·标准与规范·

经鼻高流量吸氧在五官科麻醉气道管理中应用专家共识(2025版)

中华医学会麻醉学分会五官科麻醉学组
通信作者:王古岩,首都医科大学附属北京同仁医院麻醉科,北京 100730,Email:guyanwang2006@163.com

【摘要】 经鼻高流量吸氧(HFNC)近年来在临床麻醉领域中的应用日益广泛,其在围手术期氧疗的可行性、有效性和安全性已逐步得到证实和认可。该技术在麻醉气道管理方面,尤其是在处理困难气道时,展现出显著的技术进步和创新。五官科手术患者常见困难气道,对气道管理技术提出了更高要求。然而,关于HFNC在五官科麻醉气道管理中的应用,尚缺乏明确的循证医学证据和系统性指导。基于国内外相关研究进展及中国临床实践,中华医学会麻醉学分会五官科麻醉学组组织专家团队制订了本共识。本共识从理论到实操,系统性阐述了HFNC的生理学机制、适用场景及具体操作方法,涵盖诱导期、术中无插管麻醉管理期、术后拔管吸氧期及特殊人群的应用等多个方面。针对不同临床需求,共识明确了HFNC的推荐意见、禁忌证和注意事项,进一步规范其在五官科麻醉气道管理中的应用方法,为提升围手术期气道管理水平提供了科学依据。本共识旨在推动HFNC技术在五官科麻醉中的规范化应用,提升患者安全性,并为未来相关临床研究和技术推广提供理论支持与实践指导。

【关键词】 麻醉; 经鼻高流量吸氧; 经鼻湿化快速充气交换通气技术; 气道管理

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Expert consensus on the application of high-flow nasal oxygen therapy in eye and ear-nose-throat anesthesia airway management (2025 edition)

The Otorhinolaryngology Anesthesiology Group of the Chinese Society of Anesthesiology
Corresponding author: Wang Guyan, Department of Anesthesiology, Beijing Tongren Hospital, Capital Medical University, Beijing 100730, China, Email: guyanwang2006@163.com

【Abstract】 In recent years, the application of high-flow nasal cannula (HFNC) in clinical anesthesia has become increasingly widespread. Its feasibility, effectiveness, and safety in perioperative oxygen therapy have been progressively confirmed and recognized. This technology has demonstrated significant advancements and innovations in airway management within anesthesia, particularly in addressing difficult airways. Patients undergoing eye and ear-nose-throat (ENT) surgeries frequently present with difficult airways, imposing higher demands on airway management techniques. However, there remains a lack of clear evidence-based guidelines and structured recommendations regarding the application of HFNC in ENT anesthesia airway management. Based on relevant research progress both domestically and internationally, as well as Chinese clinical practice, the Otorhinolaryngology Anesthesiology Group of the Chinese Society of Anesthesiology organized an expert team to formulate this consensus. The consensus systematically

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elaborates on the physiological mechanisms, applicable scenarios, and specific operational methods of HFNC, from theory to practice. It covers multiple aspects, including the induction phase, intraoperative non-intubated anesthesia management, postoperative extubation oxygen therapy, and applications in special populations. Addressing different clinical needs, the consensus clearly outlines the recommendations, contraindications, and precautions for HFNC, further standardizing its application in ENT anesthesia airway management and providing an evidence-based framework for optimizing perioperative airway management. This consensus aims to promote the standardized application of HFNC technology in ENT anesthesia, improve patient safety, and provide theoretical support and practical guidance for future clinical research and technological advancements.

【Key words】 Anesthesia; High-flow nasal cannula; Transnasal humidified rapid-insufflation ventilatory exchange; Airway management

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氧疗的首次临床应用报道可追溯至1890年，然而，传统的高流量吸氧因未对吸入气体进行加温和湿化处理，常导致患者鼻咽和口腔黏膜干燥，从而影响其舒适度，这一缺陷限制了高流量氧疗在临床的普及。21世纪初，经鼻高流量吸氧（high-flow nasal cannula，HFNC）技术进入临床，受到医学界的广泛关注。HFNC系统包括空气和氧气混合器、加温加湿单元以及单回路吸气管路，能够精确调节吸氧浓度（21%~100%）和气体流量（0~80 L/min），并维持吸入气体温度在31~37 ℃，从而提高患者的氧疗依从性。经鼻湿化快速充气交换通气技术（transnasal humidified rapid-insufflation ventilatory exchange，THRIVE）是一种在患者没有自主呼吸或未建立机械通气时，利用HFNC维持患者的氧合和一定量的CO_2清除的技术。近年来，HFNC和THRIVE技术在全身硬质气管镜诊疗的麻醉管理和麻醉患者气道管理中的应用日益广泛，特别是在五官科手术麻醉中。五官科手术通常涉及头颈部区域，困难气道多见，常与麻醉共享气道，要求麻醉医师熟练掌握并创新气道管理技术，以保障患者围手术期的安全、平稳、快速、高质量康复。中华麻醉学分会五官科麻醉学组的专家组以国内外临床研究进展为基础，结合中国的临床实践，经过反复论证，形成了本共识。

一、共识制订方法

（一）共识制订专家组

本共识由中华医学会麻醉学分会五官科麻醉学组发起，共识专家组由该委员会委员及相关领域专家共同组成。包括临床医师、方法学专家和循证医学专家。共识制订工作于2023年10月启动，于2024年6月定稿。

（二）共识涵盖的范围和目的

本共识涵盖的临床问题包括：HFNC的生理学机制，其用于五官科麻醉的诱导期、术中无插管麻醉管理期、术后拔管吸氧期和特殊人群中的应用。本共识旨在制订规范的HFNC在五官科麻醉气道管理中应用，为麻醉医师在面对五官科手术气道管理时，能更好地理解和应对围手术期可能遇到的临床问题，并提供指导性意见。

（三）共识撰写

参考了《中国制订/修订临床诊疗指南的指导原则（2022）版》[1]的制订流程及方法学标准。通过广泛检索和评价国内外相关研究证据，结合临床实际需求，共同起草并议定相关推荐意见，依据指南研究与评价工具（appraisal of guidelines for research and evaluation Ⅱ，AGREE Ⅱ）[2]和卫生保健实践指南的报告条目（reporting items for practice guidelines in healthcare，RIGHT）[3]撰写全文。

（四）证据的检索、评价与分级

1. 英文文献检索：数据库为Pubmed、Embase和Cochrane，检索词为“THRIVE”“transnasal humidified rapid insufflation ventilator exchange”“humidified high flow oxygen therapy”“HFNC”“high-flow nasal cannula”“nasal high-flow oxygen therapy”“high-flow oxygen therapy”“HFNO”和“tubeless anesthesia”“anesthesia”“general anesthesia”“microlaryngeal surgery”“perioperative”“obesity”“apnea”“apneic”“operation”“othorhinolarygnology anesthesia”，以AND和OR组合。

2. 中文文献检索：数据库为中国知网、万方数

据库、维普数据库，使用"经鼻湿化快速充气交换通气技术""经鼻高流量吸氧""高流量氧疗"高流量湿化氧疗""快充式经鼻湿化高流量通气""加温湿化高流量鼻导管""耳鼻喉手术麻醉""无插管麻醉""气道管理""窒息氧合技术"进行检索补充。

检索时间为建库到2024年6月。排除标准为动物实验、体外实验以及与HFNC和THRIVE无关的研究。

以文献分析为基础，对设计严谨且研究质量较高的文献进行总结分析，共识的推荐意见依据最高等级的研究数据制订，并参考循证医学证据分级标准[4]。结合专家组一致意见，将证据质量划分为高、中、低三个等级，同时将推荐强度分为强、中、弱三个层级进行评价（表1）。通过共识制订会议法，初步形成共识草案，随后由全体专家组成员进行讨论和评估，并对内容进行进一步修订，以确保推荐意见具有较高的一致性，最后经核心组专家成员审阅后定稿。

二、HFNC与THRIVE的生理学机制

（一）HFNC的生理学机制

1. 呼气末正压效应：HFNC通过对气道输送恒定高流速气体而使气道内产生低呼气末正压。对于正常体型的成人，HFNC产生的口咽部压力随着流量增加呈线性增加[5]，张口状态产生的压力小于闭口状态[6]，同样流速对女性口咽部产生的压力小于男性[7]，流速80 L/min以内，HFNC提供的正压不超过10 cmH_2O（1 cmH_2O=0.098 kPa）。不论是自主呼吸还是呼吸暂停的患者，HFNC均不增加胃内容量[8-9]。同时，HFNC产生的低呼气末正压可维持肺泡开放，增加呼气末肺容积[10]，产生肺复张效应[10-11]。

2. 死腔冲刷效应：终末细支气管以上只参与气体运输不参与气体交换的气道为解剖无效腔，成人容积大约150 ml，鼻咽喉所组成解剖无效腔约50 ml，解剖无效腔的存在可导致上气道CO_2重复吸收，降低肺泡通气量。HFNC通过提供高速气流，冲刷呼气末残留在解剖无效腔的气体，降低CO_2的重吸收，增加肺泡通气量[12-13]。

3. 恒温恒湿、维持黏液纤毛系统功能：HFNC为患者提供恒温恒湿气体，增加黏膜湿度，符合生理状态下呼吸道的气体温度及湿度，降低干冷气体对上下呼吸道黏液纤毛功能和黏膜的影响[13-15]，提高患者舒适度[15-16]，保护黏膜及纤毛转运系统功能[10]。

4. 减少上呼吸道阻力和呼吸功：常规呼吸时鼻咽腔通过提供较大的表面积对吸入气体进行湿化和温化，同时吸入气体之间的摩擦会对气流产生明显的阻力[13]。HFNC可提供高流速、恒温、恒湿气体，患者无需在吸气时用力吸气及消耗能量即对吸入气体加温加湿，减少呼吸功[16]。此外，HFNC提供超过患者所需的吸气峰流速的气体，减少吸气时空气的稀释作用，保证精确的吸入氧浓度，有利于改善患者氧合[10]。

（二）THRIVE的生理学机制

THRIVE技术最早于2015年由Patel和Nouraei[17]提出，THRIVE是指患者在没有自主呼吸和机械通气的状态下应用HFNC，以维持患者氧合和CO_2清除[17-19]。THRIVE除了具备HFNC的生理学机制外，还包括以下机制：

1. 无呼吸氧合：由于血液中氧气和CO_2溶解度的显著不同，血红蛋白对氧气的亲和力较高，氧气以250 ml/min速度从肺泡中被摄取，而在非通气的情况下，血液中的缓冲系统和CO_2高溶解性使得CO_2以约10 ml/min释放回肺泡，肺泡内压力低于大气压，肺泡内负压使得气体从咽部流入肺泡，从而允许在无自主呼吸和无机械通气的时候维持一定的氧合作用[18,20-21]。HNFC通过向气道持续输送高流量高浓度氧气，实现患者无呼吸运动状态下的持

表1　本共识推荐意见的证据等级和推荐强度标准

级别	说明
证据级别	
高	高质量的随机对照研究、权威指南以及高质量系统综述和荟萃分析
中	有一定研究局限性的随机对照试验、队列研究、病例系列研究及病例对照研究
低	病例报道、专家意见等
推荐强度	
强推荐	该方案大多数患者、医师和政策制定者都会采纳
中度推荐	该方案大多数人会采纳，但仍有部分人不采纳，需要结合患者具体情况做出体现其价值观和意愿的决定
弱推荐	证据不足，需要患者、医师和政策制定者共同讨论决定

续氧合。

2. 心脏的振动及声门上气体涡流与强湍流相互作用：高流速气体破坏层流使得流场中出现许多小漩涡而形成湍流，湍流可改善气体混合，增加气体交换速率[6,22-23]。心源性震荡是由心脏活动引起的气体运动，气道压力、流量波形随心动周期规律性波动，从涡旋中产生的涡流被引至气管，增强了声门下方的气体混合。大量气体的流动可清除死腔，高流量的气体和心源性震荡所产生的声门上气体涡流与强湍流相互作用，增加了 CO_2 清除[9]。

三、HFNC 与 THRIVE 在五官科麻醉中的临床应用

HFNC 近几年在围手术期的应用研究广泛[24]，从已预料困难气道的处理，到应用于各种特殊患者的预给氧、短小手术的无插管麻醉管理及全身麻醉术后的呼吸支持等。HFNC/THRIVE 在五官科麻醉中的应用主要包括以下几个方面：

（一）全身麻醉诱导期

1. 诱导期氧合策略：麻醉诱导期包括预充氧阶段和无呼吸氧合阶段，去氮给氧的目的是提高患者肺内氧气储备，延长患者耐受缺氧时间，为麻醉诱导后建立气道提供充足的操作时间，即安全窒息时间。无呼吸氧合是指在麻醉诱导后无通气的情况下，提供补充性氧合延长安全窒息时间。困难气道在五官科手术中比较常见，口、咽、喉部病变常常改变正常解剖结构，常使面罩通气与气管插管过程变得复杂而不可预知，一旦气管内插管时间延长或面罩通气困难，患者面临缺氧甚至窒息危险，因此，延长安全窒息时间对于困难气道的处理具有重要意义。

2. HFNC 的应用优势：麻醉诱导常采用紧扣面罩预充氧方式，部分患者存在憋闷、恐惧等不适感，采用 HFNC 预充氧对于麻醉医师而言操作更为方便，且可提高患者舒适度[15]。对于巨大面部肿物、唇部肿物等无法面罩通气的患者，HFNC 可作为麻醉诱导期间的有效氧合方式[25-26]。研究表明，以吸氧 3 min 后呼气末氧浓度≥90% 为预充氧目标，HFNC 仅作为预给氧技术给氧效率不如传统面罩[27-29]，但将预充氧技术（使用 HFNC）与无呼吸氧合技术（使用 THRIVE）结合，在插管期可持续供氧，有效提高插管后呼气末氧分压水平[25]，显著延长患者安全窒息时间[30]。

3. HFNC 的应用场景：五官科困难气道多见，保留自主呼吸的气管内插管是处理已知困难气道的一线方案和核心技能，麻醉偏浅时患者难以耐受，麻醉偏深时患者易发生呼吸抑制而缺氧，因此，保留自主呼吸的气管内插管时维持患者氧合亦十分重要。困难气道插管指南推荐使用 HFNC 作为传统氧合技术的最佳替代方案[31]，在清醒纤维支气管镜引导气管插管过程中使用 HFNC，可改善患者氧合和舒适度，降低缺氧发生风险[32-35]。

随着社会老龄化，老年患者发生眼、耳、鼻、喉疾病的概率不断增加，老年患者口腔周围肌肉萎缩，缺牙引起面部形态改变，导致面罩密闭通气存在困难，HFNC 可用于老年患者在全身麻醉诱导前预充氧[36]。

急诊患者常因禁食水时间不够、胃排空障碍，胃内容物的反流误吸风险高，需避免面罩加压给氧，同时缺氧是急诊手术在麻醉诱导期最为严重并发症之一。对于需要快速诱导插管的患者，有证据表明[30,37-38]，THRIVE 可以为气管插管操作提供更长的安全窒息时间，保证足够氧合水平，提高首次气管插管成功率。THRIVE 将紧急插管和困难插管从紧张的过程转变为平稳而从容的工作。

推荐意见 1：对于一般患者，不推荐将 HFNC 替代面罩给氧作为常规气管插管的预充氧技术（证据质量：高；推荐等级：强）。对于无法面罩通气或面罩通气效果不佳患者，推荐在诱导期使用 HFNC（证据质量：中；推荐等级：强）。对于困难气道，推荐在保留自主呼吸气管内插管时使用 HFNC（证据质量：高；推荐等级：强）。推荐在快速序贯诱导时应用 THRIVE（证据质量：高；推荐等级：中）。

（二）术中气道通气管理

咽喉显微外科手术术中传统通气模式为气管插管，气管导管遮挡手术视野，同时较小病变可因气管导管遮挡而被忽略。生理学理论依据证明[31,39]，THRIVE 能够使美国麻醉医师学会（American Society of Anesthesiologists，ASA）Ⅰ/Ⅱ级且体质指数（body mass index，BMI）<30 kg/m² 的患者在 30 min 内保持良好的氧合状态及稳定的 pH 值。THRIVE 于 2015 年首次被应用于咽喉手术[17]。在咽喉显微外科手术术中使用 THRIVE[40-43]，可扩大术者视野从而对病变范围进行更好地判断，在手术期间将血氧维持在安全范围内，并缩短手术时间、麻醉维持和麻醉苏醒时间，提高术者满意度。对于声门或声门下狭窄的患者使用 THRIVE，虽然进入肺部气体减少，但仍可在一定时间内保证手术通气安全性[44-46]。现有文献表明，仅用 THRIVE 作

为单一通气模式就可以完成可视喉镜下环杓关节脱位复位术[47]、声带息肉切除术[48-49]、气道异物取出术[50]、甲状腺切除术[51]、食管异物取出术[52]。

共用气道手术的气道管理给麻醉医师带来巨大挑战,术中应保证足够的麻醉深度和氧合水平,应用无插管麻醉可以提供无遮挡的手术视野。HFNC 已被证实可以安全用于保留自主呼吸的静脉麻醉中,减少成人和小儿患者的缺氧事件发生[53-54]。对于成人和小儿患者接受短小共用气道手术如声带囊肿、气管造口等,保留自主呼吸的静脉无插管麻醉,应用 HFNC 可有效保证术中氧合[55-57];同时,为满足手术条件需保证肌松强度,应用 THRIVE 可延长安全窒息时间长达 30 min,提供良好通气的同时不占用气道空间[44, 58-63]。小儿喉乳头状瘤切除术术中拔除气管导管进行后联合和声门下操作时,应用 THRIVE 可以保证氧合水平,减少插管次数与手术时间[64]。

推荐意见 2:咽喉显微外科手术中使用保留自主呼吸的静脉麻醉时,推荐应用 HFNC 改善氧合(证据质量:中;推荐等级:中)。THRIVE 可作为单一或者辅助通气策略用于非激光共用气道手术或短小外科手术术中,延长安全窒息时间(证据质量:高;推荐等级:中)。

(三)全身麻醉拔管后吸氧期

全身麻醉患者拔管后由于呼吸系统病理生理学改变,易发生肺不张、呼吸衰竭等并发症,常规于拔管后吸氧以避免再次气管内插管。术前困难气道患者拔管后紧急情况下的再插管失败率较高。低氧血症是全身麻醉苏醒期最常见的并发症之一,HFNC 已被证实用于重症监护病房气管拔管时可改善患者氧合,降低低氧血症和再次插管发生率[65-67]。有证据表明,全身麻醉拔管后应用 HFNC 可降低舌后坠和低氧血症发生率,缩短术后恢复室停留时间[68],减少腹部手术术后肺部并发症[69]。

五官科手术患者中术后呼吸道不良事件高危患者比例较高。包括慢性鼻窦炎患者伴发哮喘概率较高,急诊眼外伤患儿和腺样体扁桃体切除术患儿术前有反复上呼吸道感染史,喉癌患者多为重度吸烟患者,急诊食管异物取出术患者多为高龄。对于高危患者术后使用 HFNC 可降低术后呼吸道不良事件和再插管率[70-71]。肥胖患者拔管后使用 HFNC 进行氧疗,可减少术后肺部并发症,缩短住院时间[72-73]。气管狭窄、喉癌、颈部脓肿、双侧声带麻痹、急性会厌炎患者常需术中气管切开,对气管切开患者使用 HFNC 时不能明显改善其氧合[74]。

推荐意见 3:对于术后呼吸道不良事件的高危(如高龄、儿童、肥胖、合并呼吸道疾病)患者建议术后使用 HFNC,以减少低氧血症和再插管率(证据质量:高;推荐等级:中)。

(四)特殊人群

低氧血症是患儿麻醉相关并发症的主要原因。与成人相比,儿童由于基础代谢率高、功能残气量小,低氧血症发生更早,安全窒息时间较短,耐受缺氧能力更差,且呈年龄依赖性[64,75]。THRIVE 可用于新生儿与小儿患者插管时维持氧合并提高首次插管成功率[19,76-77],对于 0~10 岁的患儿使用 1~2 $L·kg^{-1}·min^{-1}$ 的 THRIVE,可延长患儿安全窒息时间,最长至 10 min[64,75,78-81]。在小儿上气道手术必需无插管麻醉时,THRIVE 作为窒息氧合技术不减少因低氧导致的手术中断率[82]。

肥胖患者的呼吸力学和通气换气生理过程发生了改变,大量脂肪堆积在面部、颈部等可导致面罩通气、气道暴露困难风险增加;此外,胸壁顺应性较差,功能残气量减低,而且肥胖患者耗氧量增加,安全窒息时间短,导致肥胖患者在麻醉诱导期间即使给予完善的预充氧,仍可在呼吸暂停后迅速出现低氧血症。肥胖患者预充氧或延长安全窒息时间方案尚无金标准,HFNC 作为预充氧技术并不降低肥胖患者插管前阶段的低氧血症发生率[83-84]。但 THRIVE 可以为非困难气道肥胖和病态肥胖患者提供更长安全窒息时间和更高的最低动脉血氧饱和度,插管后恢复基线血氧饱和度时间更短[85-88]。使用 THRIVE 时高 BMI 患者比正常 BMI 患者去氧合速度更快,肥胖患者使用 THRIVE 的安全窒息时间 5~18 min。

推荐意见 4:低龄儿童(<10 岁)与肥胖患者围手术期低氧血症发生风险高,在麻醉诱导时,建议插管期间使用 THRIVE 进行持续氧合(证据质量:高;推荐等级:中)。

四、HFNC 与 THRIVE 的禁忌证与注意事项

(一)禁忌证

1. 绝对禁忌证:上呼吸道完全阻塞;颅底骨折或鼻骨骨折;拒绝使用 HFNC/THRIVE 的患者;气胸或纵隔积气;心跳呼吸暂停需进行有创机械通气患者;极重度Ⅰ型呼吸衰竭:氧合指数(arterial partial pressure of oxygen to fraction of inspired oxygen ratio, PaO_2/FiO_2)<60 mmHg(1 mmHg=0.133 kPa);严重 CO_2 潴留(pH 值<7.15)。

2. 相对禁忌证：重度Ⅰ型呼吸衰竭（$PaO_2/FiO_2<$ 100 mmHg）；通气功能障碍（pH值<7.25）；不能配合或者不耐受患者；气道保护功能差、误吸高风险患者；气道分泌物多且无排痰能力；矛盾呼吸运动；可预计的术中气道出血高风险患者。

（二）注意事项

1. CO_2蓄积：使用THRIVE期间，需要注意CO_2的蓄积，THRIVE使用的最大安全时长因CO_2过高和呼吸性酸中毒而受限。人体可耐受短时间的呼吸性酸中毒，但高碳酸血症可引起心脑血管抑制和CO_2麻醉。对于小儿患者，无呼吸时使用THRIVE时CO_2增加速度范围为2.4~4.1 mmHg/min[64,75,69-79]，THRIVE是否增加小儿的CO_2清除率暂无统一结论。成人消除CO_2能力比儿童高，对于呼吸暂停的成人患者，使用THRIVE时CO_2增加速率范围为1.2~2.8 mmHg/min[88-90]，成人在呼吸暂停后无论是否使用THRIVE，其第1分钟CO_2增加速率最快（>10 mmHg/min）[89,91]。虽然理论上，THRIVE可以增加CO_2清除率，但目前有限的研究表明，不同流量时的THRIVE的CO_2增加速率无差异，THRIVE对CO_2清除没有优势[88-89]。经皮CO_2为代替动脉血CO_2最为准确的无创检测手段[92]，可较好地反映$PaCO_2$，但$PaCO_2$超过75 mmHg后，经皮CO_2值比实际值偏高[93]。

推荐意见5：在使用HFNC/THRIVE时，应全程监测CO_2水平，当所监测到的CO_2水平超出安全范围时，应立即停止使用HFNC/THRIVE，并改为面罩加压给氧或机械通气等替代方式。（证据质量：高；推荐等级：强）

2. 气道着火：在使用HFNC进行通气氧合的过程中，高氧环境下使用激光或电刀可能导致氧气燃烧，对患者和术中均存在安全隐患[94]。在支撑喉手术中使用THRIVE时，关闭氧气40 s后或将氧浓度降至30% 10 s后再使用激光未发生气道着火事件[95]。

推荐意见6：在激光或电刀操作时应尽量避免使用HFNC，如需使用，至少降低氧浓度为30%（证据质量：低；推荐等级：强）。

五、展望

HFNC/THRIVE在围手术期使用的可行性、有效性和安全性逐渐被证实和认同，其对于麻醉气道管理，特别是困难气道的管理是一种技术的推动和革新，但在五官科围手术期的应用和研究仍处于早期阶段，尤其是在以下方面尚需进一步探索：THRIVE技术针对五官科特殊人群（如有困难气道的肥胖患者、阻塞性睡眠暂停综合征及儿童患者）的应用；儿童患者最大安全窒息时间的研究，深麻醉下拔管作为通气策略的可行性及有效性评估；以及特殊手术患者的气道管理策略改进。这些领域亟须大样本、随机对照试验提供循证医学依据，以促进HFNC/THRIVE技术在临床中的规范化应用。

（一）特殊人群中的应用挑战

阻塞性睡眠呼吸暂停综合征是一种常见的与睡眠相关的呼吸障碍性疾病，腭咽成形术患者上呼吸道因咽部脂肪堆积、解剖结构异常而且较为狭窄，存在面罩通气困难和气管插管困难[96]，全身麻醉后肥大舌体后坠，气道括约肌张力减少、顺应性降低，使得上呼吸道塌陷而容易出现上呼吸道梗阻，在麻醉诱导和拔管后均易出现完全气道阻塞的紧急情况；同时此类患者多合并病态肥胖，功能残气量下降、氧耗增加，与体型正常患者比较，其安全窒息时间明显缩短。THRIVE是否可以减少此类患者诱导过程中与拔管后的低氧血症发生率值得进一步研究。小儿腺样体扁桃体切除术、围手术期气道并发症发生率较高[97]，合适的拔管时机十分关键，拔管过早时可能因上呼吸道肌肉张力未恢复而发生低氧血症，拔管过晚可因患儿恢复意识导致呛咳、喉痉挛等并发症。

（二）特殊类型手术患者的气道管理问题

对于眼部手术、声带手术如脂肪注射术、颈部手术的患者，麻醉拔管期间出现咳嗽、呛咳、屏气和肌紧张可能导致颅内压和眼压升高的生理变化，带来灾难性后果，HFNC用于此类患者的深麻醉下拔管是否可以促进此类患者平稳拔管值得进一步研究。

综上，本共识基于当前的证据和最佳临床实践，提出了前述指导意见。随着循证医学证据的不断积累，本共识将定期进行更新与优化，以期为临床提供更加全面和精准的指导。共识形成之后，仍需积极倡导和实施综合管理策略，并着力强化关键领域内的多学科合作，以确保共识的建议能够得到有效执行。本共识仅代表参与编写及讨论专家的观点。共识内容仅用于指导相关领域临床实践，不具有法律约束性质。共识内容是该领域的阶段性认识，今后会根据新的临床证据随时更新。

本共识制订专家组成员

执笔者：王古岩、雷桂玉（首都医科大学附属北京同仁医院

麻醉科)

共识编写组成员(按照姓氏汉语拼音排序):程庆好(应急总医院麻醉科);杜立宏(鞍山市中心医院麻醉科);弓胜凯(郑州大学第一附属医院麻醉科);官学海(广西医科大学第一附属医院麻醉科);韩园(复旦大学眼耳鼻喉科医院麻醉科);李旭(中国医学科学院北京协和医院麻醉科);李宏(天津武警特色医学中心麻醉科);刘炜烽(福建医科大学附属第二医院麻醉科);苏少飞(首都医科大学附属北京妇产医院中心实验室);涂远艳(广东省东莞市妇幼保健院麻醉科);唐玲玲(云南省第三人民医院麻醉科);谭文斐(中国医科大学附属第一医院麻醉科);吴多志(海南省人民医院麻醉科);吴震(华中科技大学同济医学院附属同济医院麻醉科);王本福(温州医科大学附属眼视光医院麻醉科);王维(火箭军特色医学中心麻醉科);奚春花(首都医科大学附属北京同仁医院麻醉科);肖锋(中南大学湘雅二医院麻醉科);谢红(陆军军医大学第二附属医院麻醉科);郁葱(重庆医科大学附属口腔医院麻醉科);杨旭东(北京大学口腔医院麻醉科);殷文渊(上海交通大学医学院附属仁济医院麻醉科);周明(喀什地区第一人民医院麻醉科);郑艳萍(江西省南昌市第三医院麻醉科);张庆(合肥市第二人民医院麻醉科)

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[97] 中华医学会麻醉学分会小儿麻醉学组, 中华医学会麻醉学分会器官移植麻醉学组, 中国心胸血管麻醉学会日间手术麻醉分会. 儿童麻醉评估与围手术期风险预测中国专家共识(2024 版)[J]. 中华医学杂志, 2024, 104(29):2688-2700. DOI: 10.3760/cma.j.cn112137-20231117-01125.