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Research Article

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Perioperative Opioids and Opioid-Induced Respiratory Depression in BMI-Stratified Patients Undergoing Emergent Facial Trauma Repair

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Abstract

Background: Opioid-induced respiratory depression (OIRD)represents a dangerous perioperative complication that affects patients receiving high opioids doses. The relationship between body mass index (BMI) and OIRD risk in emergent facial trauma patients remains unknown because these patients face both high opioid exposure and increased airway susceptibility.

Methods: A scoping review was conducted using PRISMA-ScR guidelines. The databases PubMed, Google Scholar, FRAML, Web of Science, Scopus and Cochrane Library were searched until July 2025. The research included terms that connected perioperative opioid administration with OIRD and BMI and facial trauma. Studies were included for adult participants (>age 18) who received documented opioid treatment, BMI measurements and OIRD assessments. Two reviewers conducted independent article screening and assessments before reaching consensus to resolve any discrepancies. The analysis examined how BMI affects OIRD risk among patients who experienced facial trauma.

Results: OIRD risk increases with higher opioid doses administered during the initial 24 postoperative hours. BMI does not function as an independent risk factor for OIRD when researchers control for sleep apnea and cardiovascular disease in their models. The current risk prediction models were developed from elective surgical data but fail to consider airway risks associated with facial trauma. The population lacks specific research that demonstrates how BMI affects opioid dosing and OIRD outcomes. The implementation of multimodal analgesia demonstrates potential in lowering opioid consumption yet its effectiveness and usage patterns in obese trauma patients remain unproven.

Conclusions: The development of BMI-specific research is essential for creating opioid protocols that adjust dosages according to patient weight in facial trauma care.

Keywords: opioid-induced respiratory depression, facial trauma surgery, body mass index, obesity, multimodal analgesia, airway compromise, and perioperative opioid dosing

Highlights:

1. High opioid doses after facial trauma raise breathing risks in obese patients.
2. Reveals unaddressed OIRD risks in obese patients with airway injuries
3. Identifies failure of current tools to assess obesity-related OIRD risk
4. Highlights underuse of multimodal pain protocols in obese trauma patients
5. Calls for urgent development of weight-based opioid safety frameworks

Introduction

The main complication from perioperative opioid use consists of OIRD (opioid-reduced respiratory depression) which reduces breathing drive and obstructs the airway to produce hypoventilation and hypercapnia and hypoxemia [1, 2]. The surgical environment represents an essential area where OIRD causes dangerous patient outcomes because it results in major complications and death rates especially during the initial 24 postoperative hours [3]. Surgical patients undergoing facial trauma surgery are at higher risk because of their complex anatomy during surgery together with their need for strong opioid doses and their common health conditions like sleep apnea and obesity [4]. The measurement of obesity through body mass index (BMI) results in increased challenges when using opioid medications. Opioid drug distribution along with hepatic metabolism and renal clearance changes in obese patients causes their opioid half-life to increase while their sensitivity to respiratory suppression rises [5]. The distinct physiological and pharmacokinetic features lead to questions about the present opioid dosing guidelines that account for BMI and the increased susceptibility of obese patients to OIRD [6]. Research indicates obese patients have compromised ventilatory reactions together with altered metabolite removal but different studies have generated conflicting evidence regarding BMI as an independent risk factor for OIRD [7]. Other health problems such as cardiovascular disease and obstructive sleep apnea may influence the results due to their frequent coexistence with high BMI according to [8].

Research currently lacks essential information because it does not separate OIRD risk evaluation and opioid dose-response assessments by BMI within the context of facial trauma surgery patients. Most existing data presents combined findings which do not provide personalized dosing recommendations or neglect

pharmacokinetic differences between body types [9]. The American Pain Society together with the American Academy of Pain Medicine recognize the insufficient patient-specific dosing tools as the main barrier to safe opioid administration according to Chou et al. [9].

This scoping review investigates how Body Mass Index affects opioid pharmacodynamics and pharmacokinetics and dose-response relationships in adult patients undergoing facial trauma surgery who are at risk of OIRD. This review uses the Population–Context–Concept (PCC) framework to identify the essential yet neglected field of surgical risk management and opioid safety protocols and personalized medical treatment.

Methods

The Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist was utilized for this review. Given the exploratory nature of this paper, a scoping review was conducted. The perioperative use of opioids remains understudied, with most research focusing on postoperative pain. Existing studies exploring the relationship between BMI and opioid-induced respiratory depression (OIRD) are highly heterogeneous in design. Additionally, emergent facial trauma repair may necessitate more intensive pain management due to the complexity of facial anatomy and potential nerve involvement. A search was conducted on PubMed, Embase, Web of Science, Scopus, and Cochrane Library from database inception to July 31st, 2025. The following keywords were used: (perioperative OR preoperative OR intraoperative or postoperative) AND (opioid-induced respiratory depression OR OIRD) AND (body mass index OR BMI) AND (facial trauma OR maxillofacial surgery).

A summary of inclusion and exclusion criteria are provided in Table 1. Inclusion criteria included: 1. adult surgical patients (age≥18), 2. opioid administration during the hospital course, 3. OIRD events, 4. BMI reported, and 5. English language articles. Exclusion criteria were: 1. Pediatric patients (age<18), 2. No opioid administration, 3. No ORID complications, 4. No BMI as a risk factor, and 5. Articles not available in English.

This review aimed to summarize the wide range of published studies spanning multiple disciplines (e.g. anesthesiology, surgery, trauma, pain medicine). Two reviewers independently screened the title and abstract for full-text screening. Discrepancies were resolved by discussion with a third reviewer. One member of the study team performed a full-text review, with the second reviewer performing a subset for accuracy. Figure 1 displays how many articles were screened.

Table 1: Summary of Inclusion and Exclusion Criteria.

Domain	Inclusion Criteria	Exclusion Criteria
Population	Adult patients ≥18 years	Pediatric patients <18 years, specific conditions (OSA)
Study Design	RCTs, observational, case reports/series, reviews	Animal studies, in vitro
Setting	Patients undergoing surgery, specifically for facial trauma repair	Patients not seeking operative care, non-medical settings
Intervention	Opioid use (morphine, fentanyl, methadone, codeine, etc.)	Non-opioid analgesics
Outcomes	ORID events with BMI	non-ORID complications, no BMI stratification
Language	English or English translation available	non-English

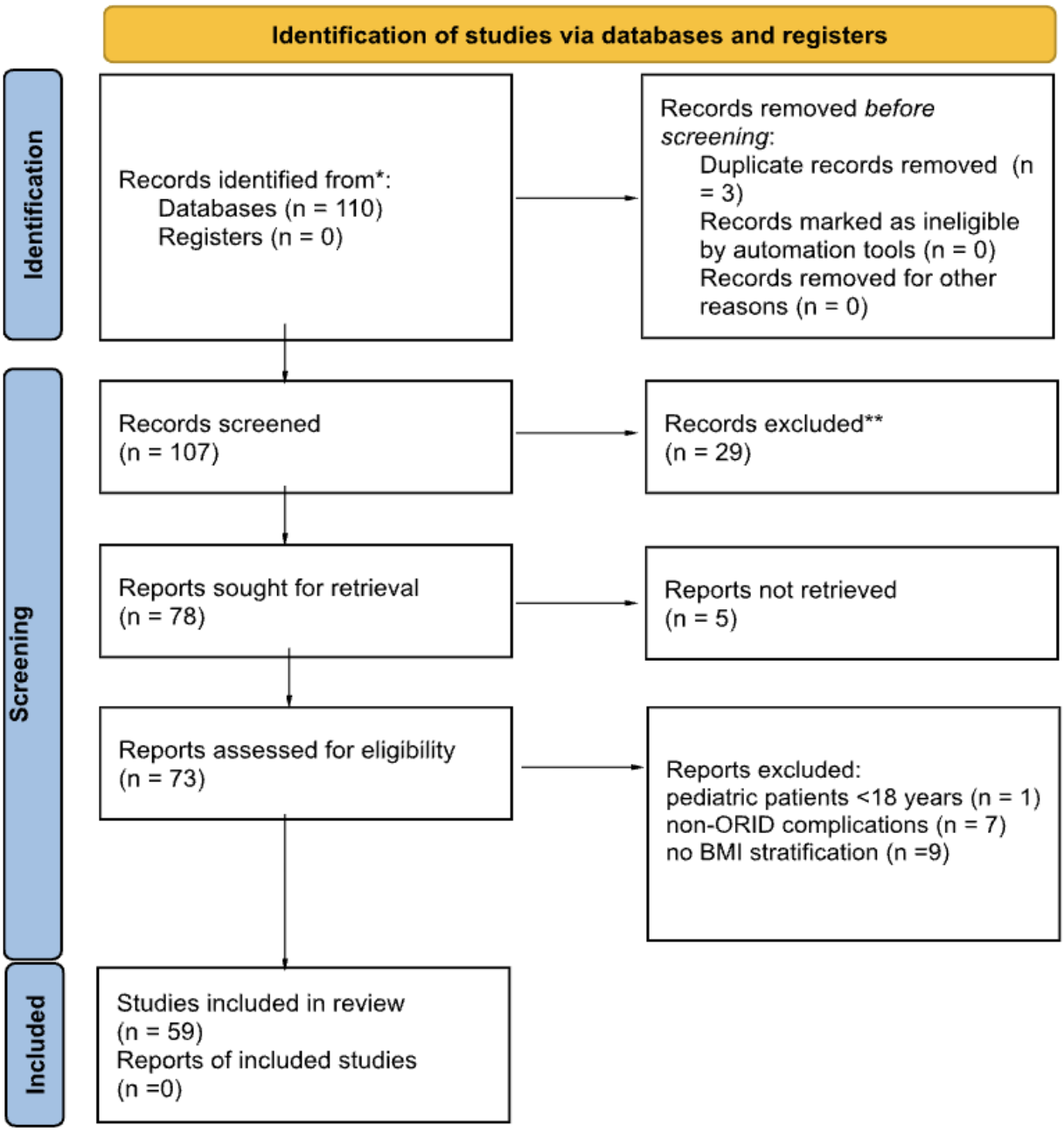

Figure 1: PRISMA Diagram.

The Role of BMI in OIRD Risk Models

Alterations in cardiovascular and respiratory physiology associated with obesity may contribute to increased risk of ORID and upper airway obstruction. Notably, obesity has been shown to reduce the sensitivity of central respiratory control centers to carbon dioxide [10]. There is debate regarding the role of BMI in predicting ORID. While one univariate analysis found a significant association [11], a pooled analysis of multiple studies did not support this relationship [12]. Risk prediction tools such as the Veterans Health Administration Risk Index for ORID (VHA-RIOSORD) initially considered BMI as a candidate variable [13], but ultimately excluded it in favor of comorbidities more directly associated with respiratory risk, such as obstructive sleep apnea (OSA). The Commercially Insured Health Plan Risk Index (CIP-RIOSORD), developed from the VHA-RIOSORD model, has demonstrated predictive utility in broader populations [14]. However, it does not account for all comorbidities potentially linked to BMI, including OSA.

Confounding is a challenge in developing accurate risk tools. Elevated BMI is often associated with both OSA and cardiovascular disease - factors that independently increase the risk of ORID. Some tools prioritize comorbidity profiles over BMI itself. Cardiovascular disease has been independently identified as a risk factor for severe ORID [15], and both the VHA-RIOSORD and CIP-RIOSORD incorporate this in their algorithms. However, while the VHA-RIOSORD includes OSA as a risk factor, the CIP-RIOSORD does not [13,14]. Other screening instruments may help identify risk indirectly. The STOP-Bang questionnaire, assessing factors such as snoring, daytime tiredness, observed apneas, hypertension, BMI >35 kg/m^2, age >50, neck circumference >40 cm, and male sex, has been validated for OSA detection in surgical patients [16]. Although STOP-Bang has not been validated specifically for predicting ORID, its focus on OSA suggests potential relevance.

In addition to physiologic risk factors, pharmacokinetic changes in obese individuals may influence the effects of opioids. Obesity is characterized by chronic low-grade inflammation, which can affect drug bioavailability [17]. Altered body composition and adipose tissue blood flow affects drug distribution, especially for lipophilic opioids. For example, lipophilic opioids like sufentanil exhibit a linear relationship with volume of distribution [18]. Thus,in patients with higher BMI, an increased loading dose may be used. But the half-life of lipophilic opioids may be longer. Half-life is also affected by drug clearance, which is controlled by hepatic and renal function. Obesity can modify glucuronidation and may increase renal clearance, though the long-term effects on kidney physiology remain uncertain [17, 19].

This may be further compounded by opioid-naïve status and susceptibility to respiratory depression. It is recommended clinicians base maintenance doses on lean body weight to account for differences in drug clearance, particularly if the drug is used chronically [19]. Therefore, clinicians should consider individual pharmacokinetic profiles and how they influence ORID risk.

While Yasunaga et al, found no differences in postoperative morbidity due to overweight BMI ≥ 25, length of hospital stay was affected [20]. Our study highlights the need for analysis based on BMI stratification. There is a lack of BMI-specific analysis in facial trauma literature, limiting our understanding of how obesity may influence postoperative outcomes, especially ORID.

Airway-Specific Challenges in Facial Trauma

Facial trauma poses an immediate threat to airway patency through several structural distortions and physiological compromise. Maxillofacial fractures often lead to upper airway compromise, as a result of anatomical impairment, leading to the necessity of securing a stable airway [21]. For example, bilateral anterior mandibular fractures often cause the tongue to slide posteriorly, obstructing the oropharynx, especially in supine patients [22]. Posterior movement of the tongue or the soft palate, due to either trauma or sedation, blocks the airway causing a temporary closure known as pharyngeal collapse. Similarly, bone fragments and dislodged teeth or foreign bodies (such as dentures, debris, or shrapnel) when relocated posteroinferiorly may obstruct the nasopharyngeal passage and the oropharynx respectively [23]. In some instances, fractures may induce trismus, causing decreased mobility creating a mechanical obstruction of the mouth, problematic for interventions such as intubation [22].

Further complications are created from injury to soft tissues through facial lacerations from blunt force trauma where oropharyngeal hemorrhage, and epistaxis induce the development of edema and hematoma formation resulting in a reduction in the size of the airway also known as pharyngeal lumen narrowing [24, 25]. The bleeding from the upper airway not only obstructs the airway but also, when swallowed, accumulates in the stomach and increases the risk of regurgitation, vomiting, and aspiration [23]. Patients are especially vulnerable when under anesthesia due to suppressed protective reflexes and diminished upper airway muscle tone. In such scenarios, airway resistance increases and complications could amount to enough severity requiring placement of an endotracheal tube and surgical intervention to ensure ample ventilation [23].

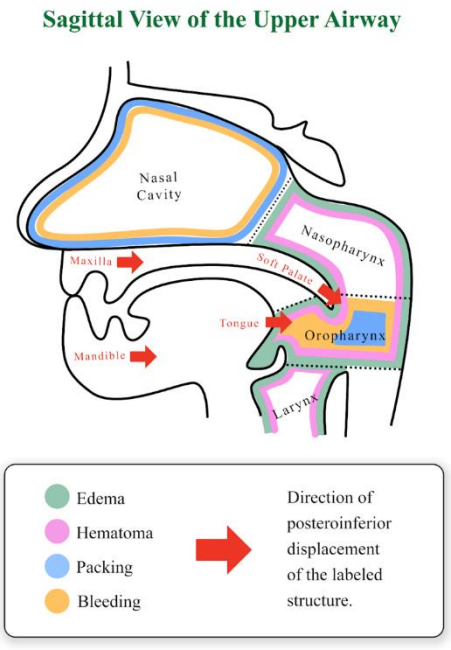

Figure 2: Sagittal View of the Upper Airway Depicting Common Sites of Obstruction due to Trauma: Nasal Cavity, Nasopharynx, Oropharynx, and Larynx. The red arrow points in the direction where bone fragments from the maxilla or mandible and structures such as the tongue and soft palate are displaced leading to obstruction of the airway.

Contradictorily, interventions meant to manage difficult airways in facial trauma patients may instead increase the risk of airway compromise. One such intervention is maxillomandibular fixation (MMF), a surgical technique often performed to correct fractures involving the maxilla or the mandible. MMF immobilizes the upper and lower jaws by attaching them together with screws. This procedure has shown to considerably reduce pulmonary function through respiratory obstruction [26]. Supported by several clinical studies, postoperative patients show a drop in forced expiratory volume and peak expiratory flow rate because of restricted oral breathing and secretion clearance [27]. Furthermore, previously mentioned post-operative issues including edema and swelling of the mucous membranes and upper airway bleeding may follow MMF further narrowing or completely blocking the already jeopardized airway.

Moreover, facial trauma and MMF in conjunction with postoperative pain and anesthesia limits a patient's ability to cooperate and communicate any distress [28]. This creates a disadvantage for the early detection of airway decline. The restriction of mouth opening and discomfort prevents an effective cough reflex in response to oral secretions, while anesthesia weakens respiratory drive. Unless monitored closely, these concerns may prove to be unnoticed and fatal to the airway.

Similarly, tracheostomy is another example of a common intervention that is accompanied by many problems, a few of which include emphysema, pneumothorax, infections, and prolonged hospitalization [29].

Additional risk arises when nasal or intraoral packing is utilized to control hemorrhage or to provide structural support. Although it is essential, packing can further reduce the nasal or oropharyngeal diameters obstructing airflow, especially in patients with previously reduced ability to breathe orally [30]. The several compilations of clinical obstruction contribute to hypoventilation, hypercapnia, hypoxia, and a significantly exacerbated airway.

Lastly, given the sensitivity of facial surgery, opioids are commonly used intra- and postoperative medications [31]. Opioids are known to cause respiratory distress through their sedative effects which cause reduced respiratory drive and diminished protective reflexes. Still, opioids are the preferred medication used for facial fractures because of the associated severity of the pain [32]. The use of these medications may lead to opioid-induced respiratory depression (OIRD) which is a major factor contributing to respiratory compromise [33].

Yet, the current OIRD risk tools in place are not accurate in the context of facial trauma. For instance, the PRODIGY score, a commonly used OIRD risk tool, is assessed on patients with planned surgeries as well as general patients as opposed to emergency situations [34]. These tools take into consideration factors such as a patient's age, BMI, sleep apnea history but they exclude trauma-specific airway issues discussed previously [34, 35]. One such specific exclusion criteria listed in this tool was "patients who were expected to be ventilated or intubated" [34]. Thus, anatomical challenges coupled with high opioid doses during intervention greatly increase OIRD risk highlighting the need to fine-tune tools and strategies to effectively manage airway complications in facial trauma.

Postoperative Opioid Use in Facial Trauma: A Mismatch Between Practice and Policy

Concerns about prescription overuse and the potential for long term dependence on opioids are of immediate concern after facial trauma surgery. The most common prescribed opioids after maxillofacial trauma surgery are typically hydrocodone, oxycodone, tramadol, and hydromorphone and a large study of over 20,000 patients, hydrocodone accounted for about 60.6% of all prescriptions [32]. Majority of these prescriptions were initiated in the perioperative period and often extended beyond what current guidelines recommend [32]. Within this group, a refill rate of 58.7% was observed, indicating that a significant proportion of patients continued opioid consumption beyond the initial provided prescription [32]. Furthermore, of those meeting criteria for inappropriate prescribing (PIP) or having overlapping prescriptions, with the usage of both opioid and benzodiazepine, or dosages over 100 MME, a total of 39.3% of patients were met [32].

The implementation of the Strengthen Opioid Misuse Prevention (STOP) Act in 2018 shown from a set of data from North Carolina displays an opposite trend where there was a mandated tighter control over opioid prescriptions for acute pain [36] set a rule that doctors could only give a 7-day supply after surgery. Following this policy, a retrospective cohort study showed a 30.9% drop in average MME prescription for facial fracture patients [36]. This drop was even greater in patients with fractures in multiple facial regions, showing that laws like this can help reduce high-dose prescriptions, even in serious cases [36].

There are national guidelines, but trauma physicians often ignore them. In a study conducted at four trauma centers in Wisconsin, a substantial number of doctors routinely prescribe excessive amounts of opioid medications, many times over what the CDC recommendations for acute pain (three (3) days) [37]. For example, many providers noted that national guidelines did not consider the nuances of trauma pain adequately and, as a result, relied on their clinical judgment instead of strict guidelines [37]. Due to the lack of clearly defined trauma-specific guidelines, there will be a considerable variation in opioid prescribing [37]. Other studies have determined that a large proportion of trauma patients, including patients with common orthopedic injuries and patients that sustained burns, were still taking opioids long after the injury was resolved [38].

The issue of long-term use of opioids following trauma is significant. One review observed that trauma patients experienced more long-term use of opioids than individuals undergoing elective surgery [39]. Hospitals can restrict the use of opioids in some circumstances, but even when they do, trauma patients often formerly had long-term uses of that opioid. However, experts have suggested that multifaceted approaches can aid lesser prolonged use, such as prescriber education, system interventions, and patient assessments for risk of ongoing narcotic use [39]. The trends are in line with trajectories regarding facial trauma cohorts where presence of psychiatric illness, prior substance use, and the presence of many injuries were predictors of ongoing opioids use [32].

In summary, hydrocodone, oxycodone, tramadol, and hydromorphone are important medications prescribed for patients with facial trauma in regards to pain management but their they are often prescribed in excessive dosages and durations [32, 36]. Practices in a practical trauma care setting

may frequently diverge from CDC guidelines, due to both clinical complexity and lack of tailored recommendations for trauma patients [37, 38]. Legislative action, as demonstrated by the NC STOP Act, can effectively reduce opioid volume, but more targeted interventions are needed to ensure consistent adherence to best practices across trauma settings [36, 39].

Opioid Dosing in Trauma Versus Elective Surgical Procedures: A Comparative Analysis

A comparative evaluation of opioid drug administration practices in trauma surgery versus elective surgical procedures exists. The knowledge of post-trauma opioid prescription and utilization patterns against elective surgery opioid use remains crucial for protecting patients from harm and promoting their future health. The research conducted by Flanagan et al. examined two patient groups through a detailed investigation of post-traumatic surgical patients and joint replacement patients (hip and knee) undergoing elective surgeries [40]. Flanagan et al. discovered that the opioid doses given to patients at the hospital and upon discharge and during recovery were equivalent for all patients [40]. People who suffer from unexpected injuries receive similar opioid prescriptions to patients who undergo scheduled surgical procedures.

The management approach toward pain differs substantially between these patient populations. Patients undergoing elective surgery benefit from advance planning before their procedure begins. According to hospital protocols most patients get regional nerve blocks together with non-opioid drugs as well as additional supportive treatments [40]. The arrival of trauma patients at the hospital usually occurs while they experience pain because their condition developed unexpectedly and requires immediate surgical intervention. The pain management approaches for trauma patients exhibit greater variability because they rely mainly on the individual healthcare providers and their teams [40].

A comprehensive assessment of 66 studies with 20 guidelines established that the majority of opioid reduction strategies focused on elective surgeries rather than trauma cases [39]. The standard methods for pain control which are available to elective surgery patients remain inaccessible to trauma patients [39].

The situation becomes more complicated when we consider trauma patients with serious injuries—especially those who have trouble breathing or are at risk for complications. The results from one research study indicated that specific patients develop dangerous opioid side effects which cause their breathing to slow down or stop [41]. Older adults together with patients who have kidney problems and those who receive other sedating medications fall under this category. Doctors reduce opioid administration to these patients particularly during the first 24 hours after surgery due to their elevated risk factors [41].

On the other hand, another study found the opposite can happen too. The study conducted at various hospitals showed that opioid medication prescriptions for trauma patients varied significantly between different physicians even though they worked in the same healthcare facility [42]. Patients with more serious injuries and those who sustained penetrating injuries from gunshot wounds received the highest doses of opioids [42]. The large discrepancies in opioid administration for trauma patients create concerns about possible overdose situations particularly when hospitals lack defined pain management protocols [42].

Even though both groups of patients receive comparable opioid quantities the methods used to manage their pain differ substantially. The planned surgery group receives methodical and uniform medical care but trauma patients receive irregular and unpredictable treatments. Safety concerns may lead to undermedication of trauma patients but the lack of clear pain management protocols might result in excessive opioid administration to these patients. To enhance medical care while decreasing risks of both long-term opioid consumption and adverse effects we need to develop better trauma-specific guidelines that help doctors manage pain effectively while protecting patient safety [36, 40, 41, 42].

Challenges in Dose Titration for Facial Trauma Patients

The adjustment of opioid medication dosages for people with facial injuries who underwent jaw repair surgery becomes complicated and requires special precautions. Patients with wired jaws pose an essential problem because they cannot communicate verbally. The inability of patients to speak or move their mouths makes it difficult for doctors and nurses to determine their actual level of pain [43]. Healthcare providers tend to administer less pain medicine to patients when they cannot provide direct feedback [44]. The Critical-Care Pain Observation Tool (CPOT) uses facial expressions and body movements to assess pain but these assessments require interpretation and produce different results based on the user (Devlin et al., 2018).

The patients face challenges with pain medication administration because most pain medications need to be taken orally but these patients cannot take medications through the usual methods. Medical staff need to use IV medications and nerve blocks as alternative methods because of this requirement [45]. Nerve blocks that target trigeminal nerve branches provide strong facial pain relief while eliminating the need for opioid medications. Research indicates that these methods show effectiveness for pain management in patients who do not respond to standard treatments [43, 46, 47, 48]. The main obstacle exists because not every hospital employs doctors who perform advanced procedures.

The situation presents a major danger to patient safety. The use of opioids results in drowsiness and breathing slowing down which creates a dangerous situation when patients receive excessive doses particularly for patients with their jaw locked because they cannot protect themselves from choking during vomiting or sedation [45]. The inability to speak makes it more difficult for patients to warn healthcare staff about side effects such as dizziness and breathing problems [44]. The fear of side effects causes medical providers to administer lower doses of medication which might result in ongoing pain for the patient.

Several hospitals have begun to use ultrasound-guided regional nerve blocks as a solution to manage patient pain. These blocks enable healthcare providers to target particular face nerves thus managing pain without using excessive opioid medication [43, 46, 47, 48]. Pregabalin serves as a medication of interest for preoperative administration to reduce postoperative opioid requirements [43, 45].

Facial trauma patients face multiple challenges when receiving opioid titration because they have communication problems and need alternative drug delivery methods and must avoid dangerous sedation effects. New pain management techniques such as nerve blocks along with alternative medications provide

safer and more effective methods to control pain in these at-risk patients.

Use and Gaps in Multimodal Analgesia Protocols

Multimodal pain protocols are effective by blocking the pain pathways at multiple checkpoints, optimizing relief while minimizing opioid use. Non-steroidal anti-inflammatory drugs (NSAIDs) inhibit cyclooxygenase (COX) enzymes to reduce prostaglandin production. Nerve blocks interrupt the signals of pain receptors from reaching the brain. Acetaminophen works similarly to NSAIDs but has no anti-inflammatory effect. Ketamine blocks N-methyl-D-aspartate (NMDA) receptors in the brain and spinal cord, which are involved in pain processing. Gabapentinoids (gabapentin, pregabalin) inhibit the release of excitatory neurotransmitters to reduce the excitability of neurons. Multimodal pain protocols are increasing as a method to decrease the use of opioids both during surgery and at discharge, thus reducing the risk for opioid induced respiratory depression (OIRD). In the Eggerstedt et al. study, they found use of a multimodal protocol reduced morphine equivalent doses needed in the first 72 hours postoperatively from head and neck free flap reconstruction (10 doses in the multimodal group vs 89 in the control cohort) [49]. This demonstrates how multimodal protocols have similar efficacy to opioids in terms of pain control without the risk of OIRD or dependence. This advantage could prove important in obese patients or patients with compromised airways, who have a further risk for OIRD. Figure 3 compares a sample multimodal protocol to an opioid-based protocol while Figure 4 assesses theoretical OIRD risk in varying BMI groups.

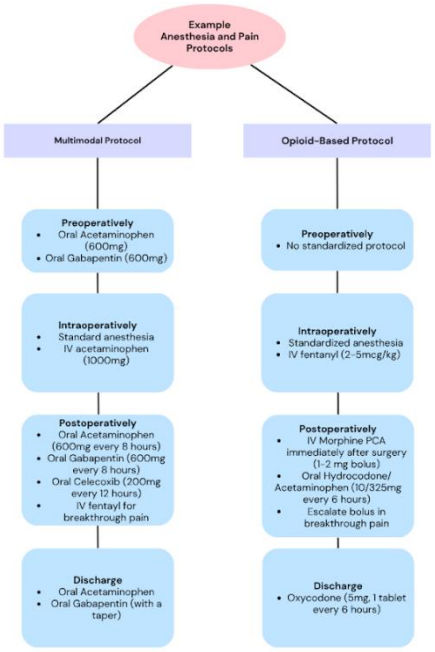

Figure 3: Example opioid-based and multimodal protocols of anesthesia and pain management. [50]

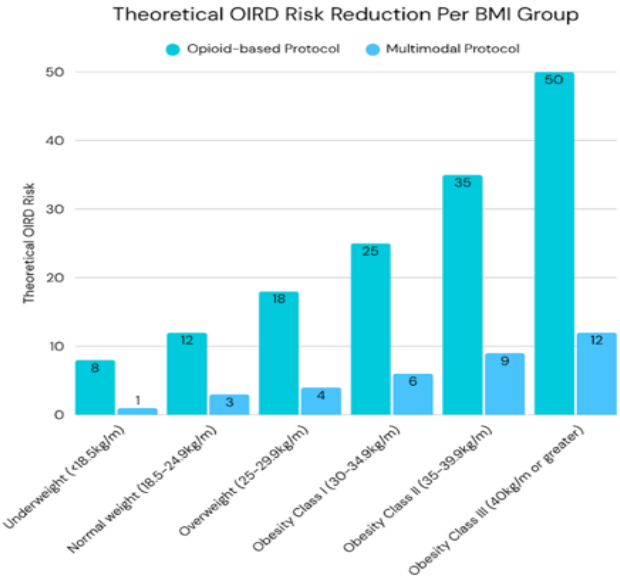

Figure 4: Bar chart illustrating the theoretical reduction risk of OIRD across BMI groups (Underweight: 87.5% risk reduction, Normal weight: 75% risk reduction, Overweight: 77.8% risk reduction, Obesity Class I: 76% risk reduction, Obesity Class II: 74.3% risk reduction, Obesity Class III: 76% risk reduction) [54].

In multimodal protocols for trauma surgeries, acetaminophen and gabapentin are often utilized both preemptively and postoperatively, as both are readily available, as supported by Harvin et al. in general traumas and Knudsen et al. in facial traumas [50, 51]. Nerve blocks are most commonly used intraoperatively, but can be used preoperatively and postoperatively. Celecoxib is also often utilized. In facial traumas, a key limitation is the lack of a generalized protocol in the literature. Due to this, it is difficult to say how often and when certain medications are used in facial trauma. Barriers to the use of certain medications in multimodal protocols are often cost or efficacy-related. Celecoxib and pregabalin, while used often, give pause to some providers due to their low coverage by insurance (Harvin et al., 2021). Abdelraouf et al. noted IV paracetamol/acetaminophen is not used in critically ill trauma patients due to the risk of hypotension and because it does not adequately reduce pain or subsequent opioid intake. NSAIDs are not used in critically ill trauma patients due to increased bleeding risk [52]. Trauma patients require special consideration due to the extent of the injuries, which can often alter which medications and methods can be safely used in a multimodal protocol.

Anesthesia protocols often do not stratify for body mass index (BMI) despite the increased risk for opioid-induced respiratory depression (OIRD) in obese patients. Due to altered pharmacokinetics, obese patients may require larger doses for similar anesthetic effects or experience delayed medication clearance, further increasing the risk for OIRD. In addition, it was found that less experienced physicians (<15 years) were more likely to utilize opioids in the treatment of their obese patients in moderate pain compared to their more experienced counterparts (>15 years) [53]. This suggests a difference in priority, pain control vs drug-induced complications. There is a lack of studies that investigate multimodal protocols and their efficacy specifically with BMI. One of the few studies that did, Brzezinski et al, noted that patients with high BMI are often excluded from clinical trials unless BMI is specifically tested in the study [54]. In their study, they examined oliceridine, a mu-opioid agonist that biases the G-protein pathway (not associated with OIRD) vs the beta-arrestin pathway (is associated with OIRD) and noted OIRD incidence was similar across BMI groups. More data needs to be gathered to confirm the safety and efficacy of multimodal protocols and determine the optimal combination specifically for obese patients undergoing trauma surgery.

Gaps in Literature and Research Priorities

Research into the OIRD risk in obese patients with facial trauma is an under-investigated field. The main cause of this is the purposeful exclusion of high BMI patients from clinical trials and studies. Among six studies reviewed (Eggerstedt et al., 2019; Harvin et al., 2021; Knudsen et al., 2023; Abdelraouf et al., 2025; Bui et al., 2018; Brzezinski et al., 2021), only the Brzezinski et al. study (2021) specifically stratified and tested outcomes in BMI groups, but this study focused on the drug oliceridine as opposed to a multimodal protocol. An additional study (Abdelraouf et al., 2025) measured BMI as a variable; however, it was not utilized as a significant factor in the analysis or outcome assessment. None of the six studies had all three components: 1) OIRD risk per BMI group, 2) Use of a multimodal protocol, or 3) A facial trauma population. Due to this lack of research, we cannot accurately describe the safety and efficacy of multimodal protocols in obese patients with compromised airways. Subsequently, there is currently no multimodal protocol in place adjusted for trauma and BMI. This represents a critical knowledge gap, as facial trauma patients with elevated BMI may face compounded risks due to possible airway compromise, the extent of the injuries requiring more medication, and obesity-related OIRD susceptibility.

To address these gaps, we recommend a systematic approach:
Knudsen et al. performed a retrospective study with the electronic medical records of 10 of their previous facial trauma patients to use as the control group to assess the efficacy of a multimodal protocol as opposed to a standard opioid protocol [51]. Chronic pain conditions and previous opioid use were screened for and excluded. This can serve as a model to perform widespread retrospective studies with electronic health data, but specifically stratifying for BMI as well. This will allow us to see trends in previous patients and provide a starting point for longitudinal prospective analyses.

In order to determine which combination of medications would be most effective, randomized clinical trials can be conducted, testing multiple multimodal protocols in order to assess which drug combination provides effective pain control while optimizing the risk reduction for OIRD. The Harvin et al. study serves as strong starting point, as they compared the generic multimodal pain regimen (oral acetaminophen, naproxen, gabapentin, lidocaine patches, and as needed opioids) to their specific multimodal pain regimen (intravenous administration, followed by oral, acetaminophen, 48 hours of celecoxib and pregabalin followed by naproxen and gabapentin, scheduled tramadol, and as needed oxycodone) to assess which better provided pain relief. A similar methodology could be utilized to determine the best protocol tailoring to weight and airway complexity. While multimodal protocols have shown their efficacy in reducing opioid use and occurrence of OIRD in normal-risk patients, this same efficacy needs to be confirmed in high-risk populations. Addressing these gaps will be imperative to developing a safe and effective multimodal protocol for obese patients.

Conclusion

Perioperative dosage of opioids remains the primary factor contributing to opioid-induced respiratory depression (OIRD); however, patients with higher body mass index (BMI) that are undergoing emergent facial trauma surgery are especially vulnerable to OIRD. While facial trauma patients are known to require high opioid doses, existing literature fails to address OIRD risk by BMI or the unique pharmacologic and perioperative airway challenges posed by obese trauma patients. In addition, much of the OIRD data come from elective surgical settings and fail to account for trauma-specific or BMI-sensitive factors—including the anatomical and physiological complexities of facial trauma, such as airway compromise, reduced respiratory function and altered drug metabolism, all which interplay in posing a challenging to standard risk prediction tools. The lack of data focusing on OIRD and BMI hinders the ability to develop trauma-specific opioid protocols. In the future, BMI-stratified investigations must be made to establish safe dosing thresholds and evaluate the effectiveness of multimodal analgesia in reducing OIRD risk in this high-risk population. There is a need to optimize analytic frameworks to ensure that obese trauma patients undergoing facial trauma surgery can receive safe and individualized pain management.

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Ochuwa Precious Imokhai: Conceptualization, Investigation, Methodology, Writing-original draft, Writing- review and editing, Supervision.

Danny Lee: Visualization, Methodology, Writing-original draft

Faith Jean: Visualization, Writing-original draft.

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