Airway Management And Patient Positioning:
A Clinical Perspective

Davide Cattano, MD, PhD
Associate Professor, Medical Director of Anesthesia Clinic
Department of Anesthesiology
The University of Texas Medical School at Houston
Houston, Texas

Laura Cavallone, MD
Assistant Professor, Department of Anesthesiology
Washington University in St. Louis, School of Medicine
St. Louis, Missouri

Dr. Cattano is a consultant for Smiths Medical, and receives research grant support from Covidien and Karl Storz. Dr. Cavallone reports no relevant financial conflicts.

Patient positioning is an important aspect of anesthesia practice. Based on data from the American Society of Anesthesiologists Closed Claims Project database,[1,2] advancements in research, improvements in airway management and education, and development of airway devices have resulted in a substantial decrease in respiratory complications—at one time the major cause of anesthesia-related morbidity and mortality. Meanwhile, other factors have started to be reported as sources of liability,[3] including complications related to patient positioning.[4]

Table. Positioning and Technique Options Proposed for Different Clinical Scenarios

Scenario	Positioning	Technique Options
Full stomach	Upright, awake Supine, cricoid pressure Head up/down controversy[8]	FO DL, VAL
Compromised airway		
Intrinsic obstruction	Sitting upright Beach chair/ supine	FO Awake tracheostomy DL, VAL, SGA, OS
Extrinsic obstruction	Sitting upright	FO
Unstable cervical spine Thoracic spine	Manual in-line stabilization, supine, neutral position Prone[9]	FO, DL, VAL, SGA, OS DL
Morbid obesity	Upright awake Beach chair asleep Ramp asleep Supine Prone awake[10]	FO DL DL VAL, SGA FO
Rescued airway	Depends on patient position at time of lost airway	DL, SGA, VAL, OS, FO
Prehospital airway	Depends on patient position in prehospital setting[11]	DL, SGA, VAL
Protected extubation	Upright, awake Supine, "deep"	Awake with/ without ETT exchanger With ETT exchanger
Simulation and research	As close to real situation as possible (The challenge is to create realistic scenarios and provide adequate instructions.)[12]	All techniques

DL, direct laryngoscopy; **ETT,** endotracheal tube; **FO,** fiber optic; **OS,** optical stylet; **SGA,** supraglottic airway; **VAL,** video-assisted laryngoscopy

This review will not deal with patient positioning in general. However, current clinical perspective is that these changing sources of morbidity[4] need to be considered in relation to the use of new airway devices. For instance, we may consider the impact that new airway devices—such as video laryngoscopes and new intubating stylets (video-assisted, rigid/semirigid)—have on the incidence of adverse events, in addition to the importance of positioning the patient properly when using each device.[5]

In this review, we have categorized various positions proposed for airway management in different clinical settings. We briefly discuss evidence for any associated benefits and caveats, as well as the role of different airway devices in different positions and clinical settings. Finally, we identify the anatomic and medical conditions of patients that, in different scenarios, lead to specific positioning decisions. The discussion will be limited to positioning for airway management in adults.

The sniffing position has been recommended as optimal for patient intubation and airway management. Historically, the definition of this position is credited to an Irish-born anesthetist, Sir Ivan Magill, who described it as "sniffing the morning air" or "draining a pint of beer."

The effectiveness of the sniffing position compared with other "head-neck extension" positions has not been clearly established.[6,7] The lack of scientific evidence to support one technique over the others is explored in this review.

Differences in positioning may be insignificant in the vast majority of patients and in clinical scenarios that do not involve a difficult airway. However, such differences may become critical in situations when even small adjustments in head and neck positioning improve visualization—that may otherwise have been impossible—of the glottis or periglottic structures.

This review focuses on particularly challenging situations in which the choice of one position over another may be critical for successful intubation and maintaining adequate oxygenation while managing the airway, and ultimately for patient outcomes. We stress the importance of teaching these techniques to providers in training, with the aim of improving the success rate among novices. Specifically, we discuss 3 different positions and their usefulness in conjunction with different intubating devices and techniques.

Examples of challenging clinical situations and different positioning options are described in the Table.

Sniffing Position

As previously mentioned, the sniffing position (Figure 1) is considered the optimal "classical" position of the head and neck for facilitating intubation. Proposed by Magill in 1936,[13] Bannister and MacBeth reviewed the technique and published their observations in 1944.[14] They analyzed the angles of the oral, pharyngeal, and laryngeal axes with the head in different positions for the purpose of identifying the best possible alignment of the 3 axes to expose the glottis

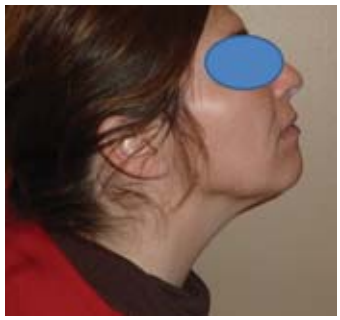

Figure 1. The sniffing position demonstrated.

In the first panel (A) the model is sniffing the air, in the second panel (B) the model demonstrates positioning as for drinking a "pint."

and facilitate endotracheal tube insertion.

The following key components were identified: flexion of the lower cervical spine, extension of the upper cervical spine, and extension of the atlanto-occipital joint. The external landmarks of the position of the chin, the angle of the mandible with respect to the operating room (OR) table, and the position of the ears anterior to or at the same level of the sternum were noted and correlated with optimal exposure of the glottis.[12,14-17]

The main advantage of this position is the optimal exposure of the glottis *for the purpose of intubation* with a Macintosh blade. Also, the position is advantageous for the anesthesia provider to facilitate the approach to the airway in the non-obese population (ie, optimal patency of the airway; ideal for mask ventilation).

Disadvantages and contraindications of the sniffing position include its inadequacy in obese patients (see next section on ramped position) to optimize glottis exposure in direct laryngoscopy (DL),[18] and the risk for spinal cord lesions in patients with known or suspected cervical spine injuries. In addition, some authors have questioned this positioning even for the "normal size, normal airway patient."[19]

Recently, Brindley and colleagues[12] proposed that the classical analogy to "sniffing" may be taught better as "win with the chin" (referring to the best position for winning a footrace, namely "the chin wins the race"). The authors suggested that, with inexperienced

Figure 2. The JED (Jaw Elevation Device; LMA North America Inc.).

providers, adequate positioning would occur more often using the "win with the chin" analogy than the sniffing one.

A new jaw-elevation device (Figure 2) is useful for maintaining a forced extension of the mandible and sustaining an open airway for sedation and asleep fiberoptic procedures.

Ramped or Head-Elevated Position For Morbidly Obese Patients

The so-called "ramped" position has been proposed to facilitate ventilation and visualization of the glottis for intubation in obese patients. The position may be achieved by placing blankets or other device (Figure 3) underneath the patient's head and torso so that the external auditory meatus and sternal notch are aligned horizontally.[18,20,21] The aim is to achieve the same "best alignment" of the 3 axes (oral, pharyngeal, and laryngeal) in obese patients that is achieved with the sniffing position in non-obese patients (Figure 4).

Both ventilation and the laryngoscopic view appear to be improved with the head-elevated position leading to potential advantages, including increased rates of successful intubation and decreased rates of morbidity and mortality related to airway management.

Two caveats regarding the use of this position are worth mentioning, on the basis of recently published data.

In a 2009 study by Dhonneur and colleagues[22] in obese patients, the use of 2 video-assisted laryngoscopy (VAL) devices (LMA CTrach, LMA North America, Inc; Airtraq, Prodol Meditec SA, LLC, distributed by Airtraq) proved to be more effective in preventing oxygen desaturation during intubation than conventional DL performed by experienced senior anesthesiologists with patients in the ramped position.

In another study, Hirabayashi and Seo found that use of the Airtraq with an "in-line" (neutral) neck position was preferable to the sniffing position with the head extended for alignment of the 3 axes.[23]

These data overall may indicate that a "neutral" position with use of a VAL device may be safer and more effective than simple DL, still using the ramped position.

Figure 3. The RAMP inflatable device (top); the Troop Elevation Pillow (bottom).

Rapid Airway Management Positioner; AirPal. Troop Elevation Pillow; Mercury Medical.

Figure 4. The RAMP before being inflated (top); the RAMP after being inflated (bottom).

Note the posture of the head in the proper sniffing position with use of the inflated device (cuneus at atlanto-occipital joint) and the optimal head extension (transverse line between the sternum and external ear canal). Photo courtesy of AirPal.

Finally, although a direct relationship between obesity and difficult intubation has not been established, obesity has been shown to be an independent predictor of difficult mask ventilation[24]; therefore, the risk associated with any intubation technique that abolishes spontaneous respiration should be considered when choosing an appropriate intubation technique in obese patients.

Special Positioning: Two Cases

Patient positioning for optimal airway management can be achieved by various means. When basic airway devices are the only ones available to use, the best position is the one that provides the best chance at successful insertion of the endotracheal tube or mask ventilation on the first try. The following 2 scenarios are illustrative.

Scenario 1. The patient was 163 cm tall, and weighed 130.5 kg (Figure 5). A simple adjustment of the bed headrest optimized positioning, in which a shoulder roll and head pillow (Figure 6) were used to support and flex the neck, and lift the head to sniffing position.

Scenario 2. The patient, 160 cm tall and weighing 132 kg (Figure 7, before appropriate positioning for intubation), was referred from another institution because of difficult laryngoscopy and impossible intubation. The use of a Troop Elevation Pillow (Mercury Medical) during the first laryngoscopy (not shown) was optimized by further shoulder support and headrest. The patient could be mask ventilated only with an oral/nasal airway (Figure 8). The laryngoscopy showed a Cormack-Lehane (C-L) grade III view that was improved after further support of the head to a C-L grade IIb. The laryngoscopic view was further improved to a C-L grade I with videolaryngoscopy. Intubation was attempted and performed only after optimization and under video-laryngoscopy, as all supports were immediately available and planned. However, the improvement from C-L grade III to grade IIb had already been achieved simply by correct repositioning.

Alternative devices to standard DL are becoming fundamental in securing the airway. Positioning, however, also affects ventilation and oxygenation as demonstrated in several studies that showed delayed desaturation in morbidly obese patients after proper positioning was achieved.

Beach Chair and Sitting Positions

These positions—which both require elevation of the patient's head and torso with regard to the lower limbs, with flexion at the hips—have been proposed for airway management with both awake and asleep intubation techniques.

Figure 5. Positioning of morbidly obese patient.

Figure 6. Optimized positioning in which a shoulder roll and head pillow support and flex the neck, lifting the head to sniffing position.

Figure 7. Patient before appropriate positioning to optimize chances of successful intubation.

Figure 8. The patient could be mask ventilated only with an oral/nasal airway.

The main advantage of these positions is that they help prevent airway collapse in patients who are obese or have obstructive sleep apnea, or in the presence of anterior extrinsic airway obstructions. They have been advocated for use with intubation with fiber-optic bronchoscopy[25,26] to maintain spontaneous ventilation.[27] Both positions also have been used for intubation performed after induction of general anesthesia and with DL.[28]

To perform fiber-optic intubation with the patient in the sitting position, the anesthesia provider is generally in front of, and beside, the patient (Figure 9); the bed height ideally is adjusted so that the head of the patient is lower than the provider's xiphoid process.[25] In the beach chair position, the head of the patient is "in line with the anesthetist's xiphisternum." If this position is chosen for DL, the provider may be "on a step and at an angle of the backrest."[28]

One possible problem with the use of these positions (especially the upright sitting position) is that the anesthesia provider may encounter difficulty performing a mask ventilation if it becomes necessary during the intubation process.

Extubation

A clinical relevant and often forgotten issue is positioning and in general success in airway management during extubation. The closed claims analysis showed that as many as 10% of respiratory complications1 were related to unexpected difficulties after extubation. Positioning plays a role as much as during the induction or initial management (increased functional residual capacity in morbidly obese patients, better airway patency with and without airway adjuncts, clearance from secretions and blood, etc.) and it is an important aspect of a safe and successful extubation. An

Figure 9. Optimal awake fiber-optic intubation.

The patient is in the beach chair position and the anesthesia provider uses the frontal approach, instead of the more common supine backward approach.

Figure 10. Safe extubation.

Oral airway, supraglottic endotracheal tube, and sniffing ramped positioning for asleep extubation in ENT procedures.

alternative and combined use of oral airway and supraglottic endotracheal tube has been used by one of the authors (DC) during recovery and asleep intubation for ENT procedures (Figure 10).

An easy and alternative way to use disposable, foam based, ramp positioner (Troop Pillow), is to utilize it

Figure 11. The "homemade" deflatable Troop Pillow.

The Troop Pillow before and after deflation using a disposable plastic bag and the suction/vacuum system provided in every operating room. Panel (A) the Troop pillow before and after (B) vacuuming.

for the recovery phase of anesthesia as well. Instead of removing the pillow for the surgery, the pillow can be "vacuumed" down and then re-expanded at the end of the procedure (Figure 11). One of the authors (DC) has used simple plastic clear trash bags sealed with tape, but specially designed vacuum bags could be easily produced and utilized for the goal.

Clinical, Anatomic, and Other Special Considerations That Influence Positioning

The nature of the clinical scenario—whether elective or emergent, and with or without the possibility of managing the airway in advance—establishes the first main constraint of the decision-making process.[29,30] Also important to consider are medical conditions that alter the anatomy and/or body habitus of the patient, which may significantly influence the choice of the appropriate position to secure the airway.[31,32] In this category, we include scoliosis, rheumatoid arthritis, unstable cervical spine, and previous cervical spine surgery.[33,34] Conditions that affect the patient's ability to maintain airway patency (eg, the presence of extrinsic or intrinsic obstruction of the upper airway,[35] or unusual positioning and airway rescue) also can be determining factors.[36]

Less obvious modifications of the body habitus must not be disregarded. One example is how certain hairstyles can affect the ability to appropriately extend the superior cervical spine and the atlanto-occipital joint, as when a large mass of firm hair braids is pulled up at the back of the head.

In specific cases, the anesthesia and surgical team may find it necessary to orient the patient on the OR table in a way other than the "standard orientation" (head of the patient toward the anesthesia provider

and the anesthesia machine) used for the majority of surgical procedures. For example, in situations when access to the patient's head or upper body is critically important for the surgical team, the setting or small size of the OR requires modifying the table orientation to achieve the desired setup.

At our institution, we have developed guidelines for managing the "threatened airway" (mainly, obstructed airway), when the surgical team—in this specific case, otorhinolaryngologists—may want the OR table oriented so that the patient's head is positioned 90 or 180 degrees away from the anesthesia machine. Such maneuvers necessarily call for extreme caution, careful coordination, and cooperation between the teams, and may increase the risk to the patient.

Another important factor to consider when determining the position and orientation of the patient in the OR is the availability of staff and equipment. Ultimately, optimal team cooperation, implementation of effective protocols, prompt and adequate availability of resources, acquisition and maintenance of technical skills, and adaptability to diverse clinical scenarios all are fundamental assets for successful airway management.

References

1. Domino KB, Posner KL, Caplan RA, Cheney FW. Airway injury during anesthesia: a closed claims analysis. *Anesthesiology.* 1999; 91(6):1703-1711.
2. Cheney FW, Posner KL, Lee LA, Caplan RA, Domino KB. Trends in anesthesia-related death and brain damage: a closed claims analysis. *Anesthesiology.* 2006;105(6):1081-1086.
3. Cheney FW, Posner KL, Caplan RA. Adverse respiratory events infrequently leading to malpractice suits: a closed claims analysis. *Anesthesiology.* 1991;75(6):932-939.
4. Cheney FW, Domino KB, Caplan RA, Posner KL. Nerve injury associated with anesthesia: a closed claims analysis. *Anesthesiology.* 1999;90(4):1062-1069.
5. Takenaka I, Aoyama K, Iwagaki T, Ishimura H, Takenaka Y, Kadoya T. Approach combining the airway scope and the bougie for minimizing movement of the cervical spine during endotracheal intubation. *Anesthesiology*. 2009;110(6):1335-1340.
6. Johnson C, Goodman NW. Time to stop sniffing the air: snapshot survey. *BMJ*. 2006;333(7582):1295-1296.
7. Benumof JL. Comparison of intubating positions: the end point for position should be measured. *Anesthesiology.* 2002;97(3):750.
8. El-Orbany M, Connolly LA. Rapid sequence induction and intubation: current controversy. *Anesth Analg*. 2010;110(5):1318-1325.
9. van Zundert A, Kuczkowski KM, Tijssen F, Weber E. Direct laryngoscopy and endotracheal intubation in the prone position following traumatic thoracic spine injury. *J Anesth.* 2008;22(2): 170-172.
10. Wu SD, Yilmaz M, Tamul PC, Meeks JJ, Nadler RB. Awake endotracheal intubation and prone patient self-positioning: anesthetic and positioning considerations during percutaneous nephrolithotomy in obese patients. *J Endourol.* 2009;23(10):1599-1602.
11. Koetter KP, Hilker T, Genzwuerker HV, et al. A randomized comparison of rescuer positions for intubation on the ground. *Prehosp Emerg Care.* 1997;1(2):96-99.
12. Brindley PG, Simmonds MR, Needham CJ, Simmonds KA. Teaching airway management to novices: a simulator manikin study comparing the "sniffing position" and "win with the chin" analogies. *Br J Anaesth.* 2010;104(4):496-500.
13. Magill IW. Endotracheal intubation. *Am J Surg.* 1936;24:450-455.
14. Bannister PB, MacBeth RG. Direct laryngoscopy and tracheal intubation. *Lancet.* 1944;1:651-654.
15. Greenland KB, Eley V, Edwards MJ, Allen P, Irwin MG. The origins of the sniffing position and the Three Axes Alignment Theory for direct laryngoscopy. *Anaesth Intensive Care*. 2008;36(suppl 1): 23-27.
16. Takenaka I, Aoyama K, Iwagaki T, Ishimura H, Kadoya T. The sniffing position provides greater occipito-atlanto-axial angulation than simple head extension: a radiological study. *Can J Anesth.* 2007; 54(2):129-133.
17. Greenland KB. The sniffing and extension-extension-position: the need to develop the clinical relevance. *Anaesthesia.* 2008;63(9): 1013-1014.
18. Collins JS, Lemmens HJ, Brodsky JB, Brock-Utne JG, Levitan RM. Laryngoscopy and morbid obesity: a comparison of the "sniff" and "ramped" positions. *Obes Surg*. 2004;14(9):1171-1175.
19. Adnet F, Borron SW, Lapostolle F, Lapandry C. The three axis alignment theory and the "sniffing position": perpetuation of an anatomic myth? *Anesthesiology.* 1999;91(6):1964-1965.
20. Cattano D, Melnikov V, Khalil Y, Sridhar S, Hagberg CA. An evaluation of the Rapid Airway Management Positioner in obese patients undergoing gastric bypass or laparoscopic gastric banding surgery. *Obes Surg.* 2010;(10):1436-1441.
21. Rao SL, Kunselman AR, Schuler HG, DesHarnais S. Laryngoscopy and tracheal intubation in the head-elevated position in obese patients: a randomized, controlled, equivalence trial. *Anesth Analg.* 2008;107(6):1912-1918.
22. Dhonneur G, Abdi W, Ndoko SK, et al. Video-assisted versus conventional tracheal intubation in morbidly obese patients. *Obes Surg.* 2009;19(8):1096-1101.
23. Hirabayashi Y, Seo N. In-line head and neck position is preferable for tracheal intubation with the Airtraq laryngoscope compared to the sniffing position. *J Anesth.* 2008;22(2):189-190.
24. El-Orbany M, Woehlck HJ. Difficult mask ventilation. *Anesth Analg.* 2009;109(6):1870-1880.
25. Fulling PD, Roberts JT. Fiberoptic intubation. *Int Anesthesiol Clin.* 2000;38(3):189-217.
26. Lai YY, Chien JT, Huang SJ. Fiberoptic intubation with patients in sitting position. *Acta Anaesthesiol Taiwan.* 2007;45(3):169-173.
27. Dabbagh A, Mobasseri N, Elyasi H, et al. A rapidly enlarging neck mass: the role of the sitting position in fiberoptic bronchoscopy for difficult intubation. *Anesth Analg.* 2008;107(5):1627-1629.
28. Fox WT, Harris S, Kennedy NJ. Prevalence of difficult intubation in a bariatric population, using the beach chair position. *Anaesthesia.* 2008;63(12):1339-1342.
29. Shakespeare WA, Lanier WL, Perkins WJ, Pasternak JJ. Airway management in patients who develop neck hematomas after carotid endarterectomy. *Anesth Analg*. 2010;110(2):588-593.
30. Bonhomme V, Hans P. Management of the unstable cervical spine: elective versus emergent cases. *Curr Opin Anaesthesiol.* 2009; 22(5):579-585.
31. Benumof JL. Obstructive sleep apnea in the adult obese patient: implications for airway management. *Anesthesiol Clin North America*. 2002;20(4):789-811.
32. Takenaka I, Aoyama K, Kinoshita Y, et al. Combination of Airway Scope and bougie for a full-stomach patient with difficult intubation caused by unanticipated anatomical factors and cricoid pressure. *J Clin Anesth.* 2009;21(1):64-66.
33. Takenaka I, Urakami Y, Aoyama K, et al. Severe subluxation in the sniffing position in a rheumatoid patient with anterior atlantoaxial subluxation. *Anesthesiology*. 2004;101(5):1235-1237.
34. Manoach S, Paladino L. Manual in-line stabilization for acute airway management of suspected cervical spine injury: historical review and current questions. *Ann Emerg Med.* 2007;50(3):236-245.
35. Erdös G, Tzanova I. Perioperative anaesthetic management of mediastinal mass in adults. *Eur J Anaesthesiol.* 2009;26(8): 627-632.
36. Weksler N, Klein M, Rozentsveig V, et al. Laryngeal mask in prone position: pure exhibitionism or a valid technique. *Minerva Anestesiol.* 2007;73(1-2):33-37.