了。

广州话，水=钱， “有冇水啊？”，意思是“有没有钱啊？”，有水就有钱！

美国的发迹史就是从海岸向内陆延伸。过去，纽约、费城、查尔斯顿、波士顿、 新奥尔良都有同样的地位。大浪淘沙，在美国历史上众多的重要城市中，纽约和波士顿经受住了历史的洗礼，在历经经济危机、金融危机、自然灾害、经济转型(二战中纽约及新英格兰地区有强大的工业生产力)的种种变故后，纽约和波士顿屹立不倒，如浴火重生的金凤凰， 而巴尔的摩、查尔斯顿在美国的经济地位却远不如以前了。

历史真的是冷酷无情！

不知道诸君是否知道，当年迪士尼在南方选址的时候，首选之地是新奥尔良北郊的Lake Pontchartrain对岸的小城市Mandeville，但是其时的路易斯安纳州政府及新奥尔良市政府不愿意提

供迪士尼要求的条件，最后迪士尼选择了当时尚是一个小村的奥兰多，因为佛罗里达州同意了迪士尼提出的要求，几十年过去了，如今奥兰多几乎两倍于新奥尔良地区的人口。

新奥尔良错过了很多重大发展的机会。历史上的机遇一旦错过，大概率就不会再来了！

想想今天的巴尔的摩，情况就更糟糕了！过去几十年几乎失去一半的人口。原本得天独厚，有着那么好的没有风浪的深水内港口（Inner Harbor），气候条件也优于纽约及波士顿，却未能物善其用。

历史的发展的确如"逆水行舟，不进则退"，这适合于每个国家（看看今天的阿根廷）和地区，其实也适合专业人员。

近年来美国麻醉护士努力蚕食麻醉医生的领域，我们如何在日新月异变换莫测的世界站稳脚跟，保持我们专业的领导地位，是每一位麻醉医师应该考虑的重要问题。

ASA 会间花絮

金秋 10/22 晚，参加 ASA 年会的 CASA 和 ICAA 部分会员近 50 人在 New Orleans 久负盛名的 Antoine’s Restaurant 欢聚一堂，召开了疫情后三年来第一次现场 CASA 年会。COVID 肆虐三年来大家首次无拘无束，不戴口罩近距离交流，共进丰盛的晚餐，看见新老朋友别来无恙，万般滋味，尽在心头！再次体验到平凡生活的来之不易。

曹锡清会长首先回顾了 CASA 自 2002 年成立以来的 20 年间组织从无到有，从小到大，从弱到强的创立、探索、合作和逐渐发展壮大过程以及 2022 年度 CASA 理事会所做的工作（可见后面曹会长的总结）。大家一起缅怀 CASA 的重要创始人之一-已逝的王海明医生。如他天上有灵，现在一定会欣慰自得，“笑傲江湖”！

曹会长还向大家介绍了 2023 年度新任 CASA 会长彭勇刚教授以及新增理事会的成员，并宣布了 CASA 杂志新任主编-陆晓薇医生。我们相信新的一年在彭教授的带领下 CASA 的工作一定会稳中求进，再创新高！

ICAA 的邵蓬夫会长席间特别提出 CASA 与 ICCA 应该联手，共图未来。他认为我们两个组织过去由于各种原因“合久必分”，现在天时地利人和，应“分久必合”，为中美的麻醉事业做出共同的努力！

席中，ASA 现任 First Vice President- Dr. Ronald Harter 莅临现场，强调 CASA 是 ASA 的重要组成部分，CASA 的工作也越来越受瞩目！卸任的 ASA president-Dr. Beverly Philip 随后也与 ASA Treasurer-Dr. Don Arnold 一起赶来出席我们的活动。Dr. Philip 不改其豪爽大气的风格，大声宣称 ASA 过去、现在乃至未来都与 CASA 在一起，我们有共同的目标和使命，为麻醉事业大家一路前进！

胡灵群教授和周少凤教授分别向大家做了学术报告。前者回顾了"无痛分娩中国行"十几年来取得的成就；后者讲述主动脉夹层紧急手术时的麻醉管理。

今天也正值仲巍教授的生日，饭店非常贴心又出其不意地"花招百出"，为其唱《祝你生日快乐》和庆祝 CASA 成立 20 周年，让大家有了意外之喜。

这次活动中一些年轻的麻醉住院医生和麻醉 Fellow 医生的出席让我们看到麻醉事业的“推波助澜”、承继有人！

传承的力量和时光的流逝！！！

餐后大家自由交流，新朋故旧相见恨晚，热烈畅谈，快乐留影。夜已深，大家才依依不舍的道别。青山横北郭，白水绕东城。此地一为别，孤蓬万里征。青山不改，绿水长流！不忘初心，后会有期！






CASA 和 ICAA 老、中、青三代麻醉医生的幸福留影。

ASA 年会期间，大家纷纷到访 ASA 会场 Exhibit hall 里观看，这里有长沙 Magill Medical SafeLM Video LMA System 器械展，公司代表--牛先生听取我们的建议以及大家所表达的对他们公司一直以来对 CASA 工作支持的感谢之情。

苗宁， MD 整理

聊聊麻醉

老年髋关节骨折的临床麻醉管理

苗宁，MD　　记录并整理

2022 年最后一期 "聊聊麻醉" 线上会议-老年髋关节骨折的临床麻醉管理在 11/12/2022 晚七点召开。此次会议由李金蕾教授主持。今天邀请了几位中美专家：包括耶鲁大学附属医院李金蕾教授，纽约威彻斯特医学中心纽约医学院许连君教授，纽约骨科特种外科医院刘家滨教授，北京医院于晖教授和北京积水潭医院许莉教授等。

每年，美国有超过 300,000 名成年人髋部骨折，几乎所有人都需要手术。近些年来的 REGAIN Trial（Regional versus General Anesthesia for Promoting Independence after Hip Fracture）的研究，即髋关节骨折手术的麻醉选择-全麻或腰麻的术后结果争议很大，两种麻醉方法在髋关节骨折的麻醉管理中是否有明显差异？心肺超声在此类手术中所起作用？中美两国麻醉医生的术中管理和术后镇痛的异同？带着这些问题，今天的讨论话题涉及以下几个方面，分别由几位教授主讲：

- 临床科研与实践：髋部手术的麻醉选择-纽约威彻斯特医学中心纽约医学院许连君教授
- 心肺超声在老年髋部手术患者围术期中的应用-北京医院于晖教授
- 全髋关节置换术的神经阻滞镇痛的进展-纽约骨科特种外科医院刘家滨教授
- 老年髋部骨折围术期 ERAS 流程：多学科共管模式的探索-北京积水潭医院许莉教授

李金蕾教授首先介绍了 3 大骨折之一的髋关节骨折的麻醉争议（另两大骨折为脊柱骨折和手部骨折）。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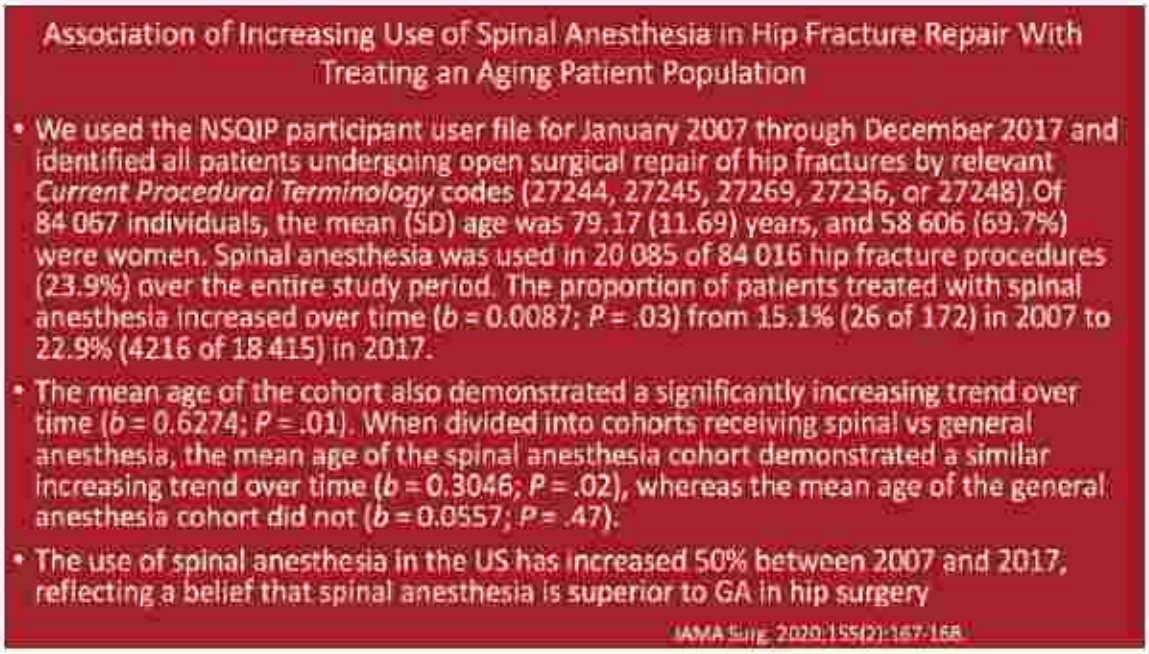
Spinal Anesthesia or General Anesthesia for Hip Surgery in Older Adults

M.D. Neuman, R. Feng, J.L. Carson, L.J. Gaskins, D. Dillane, D.I. Sessler, F. Sieber, J. Magaziner, E.R. Marcantonio, S. Mehta, D. Menio, S. Ayad, T. Stone, S. Papp, E.S. Schwenk, N. Elkassabany, M. Marshall, J.D. Jaffe, C. Luke, B. Sharma, S. Azim, R.A. Hymes, K.-J. Chin, R. Sheppard, B. Perlman, J. Sappenfield, E. Hauck, M.A. Hoeft, M. Giska, Y. Ranganath, T. Tedore, S. Choi, J. L, M.K. Kwofie, A. Nader, R.D. Sanders, B.F.S. Allen, K. Vlassakov, S. Kates, L.A. Fleisher, J. Dattilo, A. Tierney, A.J. Stephens-Shields, and S.S. Ellenberg, for the REGAIN Investigators*

Dr. Mark D. Neuman 团队 2021 年在 NEJM 上发表他们的 1600 例髋关节骨折老年病患手术麻醉选择的随机研究。患者平均年龄为 78 岁，按 1：1 的比例将患者随机分为两组，分别接受腰麻和全麻。术后 60 天比

较病患的死亡率、新发谵妄、无法独立行走、心肺肾并发症等，两组均无明显差异。作者因而得出结论：老年患者髋部骨折手术采用腰麻不优于全身麻醉。

与此相对，Dr. Bryan G. Maxwell 等 2020 年在 JAMA 发表的 10 年回顾性文章中论述了美国 8 万多例老年病患（平均年龄 79.17 岁）髋关节骨折后开放性修复术选择腰麻的病例比例增长了 50%，接受腰麻的病患平均年龄也明显增加，而接受全麻的患者年龄无显著变化。因此文章作者认为腰麻在髋关节骨折手术中优于全麻。



另外，李教授讲到髋关节骨折手术时机。过去普遍认为骨折后应 48 小时内手术，后缩短到 24 小时，现在甚至可 6 小时内手术。研究发现这些时间段手术对病患的手术影响无明显差异，而骨折后短时基础疾病还未加重，手术修复帮助患者尽早站立，利于基础疾病控制，又可防止骨折后卧床导致的肺炎等并发症的发生。

随后**许连君教授**阐释临床科研与实践关系：髋部手术的麻醉选择。他指出 Dr. Mark D. Neuman 团队 2021 年在 NEJM 上发表的随机研究中，腰麻手术后患者的死亡人数、心肺和肾的并发症人数均低于全麻。许教授通过自己的科研和临床实践经验提醒大家，阅读文献时首先要牢记几点基本要素：

- 阅读文献要有自我逻辑性思考，检查结论是否符合常识和合理性
- 仔细分析研究的设计方法是否准确和全面
- 有时统计学上的显著意义并非代表临床上的显著意义
- 以文献为基础，根据患者的实际身体和临床状况，采用自己最有经验和对患者最安全的麻醉方法进行麻醉

许教授例举近年来发表的许多关于髋/膝关节手术的麻醉选择的研究结果以飨读者，并论证科研合理设计以及科学分析的重要性。

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Outcome	Spinal Anesthesia (N=795)	General Anesthesia (N=804)
Outcomes in the hospital		
Complications — no./total no. (%)		
Death	5/782 (0.6)	13/790 (1.6)
Myocardial infarction*	6/783 (0.8)	9/793 (1.1)
Nonfatal cardiac arrest	2/780 (0.3)	0/784
Stroke*	5/783 (0.6)	7/793 (0.9)
Pneumonia*	8/783 (1.0)	16/793 (2.0)
Pulmonary edema*	9/783 (1.1)	8/793 (1.0)
Pulmonary embolism*	4/783 (0.5)	5/793 (0.6)
Unplanned postoperative intubation	4/783 (0.5)	7/793 (0.9)
Acute kidney injury*	32/709 (4.5)	55/726 (7.6)
Surgical-site infection†	2/783 (0.3)	0/793
Urinary tract infection*	35/783 (4.5)	28/793 (3.5)
Postoperative transfusion	130/782 (16.6)	146/793 (18.4)
Any return to the operating room	10/783 (1.3)	14/793 (1.8)
Critical care admission	18/783 (2.3)	29/793 (3.7)

还是以 Dr Mark D Neuman 团队的《老年病人髋关节手术腰麻或全麻的选择》一文为例。试验在美国和加拿大 46 家医院进行，随机分组因髋关节骨折接受手术，并且既往可行走的≥50 岁的患者，比较腰麻与全麻下手术后的结局。腰麻组的患者中，有 119 例（15.0%）实际接受了全麻。结果表明术后 60 日，腰麻组和全麻组患者死亡或新发无行走能力的发生率无显著差异。两种麻醉方式的次要结局无明显差异，其中包括 60 日内死亡，存活者在 60 日时有新发无行走能力，新发谵妄，以及从随机分组至出院的时间。

对此文献的发表结果，许教授有几点不同的看法：

- 文章题目"老年病人髋关节手术腰麻或全麻的选择"有点模糊视听，因为择期髋关节置换术和较紧急髋关节骨折手术病患是两组不同的人群，他们的疼痛指数和并发症区别明显
- 15%的腰麻组病人转为全麻的比例太高，各中原因不能让人信服

- 从上表可看见：两组术后实际死亡人数、肺炎、急性肾损伤和转入 ICU 的病人数有较大的不同，腰麻组明显少于全麻组

JAMA | Original Investigation

Effect of Regional vs General Anesthesia on Incidence of Postoperative Delirium in Older Patients Undergoing Hip Fracture Surgery The RAGA Randomized Trial

Ting Li, PhD; Jun Li, PhD; Liyong Yuan, MD; Jinze Wu, MD; Chenchen Jiang, MS; Jane Daniels, PhD; Rajnikant Laxmishanker Mehta, MS; Mingcang Wang, MD; Joyce Yeung, PhD; Thomas Jackson, PhD; Teresa Melody, RN; Shengwei Jin, PhD; Yingxiang Yao, MD; Jinxin Wu, MD; Junping Chen, MD; Fang Gao Smith, PhD; Qingguan Luo, PhD; for the RAGA Study Investigators

2021 年 Dr. Ting Li 等总结四年时间中国 9 所大学医院 950 例 65 岁以上老年病例髋关节手术的麻醉。病人随机选择腰麻或全麻。结果显示由于两组病患均接受外周神经阻滞，术后两组病患疼痛指数极低。结论是腰麻组病患其术后谵妄发生率与全麻病人无明显降低，是否外周神经阻滞成为混淆因子？

ORIGINAL RESEARCH Annals of Internal Medicine

Pain, Analgesic Use, and Patient Satisfaction With Spinal Versus General Anesthesia for Hip Fracture Surgery

A Randomized Clinical Trial

Mark D. Neuman, MD, MSc; Rui Feng, PhD; Susan S. Ellenberg, PhD; Frederick Sieber, MD; Daniel I. Sessler, MD; Jay Magaziner, PhD, MSHyg; Nabil Elkassabany, MD; Eric S. Schwenk, MD; Derek Dillane, MD; Edward R. Marcantonio, MD, MSc; Diane Mario, MS; Sahry Ayad, MD; Manal Hassan, MD; Trevor Stone, MD; Steven Papp, MD; Derek Donegan, MD; Mitchell Marshall, MD; J. Douglas Jaffe, DO; Charles Lake, MD; Balram Sharma, MD; Syed Azim, MD; Robert Hynes, MD; Ki-Jinn Chin, MD; Richard Sheppard, MD; Barry Perlman, PhD, MD; Joshua Sappenfield, MD; Ellen Hauck, DO, PhD; Mark A. Hoeft, MD; Ann Tierney, MS; Lakisha J. Gaskins, MHS; Annamarie D. Horan, MPA, PhD; Trina Brown; James Dattilo, BS; and Jeffrey L. Carson, MD; on behalf of the REGAIN (Regional versus General Anesthesia for Promoting Independence after Hip Fracture) Investigators*

2022 年， Dr. Mark Neuman 团队发表了另一篇文章，着重于老年病患髋关节手术采用腰麻或全麻术后的疼痛指数，镇痛药使用和病人的满意度比较。在同样的 1600 名病患中，他们的研究结果表明术后 24 小时，腰麻组病患的疼痛指数高于全麻组，其他时间两组的疼痛指数相似。这可能由于腰麻组病人术后腰麻消退后疼痛反差相对较大所致。

针对以上结论，许教授认为研究设计不甚完善的原因如下：

- 研究设计未表明或统计是否手术医生对病患注射关节囊局麻浸润
- 设计未表明麻醉医生是否做过外周神经阻滞
- 设计未表明髋关节骨折病患是否有过往慢性疼痛史和用镇痛药史
- 设计未表明腰麻组病患在接受腰麻前，是否给与镇痛和镇静药

由于以上的未考虑因素，贸然认定腰麻病人术后的疼痛指数和镇痛药用量高于全麻组，结论有些牵强附会。

A propensity-matched analysis of the National Surgical Quality Improvement Program (NSQIP) database

69,385 patients had general anesthesia, 10,839 regional or neuraxial cases were successfully matched to a general anesthetic case.

- **the risk for 30-day mortality (OR, 1.21; *P*<0.001);**
- **30-day cardiac arrest requiring cardiopulmonary resuscitation (OR, 1.65; *P*=0.004);**
- **30-day unplanned reintubation (OR, 1.58; *P*=0.001);**
- **30-day deep vein thrombosis (OR, 1.37, *P*=0.02).**

The 2022 virtual annual meeting of the International Anesthesia Research Society (abstract B90)

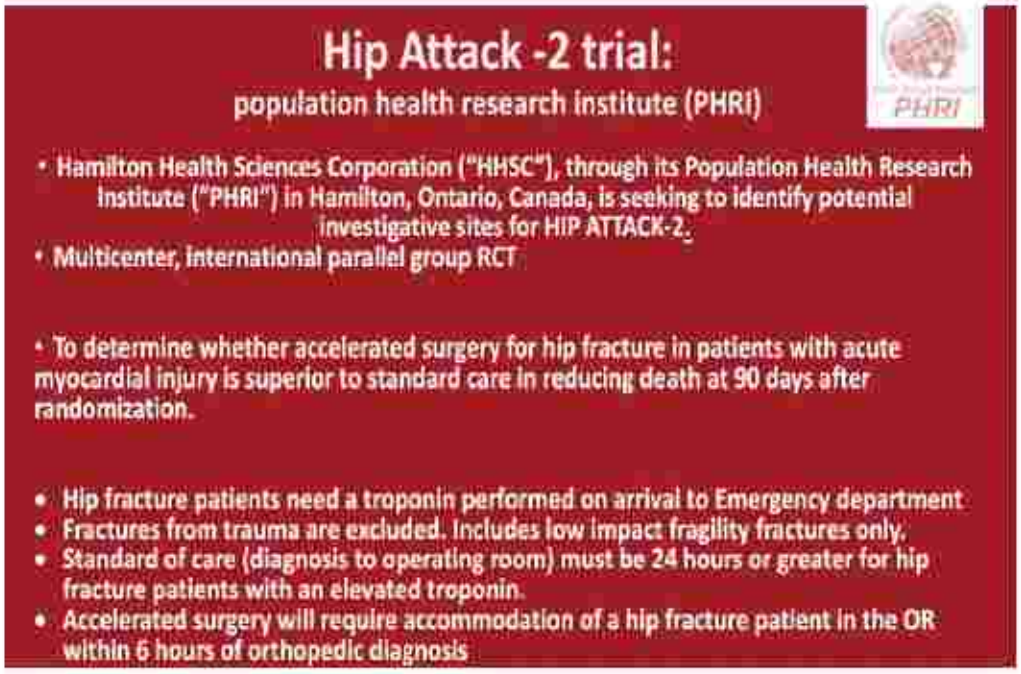
2022 年研究人员在 International anesthesia research society virtual 年会上发表了大数据分析全麻和椎管麻醉。他们发现术后 30 天全麻组病患的死亡率、心脏骤停和气管再插管率均高于椎管麻醉组。

Anaesthetic care of patients undergoing primary hip and knee arthroplasty: consensus recommendations from the International Consensus on Anaesthesia-Related Outcomes after Surgery group (ICAROS) based on a systematic review and meta-analysis

- Conclusions: Recommendation: primary neuraxial anaesthesia is preferred for knee arthroplasty, given several positive postoperative outcome benefits; evidence level: low, weak recommendation.
- Recommendation: neuraxial anaesthesia is recommended for hip arthroplasty given associated outcome benefits; evidence level: moderate-low, strong recommendation.
- Based on current evidence, the consensus group recommends neuraxial over general anaesthesia for hip/ knee arthroplasty. (PMID: [redacted])

李教授也介绍了另外几篇文章。2019 年，Dr. Stavros G. Memtsoudis 团队在他们的综述中分析了自 1946 年到 2018 年髋/膝关节成形术中选择椎管麻醉或全麻一共 94 个研究。结果显示，术后死亡率、肺肾并发症、深静脉血栓发生率、感染率等方面，髋、膝关节手术中选用椎管麻醉的结果均优于全麻组。

2020 年，Dr Rebecca Ljohnson 等发表了他们自 2005 到 2016 年对 18458 例关节成形术病患选择椎管麻醉或全麻所致结果的研究．研究发现麻醉的选择不同对术后并发症的发生无明显影响．但对虚弱病人和有原发疾病的老年患者而言，椎管麻醉所致的死亡率、伤口并发症或血肿发生率少于全麻组．他们认为椎管麻醉科改善这类病患的生存率．



Hip attack 2 trial 是一项多中心，随机对照试验，旨在确定急性心肌损伤患者髋部骨折的加速手术在减少 90 天的死亡率方面是否优于标准治疗．HHSC 的研究发现，加速手术（6 小时）并没有减少死亡率或一系列主要并发症．与随机接受标准治疗的患者相比，随机接受加速手术的患者发生谵妄、尿路感染、中度至重

度疼痛的风险较低，而且站立、活动和回家的速度更快，在因髋部骨折到医院就诊时 Troponin 升高显示心脏损伤的患者中，与标准手术时间相比，在 6 小时内进行手术降低了死亡风险。

于辉教授演讲时首先引用下文表述心肺超声在老年髋部手术患者围术期中的评估和应用，注意这类病患多有合并症存在。

HSS J. 2020 Dec; 16(Suppl 2): 378–382. PMCID: PMC7749896
Published online 2020 Jun 8. doi: 10.1007/s11420-020-09762-8 PMID: 33378460

Clinical Practice Guidelines on Ordering Echocardiography Before Hip Fracture Repair Perform Differently from One Another

Eric Swart, MD,[1] Chris Adair, MD,[2] Rachel B. Seymour, PhD,[2] and Madhav A. Karunakar, MD[2]✉

Table 1 Indications for TTE, by guideline

Guideline	Indications for TTE
ACC/AHA [14]	• Dyspnea of unknown origin • Worsening of known heart failure signs or symptoms • Known history of valvular dysfunction or heart failure without echocardiography in last year or worsened symptoms • Suspicion of moderate or greater valvular stenosis or regurgitation
BSE [5]	• Documented ischemic heart disease • Unexplained dyspnea • Murmur with concomitant cardiac or respiratory symptoms • Murmur in asymptomatic patient where structural heart disease is suspected
ESC/ESA [15]	• Presumed or confirmed severe valvular disease
AAGBI [1]	• Dyspnea at rest or low level of exertion • Murmur suggestive of significant aortic stenosis
SIGN [22]	• New murmur that raises concerns about aortic stenosis • Known murmur in the presence of worsening clinical symptoms

TTE transthoracic echocardiography, *ACC/AHA* American College of Cardiology/American Heart Association, *BSE* British Society of Echocardiography, *ESC/ESA* European Society of Cardiology and the European Society of Anaesthesiology, *AAGBI* Association of Anaesthetists of Great Britain and Ireland, *SIGN* Scottish Intercollegiate Guidelines Network

Table 2 Prevalence of comorbidities on presentation

Documented comorbidity on presentation	Prevalence
Hypertension	62%
Congestive heart failure	42%
Hyperlipidemia	29%
Diabetes mellitus	27%
Osteoporosis	24%
History of cancer	22%
Depression	22%
Chronic obstructive pulmonary disease	21%
Cerebrovascular accident	19%
Gastroesophageal reflux disease	17%
End-stage renal disease	4%
History of previous fragility fracture	4%
Hemodialysis	3%

Table 3 Performance (sensitivity and specificity) of the five CPGs

	Guideline				
	ACC/AHA	BSE	ESC/ESA	AAGBI	SIGN
TTEs performed in accordance with guidelines	66%	65%	32%	30%	66%
Sensitivity	100%	79%	71%	71%	100%
Specificity	40%	37%	74%	54%	40%
Reduction in TTE[a]	34%	35%	68%	58%	34%
Missed pathology[b]	0%	12%	3%	4%	0%

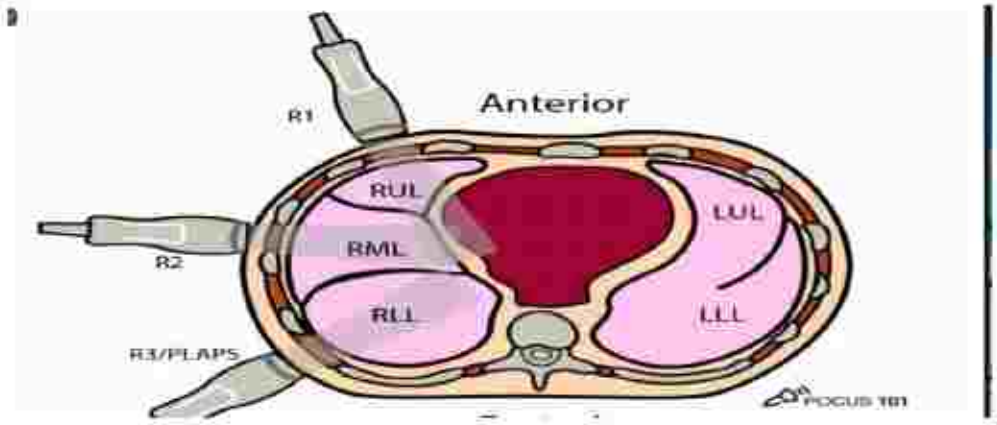
CPG clinical practice guideline, *ACC/AHA* American College of Cardiology/American Heart Association, *BSE* British Society of Echocardiography, *ESC/ESA* European Society of Cardiology/European Society of Anaesthesiology, *AAGBI* Association of Anaesthetists of Great Britain and Ireland, *SIGN* Scottish Intercollegiate Guidelines Network, *TTE* transthoracic echocardiography

[a] Potential percentage reduction in TTE ordering if CPGs were followed

[b] Percentage of patients with pathology detected by TTE that would have been missed if CPGs were followed

于晖教授强调，他们诊治的病患年龄远远超过文章的病患年龄，多为 70-90 岁骨折病患并合并多项基础疾病，大多髋关节骨折病患入院后 48 小时手术治疗以减少骨折导致的并发症发生。

他们术前做心肺超声可排除心包积液、填塞，PE，左室流出道梗阻；是否低血容量，心室功能不全或外周阻力降低等。另外于晖教授还示范关节手术放置骨水泥时动态 Echo 监测心室可见小颗粒骨水泥颗粒。应密切监测并即时治疗心衰，高血凝，肺高压和肺栓塞。



超声探头不同位置的放置可诊断肺部各区域的病理变化。

第四位是 New York 骨科特种外科医院的**刘家滨教授**。他主讲内容为跨关节置换术的神经阻滞镇痛的当前进展。

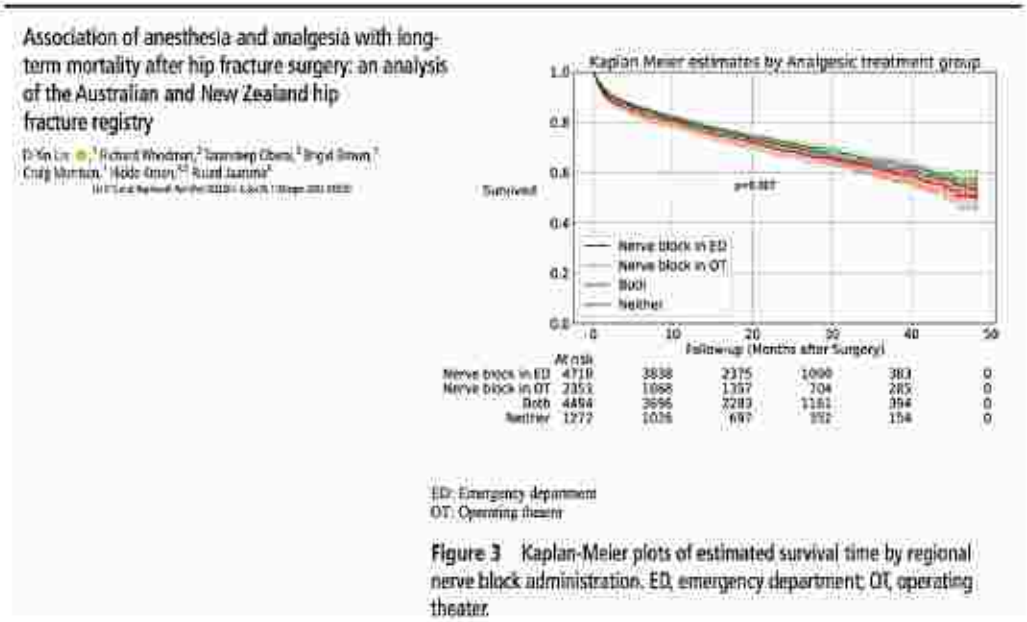
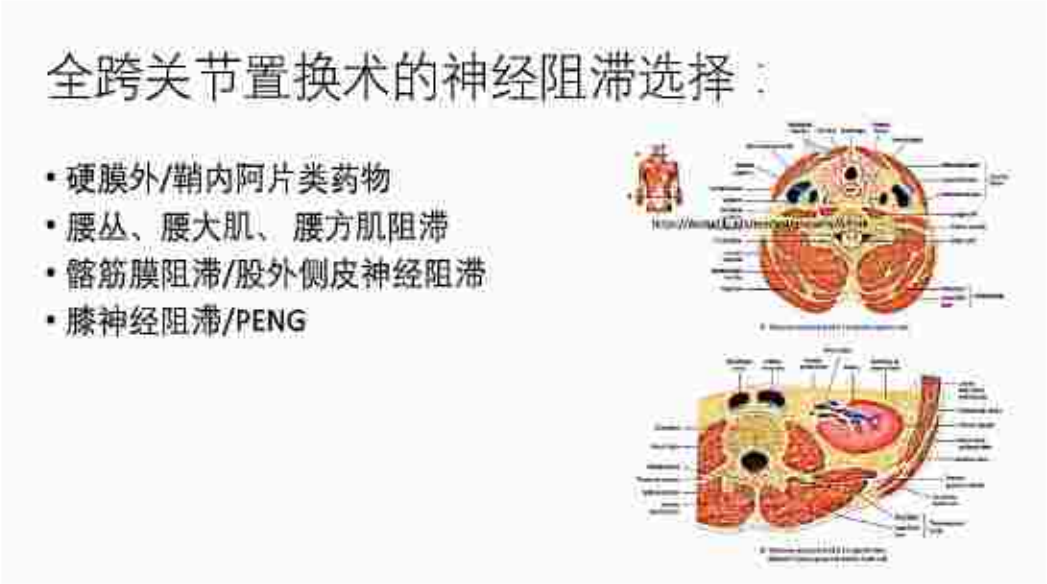
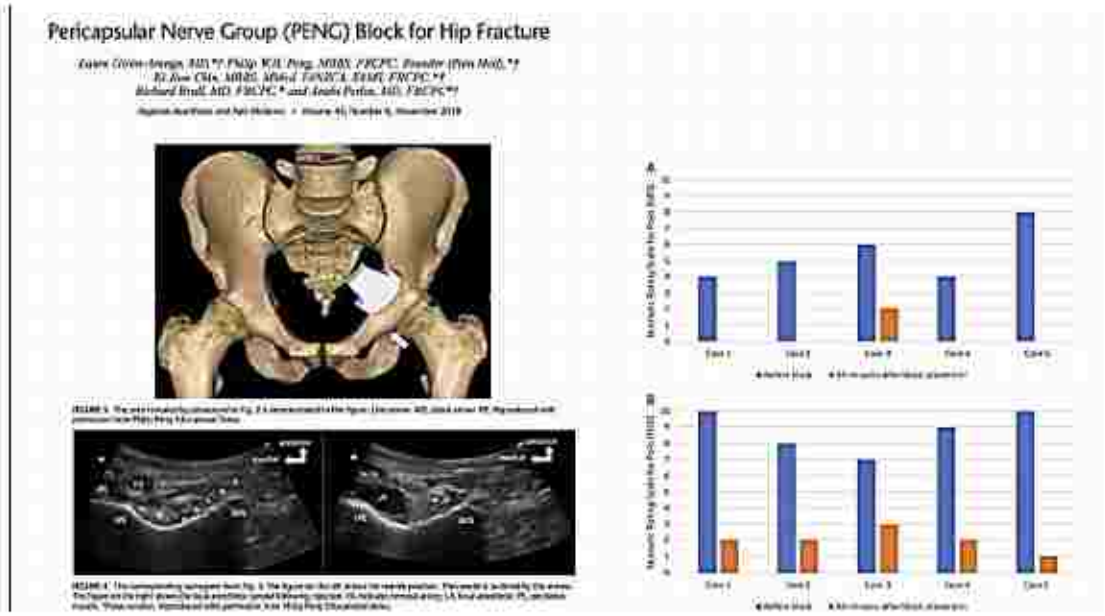


Figure 3 Kaplan-Meier plots of estimated survival time by regional nerve block administration. ED, emergency department; OT, operating theater.

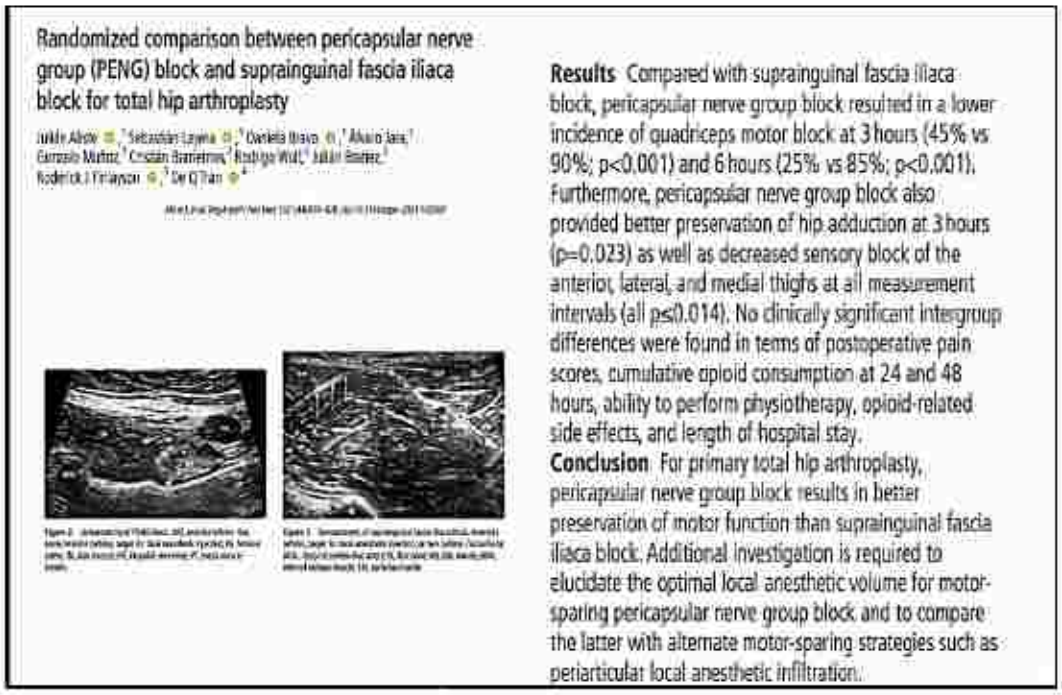
刘家滨教授引用 Dr. D-Yin Lim 等 2022 年发表的文章，他们回顾 17635 名病患髋关节骨折手术腰麻或全麻术后并发症，发现术后 12 个月病患死亡率两组无差异；同种手术的病患如接受腰麻和全麻其 12 个月死亡率危险性增加；但两组病患在 ER 和 OR 如接受外周神经阻滞则降低 12 个月和长期死亡率危险。刘教授认为麻醉医生应选择擅长的麻醉方法做髋关节骨折成形术，有时研究上统计学意义并不完全具有临床意义！



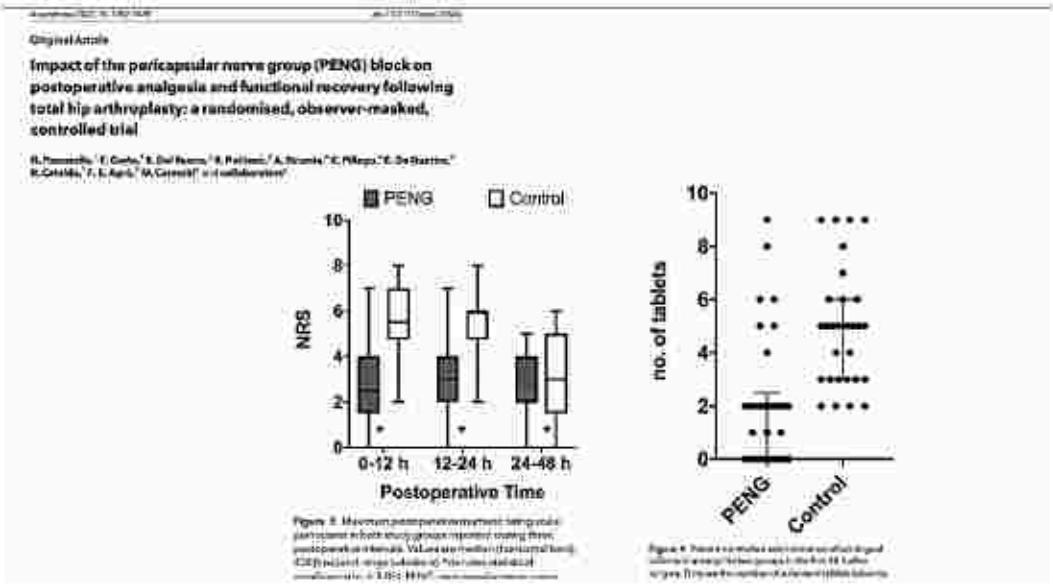
刘教授所在医院对于关节置换术多用以上方法镇痛，效果良好。他也介绍了其他研究人员的观测成果：



2018 年， Dr Laura Girón-Arango 等用超声引导做 Peri-capsular Nerve Group block （PENG） 以阻滞髋关节支的髂筋膜、闭孔和股神经。这种方法提供了髋关节骨折和术后的良好镇痛效果，安全并减少使用 Opioid 类药物。



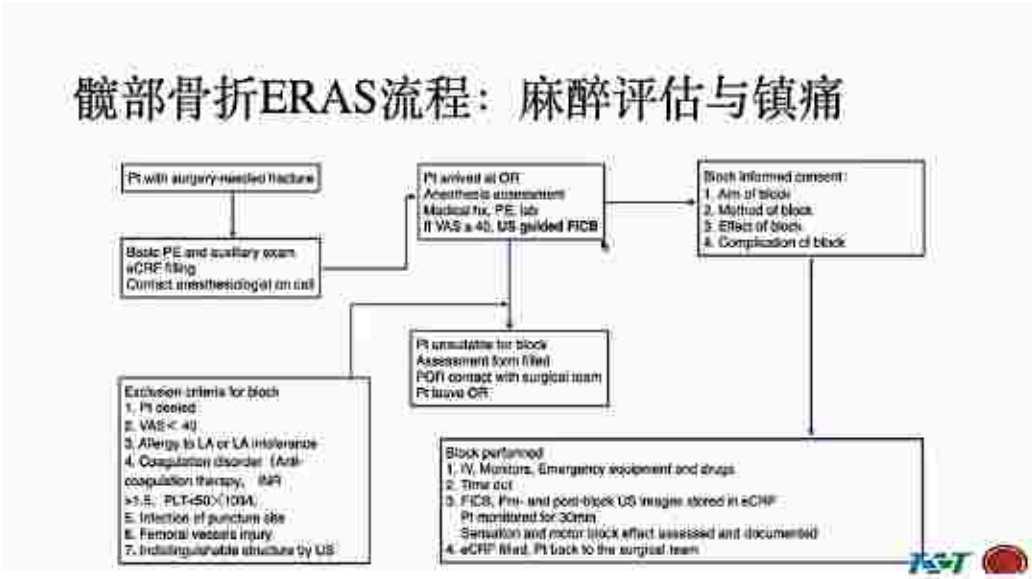
2021 年， Dr. Julien Aliste 等采用随机试验比较了超声引导全髋关节置换术患者的囊周神经组阻滞和腹股沟筋膜上髂筋膜阻滞。结果显示囊周神经组阻滞不仅有良好镇痛效果，较之腹股沟上筋膜阻滞能更好地保留运动功能。



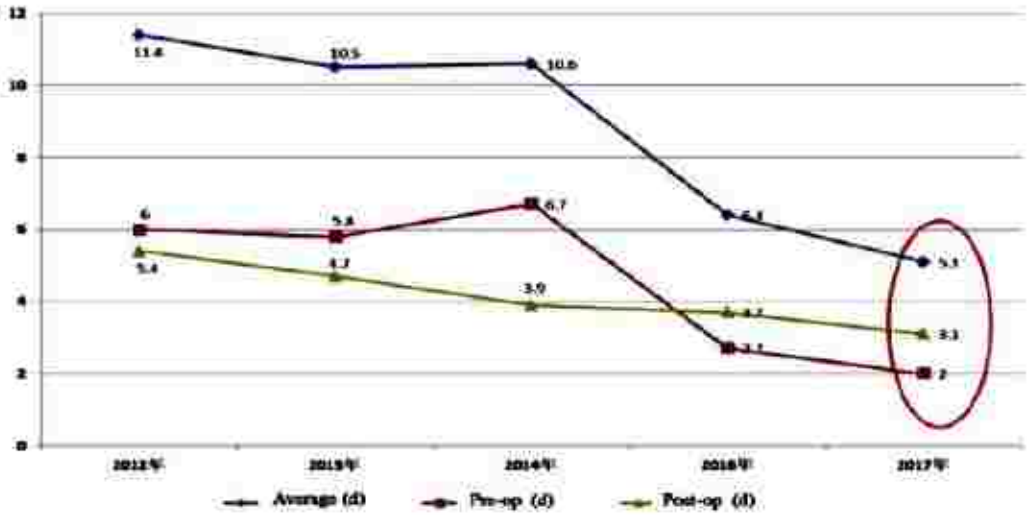
2021 年，Dr. G. Pascarella 等在这项单中心随机对照试验中，全髋关节置换术的患者接受了囊周神经组阻滞或不阻滞（对照组）。他们发现接受囊周神经组阻滞的患者的最大疼痛评分在所有时间点均显著低于对照组，此外，囊周神经组显示出阿片类药物消耗显著减少，较好的髋关节运动，较早可行走，并且接受囊周神经组阻滞的患者在全髋关节置换术后改善了术后功能恢复。

北京积水潭医院**许莉教授**压轴演讲：老年髋部骨折围术期 ERAS 流程：多学科共管模式的探索。

许莉教授介绍在 2015 年以前麻醉科医生仅在手术前其他检查完成后才访视病患并准备麻醉；2015 年后，麻醉医生更早、更多地参与诊治病患，评估病情及做镇痛处理。骨折病患一入院，学科医生包括创伤骨科、老年科、麻醉科医生介入，其他必要的专科医生会诊等等。另外，多科医生微信群可即时相互了解病患的病情、需求、治疗和预后，使整个医生团队的工作更紧密和有效。



因为有一套非常细致周密的 ERAS 流程，麻醉评估过程与镇痛措施及时到位，病患可尽早在超声引导下做区域麻醉而行手术治疗。



Hospital Length of Stay

由于 ERAS 的有效流程和医生群的密切合作，病患手术住院时间从 2012 年的 10 天缩短至 2017 年的 5 天。目前，70%的髋关节骨折病患在入院后 72 小时手术，82.1%病患在 48 小时内手术，死亡率 0.69%。

2018 年，积水潭医院成立了老年骨科病房。病患平均年龄 80 岁，入住的老年骨折病患 98.3%进行了手术治疗，平均住院时间 4 天。出院后有专门的护理人员上门随访，随访率约 80%。骨折手术的麻醉方法依病患情况有多种选择（见下表）。

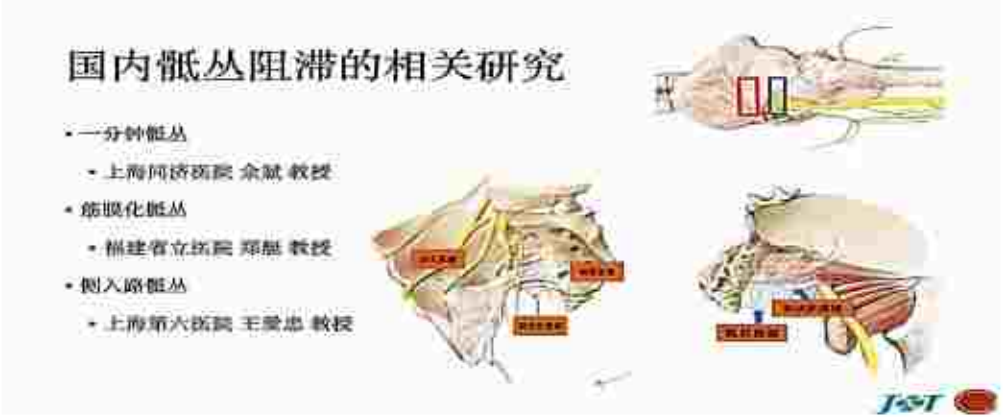

北京积水潭医院老年骨科病房年报
1309(例)
98.3%
4.03(d)
23.3(h)
82.1%
51.2%


麻醉方式如何选择?
• 全麻
• 椎管内麻醉
• 神经阻滞
• 神经阻滞+全麻
• 神经阻滞+椎管内麻醉
• 椎管内麻醉+全麻
EVERYTHING HAPPENS
FOR A REASON


超声引导椎管内穿刺


髋关节手术的神经阻滞方案


PSPS



许莉教授向大家介绍了国内的几位麻醉教授创立的几种骶丛阻滞的方法。

许莉教授比较了单纯神经阻滞的优缺点，并解释由于以上原因，他们一般对髋关节骨折手术患者通常不做单纯神经阻滞麻醉。老年髋关节骨折的麻醉一般以神经阻滞/腰麻或神经阻滞/全麻为主（下图），但应注意老年病患区域阻滞的特点和药物浓度和药量的把控。

几位嘉宾演讲完毕，到场的许多医生的提问/解答环节：

Q: 神经阻滞时是否置管？

A: 除了肘关节神经阻滞常规置管，其他神经阻滞不置管，因为导管价格太高，病患的负担巨大。

Q: 深部组织神经阻滞是否仅用超声引导？

A: 深部阻滞神经阻滞时，除了超声，最好再用神经刺激器确认定位。

Q: 如果骨折病患使用血液抗凝剂如何麻醉？

A: 不用腰麻而用全麻，当 INR<3 就可手术。

Q: 髋关节骨折病患术后镇痛方法？

A: 腰麻/硬膜外镇痛现已少用，多用神经阻滞：股神经，股外侧皮神经，闭孔神经，髂筋膜阻滞等。

Q: 外周神经阻滞用药？

A: 常用布比卡因加小剂量地塞米松 （2-4mg）。

Q: 是否每一髋关节骨折病患需麻醉医生做神经阻滞术后镇痛？

A: 依据骨外科医生：如外科医生对病患注射关节囊局麻浸润，则麻醉医生只做股外侧皮神经阻滞；如外科医生不注射局麻药浸润，麻醉医生多需用腹股沟筋膜上髂筋膜神经阻滞或股外侧皮神经阻滞+囊周神经组（PENG）阻滞做为术后镇痛。

Q: 美国的骨折手术时间近年来从 24 小时可缩短至 6 小时，中国的骨折手术时间标准？

A: 中国现阶段无明显手术时间标准，大多病患在 48 小时内进行手术。

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2021-2023 年资深 CASA 会员受 NIH 麻醉科邀请授课录

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1/6/2023. 周少凤教授

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We are very much honored to invite above speakers to give lectures for anesthesiologists, CRNAs, residents, SRNAs, medical students and Pre-anesthesia clinic nurses in our department. On behalf of the Chief in our DPM, I'd like to express our appreciation for your willingness to present to our department. All lectures are excellent!

Ning Miao, MD, FASA
Senior research Physician
DPM, CC, NIH

天仙碧玉琼瑶，点点扬花，片片鹅毛。　元. 薛昂夫

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