

# Oxygenation and Ventilation

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## KEYWORDS

- Hypoxemia • Hypoventilation • Mechanical ventilation • Blood gas analysis
- Postoperative

## KEY POINTS

- Anticipation of oxygenation and ventilation abnormalities is very helpful in preventing complications.
- Respiratory failure may be due to ventilatory or oxygenation defects.
- Identification of the key abnormalities is essential to treating the patient.
- Intermittent positive pressure ventilation (PPV) may be required to support the patient until recovery and subsequent discharge home.

Perioperative and postoperative care of critically ill animals are vital to a good outcome in patients requiring a surgical procedure. Hypoxemia and/or inadequate ventilation contributes to patient morbidity and mortality if left unsupported. It is ideal to prevent respiratory dysfunction from developing if possible, rather than to play catch-up after failure has occurred.

## PREDICTING RESPIRATORY CONCERNS

### *Evaluation*

In a postsurgical intensive care unit (ICU), preparation for a potentially challenging recovery is vital. In smaller hospitals, where all cases are known, it may be easier to keep track of the emerging postoperative case. However, in larger specialty hospitals and academic centers, it may be hard to know all the cases “in motion.” The surgical schedule for the day should be carefully perused for cases with known or suspected challenging recoveries. The emergency service clinician should discuss critical admits with planned urgent surgical interventions with the criticalist. If possible, surgeons should be questioned about the extent of the planned intervention, and any preoperative imaging should be reviewed with a radiologist. Critical surgical procedures, when feasible, should go as early in the day as possible to prevent late-day recoveries. For

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patients with anticipated potential blood loss (eg, adrenalectomy with vena caval invasion), the patient's blood type should be determined and the blood bank resources should be evaluated in case of the potential for massive transfusion. As the surgical procedure is coming to an end, the attending anesthesiologist and receiving criticalist should review the case and discuss postoperative care, including provision of analgesics. The ICU nursing team should be similarly rounded as to the patient's expected arrival time and medical, surgical, and nursing concerns.

Postoperative respiratory complications may be divided into hypoventilation and hypoxemia. Even apparently healthy dogs may desaturate during recovery.<sup>1</sup> However, in healthy animals, oxygenation and ventilation typically return to normal quickly postoperatively. In more seriously ill animals, postoperative prolonged respiratory dysfunction may be loosely divided into difficulty moving air or difficulty with gas exchange. Difficulty moving air includes conditions such as upper airway obstruction, chest wall and diaphragmatic diseases, and severe neuromuscular disease such as cervical intervertebral disk disease (IVDD), while difficulties with gas exchange include conditions such as pneumonia, pulmonary edema, or atelectasis.

## TYPES OF SURGICAL PROCEDURES

The following are the surgical procedures that may require significant care from a respiratory perspective postoperatively:

1. **Airway:** Upper airway surgery in general may be fraught with difficulty recovering from anesthesia because of airway swelling and/or hemorrhage. Breathing against a fixed obstruction can worsen airway edema, which may further narrow the lumen and perpetuate respiratory distress. In addition, transient upper airway obstruction may result in the formation of noncardiogenic pulmonary edema and aspiration of blood or stomach contents and may lead to aspiration pneumonia.
2. **Thoracotomy:** Exploration of the chest cavity may be performed via a median sternotomy or lateral thoracotomy, depending on the goals of the surgery. Although the choice of the surgical approach is at the discretion of the surgeon, it is important for the managing criticalist to participate in the discussion preoperatively. Open thoracotomy is standard in most small animal practices; however, because current limitations to advancing minimally invasive surgeries are primarily related to equipment and techniques, these will likely be overcome in coming years. As thoracoscopic procedures continue to evolve in animals, it is likely that more and more cases will be performed using minimally invasive techniques. Lung biopsies may also be performed via a keyhole (limited approach), and caudal lung lesions may sometimes be accessed via a transdiaphragmatic approach, which may limit morbidity. Postoperative respiratory dysfunction after thoracic surgery may reflect pain, atelectasis associated with positioning, pleural space disease, pneumonia, vasculitis, or pulmonary embolism. Mild pulmonary hypertension may be associated with a large resection.<sup>2</sup>
3. **Abdominal celiotomy:** Abdominal surgery ranges from limited approaches to the caudal abdomen such as cystotomy to more extensive procedures such as abdominal sepsis from a gastrointestinal perforation or gastric dilatation volvulus. Respiratory dysfunction after abdominal surgery may be due to a variety of causes, with the most serious being acute respiratory distress syndrome (ARDS) associated with intra-abdominal sepsis and/or aspiration pneumonia.
4. **Neurosurgical procedures:** The most common procedures include laminectomies and craniotomies. Pulmonary complications associated with neurosurgical procedures include primarily hypoventilation, which is most common in cervical IVDD

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