Obstructive sleep apnea (OSA) is characterized by repetitive partial or complete obstruction of the upper airway associated with cortical microarousals and oxygen desaturations, leading to disrupted sleep architecture and increased sympathetic neural activity. The prevalence of OSA in the general population is approximately 5%, with most cases remaining undiagnosed. Because of the aging of the population and the increasing obesity epidemic, OSA is expected to become more prevalent. Studies using screening questionnaires to estimate OSA prevalence in patients undergoing elective surgery have found that between 24% and 41% of patients are considered at risk for OSA. Most of these patients (81%–87%) have not been diagnosed with OSA at the time of their presentation. In certain patient populations, i.e., bariatric surgery candidates, prevalence rates of OSA may reach as high as 70%.

Patients with OSA are at an increased risk for perioperative complications. A number of mechanisms for this have been proposed, including difficulty during tracheal intubation and extubation; the effects of anesthetics, sedatives, and narcotics on upper airway muscle tone and ventilatory responsiveness; postoperative supine positioning; and increased rapid eye movement (REM) sleep on the nights following the first postoperative night. All these factors can potentially aggravate OSA, leading to worsening nocturnal hypoxia and hypercapnia, which are believed to be the primary mediators for postoperative complications, particularly in an unmonitored setting.

Although some of the reported postoperative complications in OSA patients are transient and reversible (i.e., transient hypoxia), others can be catastrophic. There are case reports identifying patients suffering major morbidity or
death in the postoperative setting directly attributable to the
presence of OSA.21,22 The purpose of this study is to describe
the reported legal ramifications associated with poor out-
comes in OSA patients undergoing surgery and to establish
the medicolegal burden of such cases.

METHODS
After consultation with MetroHealth Medical Center’s IRB,
the study was exempt from requiring informed consent. The
study was not registered with Clinicaltrials.gov, because it
was a review of the legal literature and did not involve the
assignment of patients to treatment groups.

This study is a retrospective review of the legal liter-
ature performed by searching the primary legal data-
bases: WestlawNext, Westlaw, LexisNexis, and LexisNexis
Academic. LexisNexis and LexisNexis Academic are the
world’s largest electronic database for legal and public
records–related information, containing >5 billion docu-
ments of source information. Westlaw and WestlawNext
are 2 of the primary online legal research services for law-
yers and legal professionals in the United States, contain-
ing >28,000 databases of case law, legislation, law reviews,
treaties, and directories. It is estimated that approximately
15,000 to 19,000 medical malpractice suits are brought
against physicians each year and that the majority of those
could be searched and found in both the LexisNexis and
the Westlaw databases. Search terms included “obstruc-
tive sleep apnea and medical malpractice,” “obstruc-
tive sleep apnea and medical negligence,” “sleep apnea and
postoperative medical complications,” and “sleep apnea
and postoperative respiratory complications.” The search
was limited to cases in the United States only, and the time
period searched included from 1991 through 2010.

Study Population
Inclusion criteria were that cases had to involve adults (>18
years of age) with known or suspected OSA who underwent
a surgical procedure that was associated with an adverse
perioperative outcome. OSA had to be directly implicated in
the outcome, and thus, primary surgical mishaps (i.e., uncon-
trolled bleeding or postoperative sepsis) were excluded. All
other postoperative adverse events, which could include
those possibly related to anesthetics and/or the use of opioids
or sedatives, were considered. The adverse perioperative out-
come also had to result in a lawsuit that was then adjudicated
in a court of law with a final decision in the case rendered.
Cases settled before going to court were excluded; most of
these cases are not reported in the legal literature (personal
communications, unpublished data) and often “sealed” from
the public, preventing analysis of details from the cases.

Plaintiffs were defined as those bringing the lawsuit
against the defendants. Defendants were those on trial in
the court of law. Defendants included medical centers/
hospitals, physicians, and nurses. More specifically, medi-
cal centers/hospitals were named in 41.7% of the cases, sur-
geons in 37.5% of the cases, anesthesiologists in 33.3% of the
cases, other/anonymous physicians in 16.7% of the cases,
and nurses in 8.3% of the cases. More than 1 defendant was
named in 29.1% of cases.

Using the aforementioned search terms, 50 cases were
initially identified. Twenty-six of these were excluded
because of being settled out of court (16), not being related
to surgery (5), involving a surgical mishap (3), error of
informed consent (1), and involving pediatrics (1). This left
24 cases for review and analysis (Fig. 1).

Data Collected
Each case was reviewed, and data were extracted from the
records available in the legal posting. Data extracted included
age, sex, type of surgery, complication leading to the lawsuit,
location where the complication occurred, type of central ner-
vous system depressant (i.e., anesthetics, opioids, benzodiaz-
epines) directly preceding or implicated in the complication,
and the final verdict of the case. Of note, none of the records
mentioned the use of or implication of benzodiazepines in
the case. Where appropriate, the assessment of financial
penalties was extracted. All cases were then categorized into
the major complication categories of death (11), anoxic brain
injury (11), or upper airway (2). Note that 6 of the patients
with anoxic brain injury died at later dates, although they
were kept in the anoxic brain injury category for purposes
of analysis. The upper airway category reflects significant
damage to the upper airway leading to disability. In 1 case,
an unplanned permanent tracheostomy was placed, and the other resulted from damage to the upper airway from reintubation leading to chronic aspiration problems.

Statistics
Descriptive statistics were used to characterize all cases with means and SDs. Cases were categorized by outcome: death, anoxic brain injury, and upper airway.

RESULTS
Twenty-four cases met criteria for inclusion in the study (Fig. 1). Although cases occurred across the entire search spectrum (1991–2010), 83% of them occurred after the year 2000 and 41% occurred in or after 2007 (Fig. 2).

Demographics (Table 1) include an average age of 41.7 years (±9.8 years), 63% male sex, and a known diagnosis of OSA in 96%. Most cases were elective surgeries (92%), with 33.3% considered general surgical procedures (all surgeries were performed below the diaphragm), 37.5% were ears, nose and throat procedures for the treatment of OSA, and 29.1% were considered other or miscellaneous interventions (Table 2). Complications occurred in the following locations: intraoperatively (21%), in the postanesthesia care unit (PACU) (33%), and on the surgical floors (46%).

The most common complications were respiratory arrest in an unmonitored setting and difficulty in airway management, usually in the form of a failed reintubation after premature extubation. Immediate adverse outcomes included death (45.6%), anoxic brain injury (45.6%), and upper airway complications (8%; Table 1). Long term, 71% of the patients died, with 6 of 11 who suffered anoxic brain injury dying at an average of 113 days (±111 days) later. The use of opioids and general anesthetics was believed to play a role in 38% and 58% of cases, respectively.

Patients who died during or immediately after their adverse event, compared with those who suffered anoxic brain injury, were more likely to have an unmonitored arrest on the general ward, although this did not reach statistical significance (Table 1). Those who suffered anoxic brain injury were more likely to have problems with a difficult airway in the operating room or the PACU, although this also did not reach statistical significance (Table 1).

Verdicts were reached in all cases, with 58% in favor of the plaintiff and 42% in favor of the defendant. In cases favoring the plaintiff, the average financial penalty was $2.5 million (±$2.3 million; range, $650,000–$7.7 million), with
a higher financial penalty awarded for anoxic brain injury compared with patients who died immediately (Fig. 3). In total, >$32 million was awarded to the plaintiffs, and the largest single settlement was $7.7 million.

**DISCUSSION**

There has been an increase in published articles related to excess perioperative morbidity associated with known or suspected OSA. However, the medicolegal burden of these perioperative complications has not been fully explored. This study demonstrates that perioperative complications directly related to OSA are increasingly recognized in the legal arena as well as with a growing number of medical malpractice suits reaching the courts. In addition, perioperative OSA cases appear to make up a growing percentage of the total legal cases adjudicated in the court of law, albeit this is a very small percentage of the total cases (Fig. 2). The majority of the cases reported here occurred after the year 2000, and >40% of cases were reported in the most recent 4 years of the study. Of interest, during roughly this same time period (2001–2010), the number of medical malpractice suits in the United States has been declining annually with an overall decrease of 35%.

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (y)</th>
<th>Sex</th>
<th>Surgery</th>
<th>Anesthetic</th>
<th>Event</th>
<th>Location</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33</td>
<td>F</td>
<td>Gastric bypass</td>
<td>General</td>
<td>Premature extubation. Unable to reintubate.</td>
<td>PACU</td>
<td>Death</td>
</tr>
<tr>
<td>2</td>
<td>NA</td>
<td>M</td>
<td>Gastric bypass</td>
<td>General</td>
<td>Sent to floor without CPAP. Opioids given postoperative. Unwitnessed arrest.</td>
<td>Floor</td>
<td>Death</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>M</td>
<td>Vertical-banded gastroplasty</td>
<td>General</td>
<td>Opioids given postoperative. Unwitnessed arrest.</td>
<td>Floor</td>
<td>Death</td>
</tr>
<tr>
<td>4</td>
<td>51</td>
<td>F</td>
<td>Vertical-banded gastroplasty</td>
<td>General</td>
<td>Opioids given postoperative. Unwitnessed arrest.</td>
<td>PACU</td>
<td>Upper airway</td>
</tr>
<tr>
<td>5</td>
<td>33</td>
<td>M</td>
<td>Laparoscopic cholecystectomy</td>
<td>General</td>
<td>Sent to floor without CPAP. Opioids given postoperative. Unwitnessed arrest.</td>
<td>Floor</td>
<td>Death</td>
</tr>
<tr>
<td>6</td>
<td>68</td>
<td>F</td>
<td>Colonic resection</td>
<td>General</td>
<td>Opioids given postoperative. Unwitnessed arrest.</td>
<td>Floor</td>
<td>Anoxic brain injury</td>
</tr>
<tr>
<td>7</td>
<td>45</td>
<td>M</td>
<td>Appendectomy</td>
<td>General</td>
<td>Opioids given postoperative. Unwitnessed arrest.</td>
<td>Floor</td>
<td>Anoxic brain injury</td>
</tr>
<tr>
<td>8</td>
<td>47</td>
<td>M</td>
<td>Appendectomy</td>
<td>General</td>
<td>Premature extubation. Unable to reintubate.</td>
<td>PACU</td>
<td>Death</td>
</tr>
<tr>
<td>9</td>
<td>47</td>
<td>F</td>
<td>UP3</td>
<td>General</td>
<td>Postextubation pulmonary edema.</td>
<td>PACU</td>
<td>Upper airway</td>
</tr>
<tr>
<td>10</td>
<td>38</td>
<td>M</td>
<td>UP3</td>
<td>General</td>
<td>Premature extubation. Unable to reintubate.</td>
<td>PACU</td>
<td>Anoxic brain injury</td>
</tr>
<tr>
<td>11</td>
<td>48</td>
<td>M</td>
<td>UP3</td>
<td>General</td>
<td>Premature extubation. Unable to reintubate.</td>
<td>OR</td>
<td>Anoxic brain injury</td>
</tr>
<tr>
<td>12</td>
<td>NA</td>
<td>M</td>
<td>UP3</td>
<td>General</td>
<td>Postoperative hypoxia.</td>
<td>PACU</td>
<td>Anoxic brain injury</td>
</tr>
<tr>
<td>13</td>
<td>44</td>
<td>M</td>
<td>UP3</td>
<td>General</td>
<td>Premature extubation. Unable to reintubate.</td>
<td>OR</td>
<td>Anoxic brain injury</td>
</tr>
<tr>
<td>14</td>
<td>NA</td>
<td>M</td>
<td>UP3</td>
<td>General</td>
<td>Opioids given postoperative. Unwitnessed arrest.</td>
<td>Floor</td>
<td>Death</td>
</tr>
<tr>
<td>15</td>
<td>36</td>
<td>M</td>
<td>UP3</td>
<td>General</td>
<td>Sent to floor without CPAP. Opioids given postoperative. Unwitnessed arrest.</td>
<td>Floor</td>
<td>Death</td>
</tr>
<tr>
<td>16</td>
<td>32</td>
<td>M</td>
<td>Cholesteatoma removal</td>
<td>General</td>
<td>Sent to floor without CPAP. Opioids given postoperative. Unwitnessed arrest.</td>
<td>Floor</td>
<td>Death</td>
</tr>
<tr>
<td>17</td>
<td>35</td>
<td>F</td>
<td>Septoplasty</td>
<td>General</td>
<td>Premature extubation. Unable to reintubate.</td>
<td>PACU</td>
<td>Anoxic brain injury</td>
</tr>
<tr>
<td>18</td>
<td>40</td>
<td>M</td>
<td>Pacemaker lead revision</td>
<td>None</td>
<td>Given opioids during procedure. Hypoxic arrest.</td>
<td>OR</td>
<td>Anoxic brain injury</td>
</tr>
<tr>
<td>19</td>
<td>39</td>
<td>F</td>
<td>Hysterectomy</td>
<td>General</td>
<td>Opioids given postoperative. Unwitnessed arrest.</td>
<td>Floor</td>
<td>Anoxic brain injury</td>
</tr>
<tr>
<td>20</td>
<td>36</td>
<td>F</td>
<td>Episiotomy</td>
<td>None</td>
<td>Given opioids during procedure. Hypoxic arrest.</td>
<td>OR</td>
<td>Anoxic brain injury</td>
</tr>
<tr>
<td>21</td>
<td>57</td>
<td>M</td>
<td>Anterior cervical fusion</td>
<td>General</td>
<td>Premature extubation. Unable to reintubate.</td>
<td>PACU</td>
<td>Anoxic brain injury</td>
</tr>
<tr>
<td>22</td>
<td>23</td>
<td>M</td>
<td>Spinal laminectomy</td>
<td>General</td>
<td>Opioids given postoperative. Unwitnessed arrest.</td>
<td>Floor</td>
<td>Death</td>
</tr>
<tr>
<td>23</td>
<td>41</td>
<td>F</td>
<td>Tooth extraction</td>
<td>None</td>
<td>Given opioids during procedure. Hypoxic arrest.</td>
<td>OR</td>
<td>Death</td>
</tr>
<tr>
<td>24</td>
<td>48</td>
<td>F</td>
<td>Retinal detachment surgery</td>
<td>NA</td>
<td>Sent to floor without CPAP. Opioids given postoperative. Unwitnessed arrest.</td>
<td>Floor</td>
<td>Death</td>
</tr>
</tbody>
</table>

CPAP = continuous positive airway pressure; F = female; M = male; OR = operating room; PACU = postanesthesia care unit.
Medical litigation related to OSA has been previously reported by Svidter et al.27 In that study, similar to our study, cases where a jury verdict was rendered were included for analysis, although some cases settled out of court were also included. In contrast to our study, cases were not limited to the perioperative setting alone. Other studies examining legal issues related to OSA in the perioperative setting focused on surgical factors, primarily tonsillectomy/adenoidectomy, and not the association of OSA with the poor outcome.28–31 Thus, our study is unique among these studies in that it reports on only surgical cases where OSA was believed to be a contributing factor to the adverse outcome that prompted the litigation.

The majority (58%) of rulings in our study favored the plaintiff. This is in contradistinction to the study by Svidter et al.,27 where 61% of cases ended with a ruling in favor of the defendant. This difference may be related to the reason for litigation, because the cause for litigation in our study was almost exclusively because of either death or anoxic brain injury, whereas there were a large variety of reasons cited for litigation in the study by Svidter et al. However, where a financial penalty was rendered, the findings were quite similar, averaging 1.5 to 2.5 million dollars per case with the highest penalties associated with cases involving anoxic brain injury. This likely reflects the expectation of prolonged intensive support and care needed for patients with anoxic brain injury and the high likelihood of subsequent death (6 of the 11 cases of anoxic brain injury in our study ultimately died on average >3 months after the initial complication).

This study carries particular relevance to the field of anesthesiology. More than half of the adverse events occurred intraoperatively or in the PACU and were often related to difficulty with airway management and/or premature extubations. Adverse events that happened intraoperatively or in the PACU were most often associated with a permanent vegetative state or required a permanent tracheostomy. Concerns for such adverse outcomes have been discussed previously and are reflected in recent reviews32 and recommendations from the American Society of Anesthesiologists for the perioperative management of patients with OSA.33 Particularly important areas of the American Society of Anesthesiologists guidelines that are relevant to our data are the recommendations for tracheal extubation while the patient is awake, only once neuromuscular blockade has completely resolved, and in the semiupright or lateral position. Following these recommendations may have avoided many of the unfortunate outcomes seen in the cases where premature extubation was believed to be a primary factor in the poor outcome.

Slightly over half of the complications reported occurred in an unmonitored setting, and a substantial minority involved the use of opioids. These cases were most likely to be associated with death as the outcome. There are controlled data supporting the use of oximetry monitoring to reduce the need for urgent intensive care unit transfers post-operatively, although this study did not specifically examine patients with OSA.34 Uncontrolled data suggest that implementation of a postoperative monitoring program for OSA patients may improve outcomes, although this requires further study.35 Most protocols and algorithms now recommend care with the use of opioids in patients with known or suspected OSA, particularly postoperatively, and alternative modes of analgesia should be considered.19,22,32,33,36–38

Of note, the cases in this study involved surgeries that were elective and performed on a relatively young patient population, averaging only 42 years of age. In addition, seemingly innocuous procedures such as an outpatient tooth extraction and revision of a pacemaker lead were found in this search. Although numerous perioperative protocols for the management of patients with OSA have been published, it remains to be proven that these protocols and proposed interventions will change the outcomes of OSA patients undergoing elective surgery. Currently, it seems that most institutions do not have policies in place.39,40 Despite the recent literature suggesting that ambulatory surgery for patients with OSA is safe,41,42 there were 2 cases of ambulatory surgery that required emergent transfer to a hospital with 1 case resulting in the death of the patient.

Our study is limited in several ways. First, this is a descriptive study and therefore the data presented serve, at best, to expose a previously unexplored area of this subject. Second, the actual medical, legal, and financial burden is undoubtedly significantly underestimated, as most such suits are settled out of court. In these cases, without a court ruling, there are little, if any, record and no reasonable manner by which to gather and analyze the data. Third, although the court findings may have implicated substandard postoperative care of patients with OSA as the reason to rule in the favor of the plaintiff in many of the cases, this study cannot medically verify that this was the case and a cause-and-effect relationship cannot be established. The study reports only on findings as stated in the legal literature. Finally, our study is limited in the presentations of the facts of each case as the medical data available are only that were published in the legal literature and are often devoid of important medical information.

CONCLUSIONS
Surgical patients with known or suspected OSA are at an increased risk for perioperative complications, and such complications are increasingly being reported as the central contention of malpractice suits. The most common

---

*ABI = anoxic brain injury

<table>
<thead>
<tr>
<th>Financial Penalty (in millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
</tr>
<tr>
<td>ABI</td>
</tr>
<tr>
<td>Upper Airway</td>
</tr>
</tbody>
</table>

Figure 3. Damages awarded to plaintiffs in millions of US dollars as categorized by major type of injury.
Perioperative Complications in OSA Patients: Legal Analysis

complications are related to cardiorespiratory arrest in an unmonitored setting and difficulty in airway management in the operating room and/or PACU, with both resulting in catastrophic outcomes including death or permanent brain damage. These cases are associated with severe financial penalties. Further research into interventions to reduce postoperative complications is needed. Our data likely underestimate the actual medicolegal burden, given that most such cases are settled out of court, and thus are not accounted for in the legal literature.

DISCLOSURES
Name: Nick Fouladpour, MD.
Contribution: This author helped design the study, collect the data, and prepare the manuscript.
Attestation: Nick Fouladpour reviewed the original data and approved the final manuscript.
Name: Rajinish Jesudoss, MD.
Contribution: This author helped design the study, collect the data, and prepare the manuscript.
Attestation: Rajinish Jesudoss reviewed the original data and approved the final manuscript.
Name: Norman Bolden, MD.
Contribution: This author helped design the study and prepare the manuscript.
Attestation: Norman Bolden approved the final manuscript.
Name: Ziad Shaman, MD.
Contribution: This author helped analyze the data and prepare the manuscript.
Attestation: Ziad Shaman approved the final manuscript.
Name: Dennis Auckley, MD.
Contribution: This author helped design the study and prepare the manuscript.
Attestation: Dennis Auckley reviewed the original data and the analysis of the data, approved the final manuscript, and is also the designated archival author who is responsible for maintaining the study records.
This manuscript was handled by: David Hillman, MD.

ACKNOWLEDGMENTS
The authors thank Mrs. Elizabeth Sparks for help with accessing the legal databases and the case search.

REFERENCES