Phenylephrine is a better vasopressor than ephedrine after spinal anesthesia in cesarian sections.

**Background:** Spinal anesthesia is often used for caesarean sections and there can be considerable hemodynamic changes following its use.

**Objective:** To compare the commonly used vasopressors ephedrine and phenylephrine as well as the secondary effects of the co-administration of ephedrine and phenylephrine along with oxytocin on maternal hemodynamics.

**Design/Methods:** This was a double-blind randomized prospective study. Forty patients were divided into 2 groups: patients in group E received ephedrine and patients in group P received phenylephrine. The need for vasopressor was defined as a 20% decline in arterial BP. Twenty patients who had not received ephedrine were randomly assigned to receive oxytocin alone or with phenylephrine. Cardiac output (CO) was measured using the BioZ LiDCO instrument. Standard monitoring was applied. Data were recorded every 5 minutes. Systemic vascular resistance (SVR) and CO were derived using the LiDCOplus monitor. All patients received spinal anesthesia for C-section along with a standard colloid preload. One mL (80 µg phenylephrine or 10 mg ephedrine) of randomly assigned vasopressor was given if mean arterial pressure (MAP) dropped below 20% every 60 seconds until it returned to baseline values. Thirty seconds after delivery, 2.5 IU of oxytocin was given alone or with 80 µg of phenylephrine.

**Results:** The primary outcome in this study was comparing the cardiac output after ephedrine and phenylephrine in response to hypotension after spinal anesthesia. The difference in heart rate was significant, but unlike ephedrine, phenylephrine induced bradycardia. Both groups had increase in MAP, though the time to peak MAP was shorter in the phenylephrine group. The mean peak of MAP was 8% lower than baseline in Group E and 8% more in Group P. In patients receiving the mixture of oxytocin and phenylephrine, absolute Heart rate and CO were lower, though MAP was higher. **Discussion:** The peak changes in CO and MAP were seen earlier in Group P than in Group E. After ephedrine, a phasic response was seen, increase in afterload, followed by a fall then a sustained increase in SVR. Atropine was used in 11 of 19 cases of bradycardia induced by phenylephrine, which made exact evaluation of CO difficult. This study showed that 80 µg of phenylephrine equals 10 mg of ephedrine, and a change in HR rather than MAP was a more important marker for CO during spinal anesthesia. It also demonstrated that coadministration of phenylephrine with oxytocin did not obtund the oxytocin response.

**Conclusions:** A low dose of phenylephrine is the better first line treatment for hypotension to restore SVR and CO to baseline compared to ephedrine.

**Reviewer’s Comments:** This is a useful and interesting study of the commonly used vasopressors, and confirms other recent studies supporting the use of phenylephrine during subarachnoid block for C-section. In addition, ephedrine has been shown to result in more neonatal acidosis. (Reviewer-Sunita Goel, MD).

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Keywords: Spinal Anesthesia, Vasopressors

Print Tag: Refer to original journal article
In this study, a blood glucose target of ≤180 mg/dL resulted in lower mortality than did a target of 81 to 108 mg/dL.

**Objective:** To determine the optimal target range for blood glucose in critically ill ICU patients.

**Participants/Methods:** In >6000 patients admitted to the ICU, the NICE-SUGAR trial examined death within 90 days of randomization. Patients were randomized at ICU admission to either “strict control,” 81 to 108 mg/dL (3045 patients) or “conventional control” of ≤180 mg/dL (3050 patients). In the first group, 27.5% of patients died versus 24.9% in the second group. The odds ratio for dying in the intensive control group was 1.14; 95% confidence interval, 1.02 to 1.28. This represents a number needed to harm of 38. The treatment effect, surgical versus medical, was negligible. Severe hypoglycemia, with blood glucose <40 mg/dL, was seen in 206 patients in the intensive care group versus 15 patients in the conventional group. In either group, the number of ICU or hospital days, time on mechanical ventilation, or renal replacement therapy was not significantly different. Euglycemia has been of concern to physicians for the longest time and has even been on the radar of the National Quality Forum (NQF) on the list of Serious Reportable Events in Healthcare, which includes 27 adverse events that are serious, largely preventable, and of concern to both caregivers and consumers. On the NQF list, number 15 is, “patient death or serious disability associated with hypoglycemia, the onset of which occurs while the patient is being cared for in a health care facility.” Limitations of the study were: with a blood glucose <40 mg/dL, no long-term sequelae were reported; with an odds ratio of 14.7 for outcomes and adverse events, it is possible that these may be the most at-risk group for death. It would seem that the difference at the 30-day analysis is similar versus 90 days, but it is not.

**Results/Conclusions:** This paper presents evidence not seen before, indicating that intensive glucose control increased mortality among adult patients in the ICU. Insulin infusion protocols replicate normal pathophysiology much better as compared to the relatively old sliding scale insulin. It is possible that this mortality is a reflection of the severe hypoglycemia that frequently accompanies the attempt at tight glucose control. It is also possible that, in the future, a natural loop biofeedback computerized or electronic system, akin to the natural one, that controls the glucose tightly in the absence of the episodes of hypoglycemia, will again demonstrate the benefits of tight glucose control. Also, humans may need a higher glucose level during periods of stress and in an attempt to achieve a glucose value alone, we may not be doing any favor to our patients, rather quite the opposite.

**Reviewer's Comments:** This article clearly demonstrates that tight glucose control can result in increased mortality; therefore, intensive glucose control might not be a good idea. Rather it may be best to have a slight hyperglycemia. (Reviewer-Sunita Goel, MD).

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Keywords: Glucose Control, Hypoglycemia, Intensive Care

Print Tag: Refer to original journal article
Establishment of a national lung cancer group with the primary tasks to implement updated national guidelines and to secure valid registration of clinical baseline data and quality parameters has been a contributory factor to significantly improve the quality of lung cancer surgery.

**Objective:** To report the results of establishing national lung cancer guidelines with special focus on surgery.

**Participants/Methods:** From 2000 to 2007 and after follow-up of >24,000 patients, following of therapeutic guidelines from the Danish Lung Cancer Group showed improvement in outcome and quality of surgery. This shows that by establishing a method of implementing national guidelines, it is possible to improve measurable parameters of cancer care, especially 1- and 2-year survival, increased lobectomy rates, decreased pneumonectomy rates, and surgery within 2 weeks of referral. In the early 90s, the thoracic surgeons, respiratory specialists, and oncologists of Denmark decided that treatment of lung cancer did not meet the criteria of good clinical practice. Subsequently, this group decided to publish a set of guidelines (expectations) and also a database of agreement between recommendations and clinical practice (measurement). This national registry was started in 2000 and used secure internet with closed network to collect, collate, and exchange data. By 2007, significant advances were made in relevant clinical parameters. By using clear and transparent processes in developing these guidelines, and rapidly incorporating international consensus guidelines, for example, in favor of lobectomy versus pneumonectomy, there was enhanced support by clinicians and improved adherence to protocol. Overall survival in the 1- and 2-year group increased from 69% and 50% in 2000 to 77% and 60% in 2005. There was not much change in the 5-year survival, from 32% to 35%. The agreement between clinical and pathological clinical staging (TNM) also increased in this period from 69% to 80%. During the same time, the lobectomy rates increased from 54% to 73% and the pneumonectomy rates decreased from 23% to 11%. Simultaneously, the percentage of patients having surgery within 2 weeks of referral went up from 69% to 83%. In this program, the fact that one could monitor one's own adherence as well as those of other centers and groups becomes a good feedback loop--sort of like looking in a mirror as well as looking around you. Measuring yourself against your peers can be a significant positive driver of good behavior. It seems that all of this has promoted the use of the rapid and optimal surgical approach with consequently improved outcomes.

**Results/Conclusions:** This report demonstrates that a well-designed total quality management program improves practice and outcomes. In this information age and the backdrop of easy potential exchange of ideas (and data), a program like this disseminates and applies information rapidly. Other systems, both regional and international, could do well to emulate and learn from this system, which could be a monitoring and evaluation tool of significant potential medical benefit.

**Reviewer’s Comments:** This article is a good example of improving quality of care through declared expectations via quality measurement and evaluation for improved outcomes. (Reviewer—Sunita Goel, MD).

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Keywords: Lung Cancer, Registry, Outcomes

Print Tag: Refer to original journal article
The use of a recruitment maneuver in obese patients during general anesthesia demonstrated improvement in oxygenation with a reduction in atelectasis.

**Background:** Atelectasis is common post-anesthesia in morbidly obese individuals. Various maneuvers have been used to decrease this atelectasis and decrease morbidity in these individuals. An alveolar recruitment maneuver with the addition of positive end-expiratory pressure (PEEP) of 10 cm H₂O has been shown to improve oxygenation and, to some extent, improve atelectasis and respiratory mechanics.

**Objective:** To evaluate the efficacy of 3 different maneuvers, namely: PEEP alone, recruitment maneuver (RM) with zero end-expiration pressure (ZEEP), and recruitment maneuver with PEEP for the improvement of lung mechanics in morbidly obese patients after general anesthesia.

**Participants/Methods:** 30 patients of ASA II/III BMI >40 kg/m² scheduled for elective gastric bypass surgery were recruited after informed consent and ethics committee approval. History of any cardiorespiratory compromise resulted in exclusion from the study. An arterial line was used in the study protocol and serial ABGs were done. All patients were ventilated with volume cycle and RR was adjusted to maintain ETCO₂ between 34 and 41 mm Hg, keeping tidal volumes constant. The patients were randomized into 3 groups: PEEP, RM + ZEEP, and RM + PEEP of 10 cm H₂O. RM was initiated by switching off the ventilator mode to pressure control with inspiratory pressure of 55 with an inspiratory hold of 10, only if the systolic BP fell below 20%, it was abandoned. CT scans were done at end expiration in awake patients and in anesthetized patients with expiratory hold.

**Results:** 33 women and 7 men were included in the study. There was no significant difference in hemodynamics in any patient in any group. RM+ PEEP improved oxygenation at 5 minutes, which lasted for 40 minutes resulting in an increase in PaO₂/ FiO₂ ratio. PEEP alone as well as RM + PEEP increased the normally aerated lung unaffected the poorly aerated lung, while ZEEP had no change.

**Conclusions:** Induction and paralysis itself in a morbidly obese patient cause airway collapse and predisposes patients to atelectasis, which can lead to hypoxia and pneumonia. In this study, an RM + PEEP effectively opened up atelectatic lung and improved oxygenation and compliance. Use of the spiral CT made it possible to evaluate the lung at different points. An RM of 55 cm H₂O with PEEP reduced atelectasis and also helped abolish it in some cases, and an RM of 55 cm of H₂O was optimal, negating ill effects of barotrauma and hemodynamic instability. This study had various limitations of being a small study group and using a fixed inspiratory pressure and PEEP with volume-controlled ventilation.

**Reviewer's Comments:** This study demonstrated that an RM + PEEP improved oxygenation and reduced atelectasis for a reasonable period of time postoperatively. (Reviewer-Sunita Goel, MD).

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Keywords: Obesity, Atelectasis

Print Tag: Refer to original journal article
Dream recall during anesthesia is associated with a REM-like EEG pattern with high frequency power and less spindle-like activity in the period just before cognition. It is not clear if the dream recall is due to actual dreaming or less amnesia.

**Background:** Dreaming occurs frequently during anesthesia, usually during the recovery phase when the patient enters a natural sleep state. Dreaming occurs during both REM and non-REM natural sleep. The electroencephalographic (EEG) signs of dreaming during anesthesia and the differences in EEG between propofol and desflurane anesthesia are unknown.

**Objective:** To compare the incidence of dream recall and EEG pattern between propofol and desflurane anesthesia, as well as the EEG pattern in patients reporting dream recall as compared to those who do not.

**Design:** Prospective randomized double-blind trial.

**Participants/Methods:** 300 adult patients presenting for non-cardiac surgery were randomly allocated to receive either propofol- or desflurane-maintained anesthesia. Fentanyl, propofol, and a muscle relaxant were used for induction of anesthesia. Propofol was infused using a target-controlled infusion device in the propofol group while desflurane concentration was titrated to bispectral index (BIS) 40 to 55 in the desflurane group. The raw EEG was recorded from induction until patients were questioned about dreaming postoperatively as soon as they became oriented to time, place, and person using a standard questionnaire. Dreaming during anesthesia was defined as any dreaming experience described by the patient occurring between induction and emergence. A power analysis was based on 16% difference in the incidence of dreaming between the 2 groups.

**Results:** Baseline characteristics were similar between the 2 groups. The incidence of dream recall did not differ between the propofol (27%) and desflurane (28%) groups. In a multivariate analysis, predictors of dream recall were dream recall >1 per week, <100 minutes anesthesia duration, and BIS >90 at interview. The raw EEG of patients who recalled dreams showed more of a REM-sleep-like pattern (fewer spindles and more high frequency power) than in non-dreamers in the 5 minutes before the interview; however, during surgery there were not any significant differences. During surgery, the raw EEG showed more and faster spindle-like activity in the propofol group than the desflurane group.

**Conclusions:** There is no difference in dream recall between propofol and desflurane. Dream recall during anesthesia is associated with a REM-like EEG pattern with high frequency power and less spindle-like activity in the period just before cognition. It is not clear if the dream recall is due to actual dreaming or less amnesia.

**Reviewer's Comments:** These findings strongly suggest that dream recall during anesthesia involves complex neural processing systems that are not well understood. The association between dream recall during anesthesia and REM EEG activity goes along with the general idea that dreams during REM sleep are vivid and easily remembered while dreams during non-REM are easily forgotten. The findings of this study agree with previous observations that dreaming actually occurs during recovery, and is not associated with the depth of anesthesia. (Reviewer-Ioanna Apostolidou, MD).

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Keywords: Dream Recall, Anesthesia, Propofol, Desflurane, Electroencephalogram

Print Tag: Refer to original journal article
Avoidance of CPB During CABG Does Not Reduce POCD Incidence

The Effects of Cardiopulmonary Bypass on the Number of Cerebral Microemboli and the Incidence of Cognitive Dysfunction After Coronary Artery Bypass Graft Surgery.

Liu YH, Wang DX, et al:

Anesth Analg 2009; 109 (October): 1013-1022

Despite the higher incidence of cerebral microembolic signals in on-CPB CABG, the use of CPB was not independently associated with the risk of POCD.

**Background:** Postoperative cognitive dysfunction (POCD) affects up to 70% of cardiac surgery patients at the time of discharge and up to 40% of patients at 6 months. Cerebral microemboli and the systemic inflammatory response induced by cardiopulmonary bypass (CPB) have been found to be associated with POCD. However, it is not clear if avoiding CPB improves POCD.

**Objective:** To explore whether off-CPB surgery reduces the number of cerebral microemboli and the incidence of POCD after coronary artery bypass graft (CABG) surgery as compared to on-CPB surgery in the Chinese population.

**Design:** Prospective cohort study.

**Methods:** 59 patients underwent on-CPB and 168 underwent off-CPB CABG surgery. The use of CPB was determined by the surgeon. A control group of nonsurgical subjects was recruited to estimate the practice effect. A battery of 7 neuropsychological tests was administered the day before surgery, at 1 week, and 3 months after surgery. Anesthesia was standardized. Cerebral microemboli were measured continuously with transcranial Doppler ultrasonography of the middle cerebral arteries.

**Results:** Baseline and perioperative characteristics were similar between the 2 surgical groups. There was a significant difference in the median total number of cerebral microemboli between the on-CPB (median, 430; range, 155 to 2088) and off-CPB (median, 2; range, 0 to 66) groups. However, cerebral microemboli were not related to the occurrence of POCD. In the on-CPB group, microemboli primarily occurred at the start of CPB, during CPB, and when the side clamp came off. In the off-CPB group, microemboli were detected during the removal of the side clamp. There was no difference in the incidence of POCD between the on-CPB and off-CPB groups at 1 week (55.2% vs 47.0%) and at 3 months (6.4% vs 13.1%) after surgery. Increasing age was an independent risk factor for POCD. Shorter hospital stay was associated with POCD at 1 week, and diabetes mellitus was associated with POCD at 3 months after surgery. Two patients developed stroke, one in each group.

**Conclusions:** Despite the higher incidence of cerebral microembolic signals in on-CPB CABG, the use of CPB was not independently associated with the risk of POCD. Non-randomization, inadequate sample size, low rate of follow-up (74%), and inability to control for surgical technique were some of the shortcomings of the study that might have influenced the results differently and were discussed further by the authors.

**Reviewer's Comments:** POCD is common after cardiac surgery, but it also exists at a lower rate in non-cardiac surgery. It appears to be transient, yet sometimes persists beyond 6 months after surgery. Little is known about the pathophysiology of POCD. Increasing age and major surgery are risk factors for POCD, and there is no evidence that the type of anesthesia, general versus regional, matters. (Reviewer-Ioanna Apostolidou, MD).

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Keywords: Postoperative Cognitive Dysfunction, Cardiopulmonary Bypass, Off-CPB Cardiac Surgery

Print Tag: Refer to original journal article
LMA Does Not Increase Risk of Pulmonary Aspiration

Risk of Pulmonary Aspiration With Laryngeal Mask Airway and Tracheal Tube: Analysis on 65,712 Procedures With Positive Pressure Ventilation.

Bernardini A, Natalini G:

Anaesthesia 2009; October 23 (): Epub ahead of print

In selected low-risk patients, classic LMA and controlled ventilation may be a viable combination.

**Background:** Although designed for use in spontaneously ventilating patients, the classic laryngeal mask airway (LMA) has become more commonly used with controlled mechanical ventilation.

**Objective:** To determine whether using an LMA increases the risk of pulmonary aspiration compared with tracheal intubations in patients undergoing positive pressure ventilation.

**Design:** Retrospective database review.

**Participants:** Over 65,000 patients, approximately half with LMA and half with endotracheal intubation, were evaluated.

**Methods:** Data extracted included demographics, type of procedure, length of procedure, and whether procedure was elective or unplanned. Aspiration was defined as gastric contents, bilious fluid, or other non-respiratory fluid suctioned from the trachea or dyspnea, hypoxia, auscultatory abnormalities, or new infiltrates on chest x-ray after the appearance of any gastric contents in the LMA or oropharynx. Patients were followed up until hospital discharge if aspiration occurred. LMA use was contraindicated if the patient did not meet NPO guidelines; had intestinal obstruction, pregnancy, or unplanned surgery with <12 hours NPO; airway surgery; and prone positioning for surgery. Default ventilator settings included 8 to 10 mL/kg actual body weight with respiratory rate titrated to end-tidal or arterial PaCO$_2$.

**Results:** Only 10 cases of aspiration were recorded in the database. The majority of the aspiration events occurred in the group with endotracheal intubation. Most of the patients were admitted to the intensive care unit, but there was no significant morbidity or mortality associated with the aspiration event. The main factor associated with aspiration in either group was the need for emergency surgery. Male gender was also a positive predictor of aspiration. No aspiration occurred in >2500 patients who had major abdominal surgery or laparoscopy with an LMA.

**Conclusions:** LMA did not increase the risk of incurring signs or symptoms of pulmonary aspiration compared with the tracheal tube in selected patients undergoing mechanical ventilation.

**Reviewer's Comments:** Despite the apparent size of their study, the authors point out that, by their calculations, several million patients would need to be randomized to demonstrate a significant difference in aspiration between the classic LMA and endotracheal intubation. I still prefer using the ProSeal version of the LMA for doing cases with mechanical ventilation. (Reviewer-Allen Miranda, MD).

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Keywords: Laryngeal Mask Airway, Mechanical Ventilation, Pulmonary Aspiration

Print Tag: Refer to original journal article
Non-supine positioning may have an influence on the displayed BIS value.

Background: A number of factors have been demonstrated to influence bispectral index (BIS) values without necessarily influencing the depth of anesthesia.

Objective: To compare the effects of changing patient position on BIS scores during general anesthesia.

Design: Prospective observational study.

Participants: 40 adult ASA 1 or 2 patients undergoing elective minor surgery were evaluated. Patients were excluded if they had hypertension, neurological disease, previous head injury, glaucoma, or retinal detachment.

Methods: Standard monitors and a standard anesthetic were performed. BIS values were recorded initially in the supine, neutral position and then in the head down position. Head down and head up were both 30° from neutral. A repeat series of values was recorded in the neutral position again and then in the head up position. Simultaneous heart rate, mean arterial blood pressure (MAP), SaO₂, ETCO₂, and end-tidal isoflurane were also recorded. Patients were interviewed postoperatively on day 2 to determine if there were any recall events.

Results: In the neutral position, BIS values were in the low 40s. Significant changes were seen in the BIS values that occurred with the changes in the patient’s position. The head down position produced a significant rise in BIS values to the mid to upper 40s. The head up position lowered the BIS values to the upper 30s. The change in BIS was greater in shifting to the head down position. Heart rate, ETCO₂, and SaO₂ were essentially unchanged during the study period, but the MAP increased significantly during the head down position and trended downward with head up positioning, but not back to baseline values. No recall was reported.

Conclusions: Changes in patient position significantly affect BIS values and might affect interpretation of depth of anesthesia.

Reviewer’s Comments: A specific mechanism for this observed phenomenon was not established by this study, but changes in cerebral blood flow, cerebral oxygenation, distance from the cerebral cortex, and the BIS monitor all are possible factors. The BIS values in this study were relatively low at baseline, so recall would be less of a risk. It would be interesting to see a similar study performed at higher baseline levels of BIS.

(Reviewer-Allen Miranda, MD).

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Keywords: Bispectral Index Monitor, Patient Position, Anesthesia

Print Tag: Refer to original journal article
A continuous femoral nerve block results in better perioperative pain control and early postoperative function; however, it has no effect on long-term function.

**Background:** Continuous femoral nerve blockade has been used to provide postoperative analgesia after total knee arthroplasty (TKA).

**Objective:** To determine the short-term and long-term benefits of continuous femoral nerve blockade after TKA compared to standard intravenous analgesia.

**Design:** Randomized open-label study.

**Participants:** 58 adult patients of both sexes scheduled to undergo primary TKA under spinal anesthesia.

**Methods:** Patients were randomized to either receive a continuous femoral nerve blockade or patient-controlled analgesia alone with intravenous morphine. The femoral nerve catheters and blocks were performed and tested prior to administering anesthesia. All patients received 15 mg of plain bupivacaine for spinal anesthesia. The patients were assessed at regular, scheduled intervals for pain via a 10-point visual analog score. The patients were also asked to rate their satisfaction with their level of analgesia. Knee flexion was measured and compared among the groups from day 3 to 6 by an independent physical therapist. Similarly, knee function was measured at 3 months in all patients by an independent, blinded physician.

**Results:** The patients who received the femoral catheter had modestly but significantly lower pain scores ranging from 4 at postoperative day (POD) 0 to 0.75 on POD 2 than those receiving intravenous morphine (4, POD 0; 3, POD 2). Their morphine consumption was also lower on POD 1 (16 mg) and POD 2 (4 mg) than those that received intravenous morphine alone (29 mg, POD 1; 12 mg, POD 2). The level of nausea and vomiting was also lower in those with the femoral catheter, and the degree of flexion at the knee was greater in the early postoperative period. In addition, the level of satisfaction with the analgesic management was greater in the femoral catheter group. However, by 3 months following surgery there were no differences among the groups.

**Conclusions:** Continuous femoral nerve blockade following TKA resulted in modestly better analgesia, better knee function, greater patient satisfaction as well as less morphine consumption and morphine-related side effects than intravenous morphine alone. But by 3 months following surgery, there were no benefits that could be demonstrated.

**Reviewer’s Comments:** This study demonstrates that continuous femoral nerve blockade following TKA is beneficial in the early postoperative period. Perhaps superior analgesia in the early postoperative period could have prevented the development of complex regional pain syndrome. This disorder is related to pain after surgery and is of too low an incidence to be detected by a study of this size. (Reviewer—David S. Beebe, MD).

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**Keywords:** Femoral Nerve Block, Total Knee Arthroplasty, Postoperative Analgesia

**Print Tag:** Refer to original journal article
The ability of the patient to flex the back and the presence of palpable spinous processes are more important than obesity itself in performing spinal or epidural analgesia for obstetric patients.

**Background:** Obesity is thought to make spinal or epidural anesthesia more difficult in pregnant patients.

**Objective:** To determine if obesity affects the difficulty in performing spinal or epidural anesthesia in pregnant patients.

**Design:** Prospective observational study.

**Participants:** 413 pregnant patients requiring spinal or epidural analgesia or anesthesia.

**Methods:** The time taken to successfully perform the appropriate block was recorded. Height and weight, the degree of maximum back flexion when sitting (convex, straight, or concave), and the ability of the practitioner to palpate the bony landmarks were noted. The type of position (sitting or lateral) and experience of the practitioner (attending or resident) were also noted. Multivariate and univariate analysis was used to determine which factors were associated with difficulty in performing the blocks.

**Results:** Body mass index (BMI) was not in itself associated with difficulty in performing spinal or epidural anesthesia. Rather, the ability of the practitioner to palpate the spinous processes and of the patient to flex the back was associated with ease in performing these 2 procedures no matter what the BMI was. However, an increased BMI did predict both difficulty in palpating the spinous processes and patient ability to flex their back.

**Conclusions:** Back flexion and the ability to palpate landmarks predict difficult spinal or epidural placement in pregnant patients. Obesity may make palpation and flexion more difficult in pregnant patients. However, if landmarks are palpable and the patient can flex her back well, spinal or epidural anesthesia should not be more difficult if a patient is obese.

**Reviewer's Comments:** This study confirms my clinical impression that some obese, pregnant patients are amazingly easy to perform neuraxial blocks upon. Palpation of landmarks and the ability of patients to flex their backs appear to be the most important factors associated with difficult spinal or epidural anesthesia for obstetric patients. (Reviewer-David S. Beebe, MD).

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Keywords: Obesity, Obstetrics, Spinal Anesthesia, Epidural Analgesia

Print Tag: Refer to original journal article
Preventing, Managing a Failed Spinal Anesthesia Block

Fettes PDW, Jansson J-R, Wildsmith JAW:
Br J Anaesth 2009; 102 (June): 739-748

Spinal anesthesia is usually a simple, effective technique, but failure can occur at any time, no matter how experienced the clinician.

**Background:** Spinal anesthesia is commonly used and is a reliable regional anesthesia technique. Failure rates range from 1% to 17%. Failure may be due to wrong technique, wrong approach, and/or inexperience of the provider.

**Objective:** To discuss the mechanisms and techniques of spinal anesthesia, reasons for failure, prevention and care following failed spinal, ways to optimize the block, and procedures available to supplement the block.

**Mechanisms of Failure:** This can occur secondary to failure to obtain cerebrospinal fluid (CSF), known as a dry tap. This can be due to poor positioning of the patient, blocked needle, obesity, wrong plane, patient anxiety, and abnormalities of the spine. This can be overcome by carefully positioning the patient, use of antianxiety techniques/drugs, and use of ultrasound to identify the intervertebral space and increase chance of dural puncture. The dose of the spinal anesthetic solution should be carefully chosen and should be based on weight, height, and obesity-related factors. Also, type of operation, baricity of the drug, and position of the patient will determine dose. One must check aspiration of CSF before injection of the solution. Inadequate drug action is a rare cause. This could be due to incompatible solutions mixed together or loss of potency.

**Management:** A successful spinal anesthetic is one that provides the required somatic and a major degree of autonomic blockade. One must test the block before initiating surgery. A failed spinal may have serious clinical and medicolegal implications and must be carefully evaluated and remedied. Options for a failed block are minimal, and a general anesthetic might be needed for the same, therefore it is essential to prevent failures.

**Prevention:** It is important to monitor the block once initiated, to observe and assess the hemodynamic status, and to interpret it. The longer the block takes to act, the higher chance of a failed block, as usually spinal anesthesia acts rapidly. There can be delayed action, but if there is no block within 15 minutes, alternatives should be considered. If there is a patchy or unilateral block, rapid changes in position will help. Inadequate duration is usually due to inadequate dose. If there is no block, a repeat block might be considered, keeping in mind the possibility of a high spinal and a failed block again if there is an anatomic problem in the space, then an epidural also might not work. One might need to give general anesthesia in cases of failed or inadequate block, but chances of hypotension are higher due to sympathetic block.

**Reviewer’s Comments:** An interesting article helps to identify a failed block, managing it, and methods to prevent it. A meticulously performed block will have higher chances of success. (Reviewer-Sunita Goel, MD).

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Keywords: Spinal Anesthesia, Regional Anesthesia Failure

Print Tag: Refer to original journal article
Hyperbaric bupivacaine at 7 mg provides equally rapid onset and effective anesthesia while reducing the incidence of hypotension in women undergoing cesarean delivery.

**Objective:** To compare clinical characteristics of 3 different intrathecal hyperbaric bupivacaine doses when administered as part of a combined spinal epidural technique.

**Design/Participants:** Prospective, randomized clinical study involving 60 ASA I to II patients with singleton full-term pregnancies presenting for elective cesarean delivery.

**Methods:** Patients were randomized into 3 groups after enrollment (n=20 each). Group 7 received hyperbaric bupivacaine 7 mg and morphine 100 µg intrathecally, group 8 received hyperbaric bupivacaine 8 mg with morphine 100 µg, and group 9 received hyperbaric bupivacaine 9 mg with morphine 100 µg. Patients were evaluated for hemodynamic status and block profile every 2.5 minutes for the first 30 minutes. Block levels, duration of surgery, Apgar scores, and complications were evaluated and recorded. Primary outcome was the maximum cephalad sensory block height.

**Results:** Demographics and baseline patient characteristics were similar in all 3 groups. Group 7’s sensory block height achieved a median height of T2. Group 8 attained a median block height of T2 as well, and group 9 attained a median block height of T1 ($P=0.02$). The time to achieving T4 (adequate block for surgery) was similar in all study groups. None of the patients required additional boluses of epidural local anesthetic. There was no difference in the duration of motor blockade among groups. There were significant differences in the incidence of hypotension between groups 7 and 9 (30% in group 7, 55% in group 8, and 70% in group 9; $P=0.04$). Recovery from lower-limb motor blockade was longer in group 9 compared to groups 7 and 8.

**Conclusions:** Hyperbaric bupivacaine at 7 mg with 100 µg of morphine provided fast and effective induction of surgical anesthesia for cesarean delivery while reducing the incidence of maternal hypotension, compared to 8 and 9 mg.

**Reviewer's Comments:** The biggest limitation of the study is its limited power to detect differences in the need for supplemental epidural anesthesia among the study groups. (Reviewer-K. George Bojanov, MD).

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Keywords: Low-Dose Hyperbaric Bupivacaine, Combined Spinal Epidural Anesthesia, Cesarean Delivery

Print Tag: Refer to original journal article
BIS Values Lower in Intellectually Disabled Children

Lower Bispectral Index Values in Children Who Are Intellectually Disabled.

Valkenburg AJ, de Leeuw TG, et al:


Bispectral index monitor values during the awake state, intraoperative anesthesia, and return of consciousness are significantly lower for intellectually disabled children.

**Objective:** To compare bispectral index monitor (BIS) values at various stages of anesthesia between intellectually disabled and normal children, and to determine BIS discriminative properties between consciousness and unconsciousness for the studied patients and controls.

**Design/Participants:** Prospective, observational study involving 18 intellectually disabled children and 35 control children, aged 2 to 13 years, for elective gastroduodenoscopy alone or gastroduodenoscopy plus percutaneous gastrostomy under general anesthesia.

**Methods:** BIS electrodes were placed immediately before induction of general anesthesia or immediately after loss of consciousness if child resistance was encountered. General anesthesia was induced via either IV or inhalation induction. Intraoperatively, BIS values, landmark events, vital signs, and functions were monitored and recorded. Return of consciousness was identified based on the patient’s preoperative reactions to verbal commands.

**Results:** 10 children in the intellectually disabled group were treated with anticonvulsants for seizure control and 3 with spasmolytics, while none of the patients in the control group were treated with anticonvulsants or spasmolytics. BIS values for intellectually disabled children were significantly lower than those for controls in the awake state, during stable intraoperative anesthesia, and during return of consciousness. The discriminative properties of BIS for the state of consciousness were comparable between groups. BIS cutoff was 65 (sensitivity, 0.81 and specificity, 0.93) for the control group and 47 (sensitivity, 0.73 and specificity, 0.81) for the study group.

**Conclusions:** BIS values are potentially lower in children who are intellectually disabled, carrying a risk that the state of consciousness in those children can be misinterpreted.

**Reviewer’s Comments:** The study does not allow establishing a causal relationship that might explain the lower BIS values in intellectually disabled children due to the small sample size and the heterogeneity in neurological diagnoses and treatments of the group. In addition, a considerable number of awake BIS values for the control group were missing. (Reviewer-K. George Bojanov, MD).

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Keywords: Bispectral Index Values, Intellectually Disabled Children

Print Tag: Refer to original journal article
Cognitive Impairment Common After Sedation for Colonoscopy

Early Cognitive Impairment After Sedation for Colonoscopy: The Effect of Adding Midazolam and/or Fentanyl to Propofol.
Padmanabhan U, Leslie K, et al:


Use of propofol alone does not result in less cognitive impairment at discharge than does use of propofol plus adjuvants.

Objective: To test the hypothesis that, in patients for elective colonoscopy, use of propofol alone would result in less cognitive impairment at discharge than would use of propofol with midazolam and/or fentanyl.

Design/Participants: Prospective, randomized clinical study involving 200 adult ASA I to III patients presenting for elective colonoscopy.

Methods: After consenting, demographic and medical data were recorded, and all patients completed the CogState brief computerized cognitive test battery. Patients were randomized to receive either propofol alone or propofol plus adjuvant drugs (n=100, each group). Desired depth of sedation was response to repeated verbal command. Patients were assessed for recall immediately after emerging from sedation, and cognitive testing was repeated at hospital discharge. Sedative drugs, doses, depth of sedation (observer assessed and bispectral index values), complications, procedure and recovery times, quality of recovery, and patient satisfaction were all recorded for further analysis.

Results: Propofol doses were significantly higher in the propofol alone group than in the propofol plus adjuvants group. There were no clinical differences between groups. Endoscopy times were significantly longer in the propofol alone group, compared to the propofol plus adjuvants group. Treatability was rated as "fair" in 20% of propofol alone patients compared to 10% of propofol plus adjuvants patients. Predictors of "good" treatability were lower ASA physical status and administration of midazolam. Recovery times, times to stage 1 postanesthesia care unit and hospital discharge, and complications were similar between groups. Performance at discharge in all patients declined significantly from baseline for "detection" and "identification" tasks (not significantly different between groups), but not for One Card Learning or One Back tasks. Thirty-seven patients showed clinically significant cognitive decline, with multivariate analysis pinpointing consumption of psychotropic drugs preoperatively and administration of >2 mg midazolam during the procedure as predictors of this decline.

Conclusions: Significant cognitive impairment is common at discharge after elective outpatient colonoscopy. Addition of midazolam and/or fentanyl to propofol did not result in more cognitive impairment and improved the ease of colonoscopy.

Reviewer's Comments: An interesting finding of this study is that the depth of sedation was not a good predictor of treatability. A minor study limitation was that the study was not designed to assess the effects of fentanyl and midazolam separately on the major study outcome. (Reviewer-K. George Bojanov, MD).

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Keywords: Cognitive Impairment, Sedation, Colonoscopy

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Postop Pain Decreased With Gabapentin

A Comparison of Gabapentin and Ketamine in Acute and Chronic Pain After Hysterectomy.

Sen H, Sizlan A, et al:


Gabapentin is beneficial for patients at high risk for developing chronic postoperative pain.

Objective: To test and compare the effects of perioperative ketamine and gabapentin on early and chronic pain after elective hysterectomy.

Design/Participants: Prospective, randomized double-blind study involving 60 patients undergoing elective abdominal hysterectomy with salpingo-oophorectomy.

Methods: Patients were randomly assigned to 1 of 3 study groups (n=20 each). The control group received oral placebo capsules and a bolus plus infusion of saline. The ketamine group received oral placebo capsules and an IV bolus of 0.3 mg/kg ketamine before incision and 0.05 mg/kg per hour ketamine infusion until the end of surgery. The gabapentin group received oral gabapentin 1.2 g and a bolus plus infusion of saline. Postoperative pain, side effects, time to resumption of oral dietary intake, time to unassisted ambulation, and patient satisfaction were assessed and recorded for further analysis. Patients were contacted at 1, 3, and 6 months after discharge and asked about residual postoperative pain and ability to resume normal daily activities.

Results: All groups were comparable with respect to demographics, ASA physical status, duration of surgery, and sedation scores at all time intervals. Pain scores were significantly lower in the gabapentin group compared to the control group at 24 hours postoperatively. The ketamine group had lower pain scores compared to the control group at 16 hours postoperatively. Total morphine requirements were decreased by 35% and 42% in the ketamine and gabapentin groups, respectively, compared to the control group. Return of bowel sounds, flatus, ambulation, and hospitalization times were not significantly different among the 3 study groups. Patient satisfaction with treatment was significantly improved in the ketamine and gabapentin groups. At the 1-, 3-, and 6-month follow-ups, the incidence of incisional pain and pain scores were significantly lower in the gabapentin group compared to the ketamine and control groups.

Conclusions: Gabapentin administered perioperatively was similar to ketamine in improving early postoperative pain and opioid consumption. However, gabapentin provided the benefit of delayed chronic postoperative pain for 6 months postoperatively.

Reviewer's Comments: Preventative multimodal analgesic treatment including ketamine and gabapentin looks to be promising for treatment of acute postoperative pain and possibly could decrease the prevalence of post-surgical chronic pain. A deficiency in this study is the arbitrarily chosen doses of gabapentin and ketamine. (Reviewer-K. George Bojanov, MD).

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Keywords: Gabapentin, Ketamine, Acute & Chronic Pain, Hysterectomy

Print Tag: Refer to original journal article
Gabapentin is effective in reducing acute postoperative pain and anesthetic and analgesic requirements during and after craniotomy for supratentorial tumor resection.

**Objective:** To evaluate the effectiveness of gabapentin on acute postoperative pain when used for antiepileptic prophylaxis in patients undergoing craniotomy for supratentorial tumor resection.

**Design/Participants:** Prospective, randomized clinical study including 80 adult patients undergoing elective supratentorial craniotomy for tumor resection in the supine position.

**Methods:** Patients were randomly assigned to 1 of 2 study groups (n=40 each). Group G received 1200 mg (3 x 400 g) oral gabapentin, while group P received 300 mg (3 x 100 mg) oral phenytoin per day for 7 days before surgery. Intraoperatively, remifentanil and propofol infusions were used and titrated to bispectral index (BIS) scores between 40 and 50, providing stable hemodynamics. In group P, routine scheduled doses of phenytoin were administered IV during surgery. In group G, scheduled doses of gabapentin were administered via a nasogastric tube. Variables followed included duration of anesthesia and surgery, duration of surgical closure, side effects, sedation scores, pain, and analgesic medication consumption in the postoperative care unit.

**Results:** Demographic data, duration of surgery, anesthesia, and surgical closure were similar between groups. Group G had a significantly lower use of propofol and remifentanil compared to group P ($P = 0.01$). In group G, tracheal extubation was significantly delayed compared to that in group P ($P < 0.001$). There was no correlation among the extubation time and duration of anesthesia, surgical closure, and total propofol and remifentanil infusion. Postoperative sedation scores were significantly higher in group G at 15 minutes, 30 minutes, 1 hour, and 2 hours ($P < 0.001$). Postoperative pain scores were significantly higher in group G at 15 minutes, 30 minutes, and 1 hour ($P < 0.001$). Total morphine consumption was significantly higher in group P than in group G at 48 hours postoperatively ($P = 0.01$).

**Conclusions:** Gabapentin was effective in reducing acute postoperative pain and anesthetic and analgesic requirements during and after craniotomy for supratentorial tumor resection.

**Reviewer's Comments:** Gabapentin has several significant side effects including dizziness, fatigue, and ataxia, which caused several patients from the gabapentin group to drop out from the study. Further studies are needed to investigate various doses of gabapentin on postoperative analgesia, nausea, and side effects. (Reviewer-K. George Bojanov, MD).

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Keywords: Gabapentin, Prophylactic Anticonvulsant, Postcraniotomy Pain

Print Tag: Refer to original journal article
For tracheal intubation in patients with rigid collar immobilization, viewing of cords and intubation times are faster with the Airtraq device than with the CTrach.

**Background:** The Airtraq® has an exaggerated curvature of the blade and an internal arrangement of optical components that provide a good view of the glottis without alignment of the oral, pharyngeal, and tracheal axes. The CTrach™ is an intubating laryngeal mask airway (LMA) with an integrated fiberoptic bundle that provides a view of the larynx.

**Objective:** To evaluate the efficacy of these 2 devices in difficult airways.

**Design:** Randomized clinical study.

**Participants:** 86 adult patients undergoing elective surgery requiring tracheal intubation.

**Methods:** Patients were assigned to either Airtraq or CTrach intubation. Anesthetic management was according to protocol. Once the Cormack-Lehane grade was made using the Macintosh laryngoscope, the pillow was removed and a rigid cervical collar was fitted in accordance with the manufacturer’s recommendations. According to randomization, intubation was performed by an anesthetist who had used both devices previously and was successful in at least 10 intubations. However, if tracheal intubation was not achieved within 120 seconds or within a maximum of 3 intubation attempts, the case was considered a failure. Other side effects such as hypoxemia, bronchospasm, regurgitation, and aspiration were recorded as well as vital parameters. Data were analyzed with the chi-squared test and the Mann-Whitney U-test. A \( P < 0.05 \) was considered significant.

**Results:** 86 patients were analyzed, and the 2 groups were comparable. Mean time to obtain a view of the glottis was significantly shorter for the Airtraq than for the CTrach (6.8 vs 16.7 seconds; \( P < 0.001 \)). Intubation time was 13.5 vs 29.3 seconds. Three patients in the Airtraq group needed a second attempt at tracheal intubation, as well as 3 in the CTrach group, due to inability to view the cords.

**Conclusions:** Viewing of cords and intubation times were faster with the Airtraq device than with the CTrach.

**Reviewer’s Comments:** The Airtraq device is very good in cases of difficult intubations, although positioning the tube might be sometimes difficult. Daily practice is very important. The advantage of the Airtraq is that the view is not blurred as it may be with the CTrach, which has an integrated fiberoptic bundle. (Reviewer-Olga Plattner, MD).

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Keywords: Laryngeal Mask Airway, CTrach™, Airtraq®, Tracheal Intubation

Print Tag: Refer to original journal article
For endotracheal intubation in children, cuffed tubes have a much higher chance in fitting at first attempt than do uncuffed tubes.

**Background:** Use of cuffed tubes in children is controversial due to the fear of mucosa injury. **Objective:** To compare post-extubation injury and intubation attempts between cuffed and uncuffed tracheal tube (TT) insertion in children. **Design:** Prospective, randomized, multicenter clinical study. **Participants:** 2246 children aged 0 to 5 years. **Methods:** 24 European pediatric anesthesia centers participated. Anesthesia management was according to guidelines and standards of local departments. Cuffed TT sizes were selected as follows: ID 3.0 mm for age 0 (>3 kg body weight) to <8 months; ID 3.5 mm for age 8 to <18 months; ID 4.0 mm for age 18 to <36 months; and ID 4.5 mm for age 36 to <60 months. Uncuffed TT sizes were selected according to local hospital guidelines. Intubation was performed without any stylet or bougie orally or nasally. In the case of resistance, a TT of 1 size smaller was used. Minimal sealing pressure was assessed under steady-state ventilation conditions and were maintained during the procedure. The minimal cuff pressure required to seal the airway and quality of sealing were recorded. Intubation time, leak pressure, peak inspiratory pressure, use of throat package, and number of TT exchanges were recorded. Extubation was performed awake or asleep. Occurrence of stridor or laryngospasm was recorded as well as postoperative pain, secretions, or airway obstruction. Data were analyzed with Student's t-test, Mann–Whitney U-test, and chi-squared analysis. **Results:** 2246 children were investigated. The TT exchange rate was 2.1% in the cuffed group and 30.8% in the uncuffed group ($P < 0.0001$). Capnography was reliable in 98.6% in the cuffed group compared to 95.6% in the uncuffed group. Postoperative stridor was noted in 4.4% in the cuffed group compared to 4.7% in the uncuffed group. **Conclusions:** Cuffed tubes have a much higher chance in fitting at first attempt than do uncuffed tubes, and they have no increased risk for post-extubation stridor. **Reviewer's Comments:** Use of high-volume and low-pressure cuffed tubes in small children is becoming routine because traumatization via tube exchange is less, as well as postoperative mucosal damage, when monitoring cuff pressure is done intraoperatively. The microcuffed endotracheal tube is particularly of benefit in this regard. (Reviewer–Olga Plattner, MD).
Magnesium Sulphate -- Role During General Anesthesia for C-Section

Magnesium Sulphate Has Beneficial Effects as an Adjuvant During General Anaesthesia for Caesarean Section.

Lee DH, Kwon IC:

Br J Anaesth 2009; 103 (December): 861-866

In this study, preoperative Mg sulfate attenuated the BIS and anesthesia requirements during Cesarian section delivery via general anesthesia.

**Background:** Magnesium sulphate has been used as a tocolytic and anticonvulsant drug. It has also been reported that it reduces anesthetic requirements.

**Objective:** To determine whether the anesthetic and analgesic potency is beneficial in patients having elective Cesarian section.

**Design:** Prospective blinded randomized clinical study.

**Participants:** 75 patients having an elective Cesarian section.

**Methods:** Patients were randomly assigned into 1 of the following groups: the Mg 30 group (n=25) received magnesium sulfate 10% (30 mg/kg) as an IV bolus and 10 mg/kg by a continuous infusion, the Mg 45 group (n=25) received magnesium sulfate 10% (45 mg/kg) as an IV bolus and 10 mg/kg by a continuous infusion, and the control group (n=25) received the same volume of saline as a bolus and as a continuous infusion. Before induction of anesthesia, monitoring including the bispectral index (BIS) was applied. After baseline values of the BIS and hemodynamics, routine induction was performed and the study drug by continuous infusion was given by the blinded anesthesiologist. Anesthesia was maintained after intubation with sevoflurane in oxygen and N₂O 1:1. After delivery, midazolam or fentanyl was administered as required. The target BIS was 40 to 60. If BIS exceeded 60, midazolam 0.05 mg/kg was administered. Analgesia was defined as the condition during which the blood pressure or the heart rate increased by 20% from the baseline requiring 1.0 µg fentanyl for management. Anesthesia was performed according to the protocol and extubation was performed when BIS reached 80 and patients recovered spontaneously. All data were recorded by a blinded anesthetist. The primary outcome was the BIS value between the groups, and a P <0.05 was considered significant. Furthermore, the requirements of fentanyl, midazolam, and atracurium were analyzed as well as the mean arterial pressure (MAP).

**Results:** BIS values were higher 10 minutes after surgery and before delivery in the control and the Mg 30 group compared to the Mg 45 group. The MAP was also higher in the control group and the requirements of midazolam, fentanyl, and atracurium were also higher in the control than in the Mg groups.

**Conclusions:** Mg sulfate attenuated the BIS and anesthetic requirements.

**Reviewer's Comments:** Mg sulphate is also used in pre-eclamptic patients and often the effect on the anesthetic requirement is underestimated and results in hangover, especially prolonging the duration of muscle relaxants. (Reviewer-Olga Plattner, MD).

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Keywords: Magnesium Sulphate, Cesarean Section

Print Tag: Refer to original journal article
Tracheal intubation in patients wearing a semi-rigid collar and having their head taped to the trolley is possible with the help of the GlideScope.

**Background:** A number of intubating devices have been developed to facilitate the management of the difficult airway.

**Objective:** To evaluate the efficacy of the GlideScope®.

**Design:** Prospective clinical study.

**Participants:** 50 patients undergoing elective surgery requiring tracheal intubation were evaluated. Preoperative parameters such as inter-incisor distance and neck circumference were recorded. After anesthesia induction and mask ventilation, the neck was immobilized with a special semi-rigid collar. The head was taped to the trolley and the maximal mouth opening was recorded again. Laryngoscopy was attempted with a Macintosh laryngoscope blade 4 and Cormack-Lehane grade was noted. The laryngoscopy was repeated with the GlideScope and the Cormack-Lehane grade was noted and the intubation time was recorded. Vital parameters were recorded. Intubation was considered as a failure if it could not be accomplished within 3 minutes and in the event of desaturation (SpO₂ <95%). The intubation procedure with the GlideScope was recorded and the laryngeal view was evaluated and scored separately by 2 principal investigators. Chi-square test was used for data analysis. The intubation success rate and the Cormack-Lehane grade at direct laryngoscopy and with the GlideScope were analyzed as well as the intubation time.

**Results:** All patients were successfully intubated. The Cormack-Lehane grade improved from 3 or 4 with direct laryngoscopy to 2a in most patients. Intubation median time was 50 seconds (43 to 61 seconds). Forty-eight patients were intubated at first attempt; 2 required 2 attempts. No damage to the teeth or lips was documented.

**Conclusions:** Tracheal intubation with the GlideScope was successful in patients with a Cormack-Lehane score via direct laryngoscopy of 3 or 4. The poor vision of the vocal cords was achieved through the application of a semi-rigid cervical collar.

**Reviewer’s Comments:** The new intubating devices such as the GlideScope and others are successful in managing the difficult airway if the procedure is done by doctors who routinely use these devices and not just in an emergency case. (Reviewer-Olga Plattner, MD).

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Keywords: GlideScope®, Tracheal Intubation, Cervical Spine Immobilization, Semi-Rigid Collar

Print Tag: Refer to original journal article