



## Avoiding General Anesthesia for a Patient with Severe Pulmonary Compromise

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### Abstract

Patients with severe pulmonary disease are sometimes denied necessary surgical procedures given the foreseen perioperative complications of general anesthesia, including respiratory failure, atelectasis, and pneumonia. Little data has been reported on the use of neuraxial anesthesia in attempt to avoid general anesthesia and the associated use of muscle relaxants and endotracheal intubation in this patient population. Our case report demonstrates the use of epidural anesthesia with the complete avoidance of general anesthesia in a patient with severe pulmonary disease, undergoing a hemicolectomy and end ileostomy for a high-grade adenocarcinoma of the colon.

### Introduction

All patients undergoing general anesthesia are at risk for perioperative pulmonary complications in the form of respiratory failure, pneumonia, and atelectasis. Furthermore, major abdominal surgery in the setting of underlying Chronic Obstructive Pulmonary Disease (COPD) places patients at a significantly increased risk of such complications, especially in the postoperative period. Sources have suggested that the avoidance of general anesthesia may mitigate some degree of the above mentioned pulmonary decline [1]. Other benefits that have been appreciated by this approach include superior hemodynamic stability [1,2]. Our case demonstrates a technique to avoid general anesthesia with the primary goal of avoiding additional insult in a patient with preexisting severe respiratory disease.

### Case Presentation

A 72-year-old male presented with a colonic mass at the hepatic flexure requiring surgical intervention. His past medical history was most notable for severe COPD and Coronary Artery Disease (CAD). Recent pulmonary function testing showed that both the Forced Expiratory Volume in 1 second (FEV1) and Forced Vital Capacity (FVC) were 0.75 liters (L) and 1.7 L, respectively. The FEV1/FVC ratio was 43%. The patient was compliant with his pulmonary medications, which included albuterol, ipratropium, tiotropium, and prednisone. He was previously denied surgical intervention at another institution citing a high risk of perioperative pulmonary complications. After evaluating the patient, our team elected to offer surgery with Neuraxial Anesthesia (NA) as the primary anesthetic. We discussed our concerns and the consideration for NA with both the surgeon and patient. All parties were cooperative and understanding of the benefits and limitations. We took the patient to the operating room and provided supplemental oxygen via facemask. Standard monitors were placed. An epidural catheter was placed in the lumbar area, at the L1-L2 interspace, to minimize thoracic compromise, cardiac accelerations, and extensive sympathectomy in the setting of CAD. Twenty-five milligrams of bupivacaine 0.25% were injected via the epidural catheter. This provided anesthesia to the T6 dermatomal distribution at 15 minutes. Midazolam sedation was provided. A dose of fentanyl 100 micrograms was provided via the epidural catheter for intraoperative analgesia at the commencement of the procedure. An open right hemicolectomy and end ileostomy was completed in 60 minutes by the surgeon without complication. The epidural catheter was kept in place for post-operative analgesia. No perioperative pulmonary decline was noted. The epidural was removed on post-operative day three and his respiratory status remained stable throughout his hospital stay.

### Discussion

Many patients with severe pulmonary compromise are denied surgery, as they are prone to further functional decline in the postoperative period. GA induction and intubation results in the

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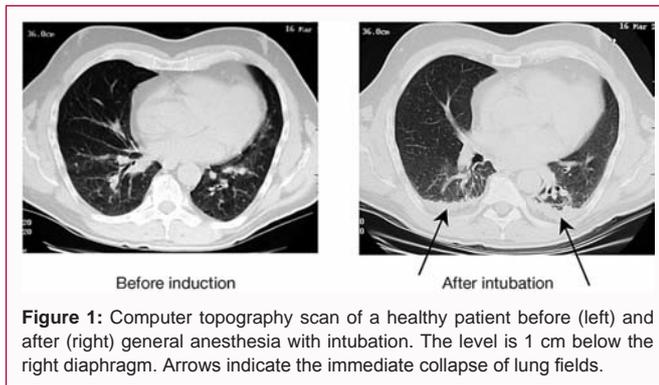
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**Figure 1:** Computer topography scan of a healthy patient before (left) and after (right) general anesthesia with intubation. The level is 1 cm below the right diaphragm. Arrows indicate the immediate collapse of lung fields.

immediate dependence of mechanical ventilation. GA also places the patient at risk for bronchospasm, V/Q mismatch, pneumothorax, and respiratory depression from residual anesthetic and muscle relaxant. In comparison, although not completely benign, NA can mitigate some of these risks. For example, the decrease in functional residual capacity brought by abdominal surgery is less profound under NA in that diaphragmatic function and chest wall compliance are improved. Conversely, NA can negatively influence  $FEV_1$  secondary to diminished abdominal muscle tone. This may result in the reduction of coughing and also the clearance of pulmonary secretions. However, aggressive pulmonary toilet in the perioperative time period can help overcome these issues [3,4].

In a review by Groeben, the physiological effects of neuraxial anesthesia are outlined. With a sensory blockade between the T1-T5 dermatomes provided by a thoracic epidural, there was a decrease in vital capacity (VC) of 5.6% and a decrease in  $FEV_1$  of 4.9% from baseline. Furthermore, a wider blockade between the C4-T7 dermatomes resulted in a decrease in VC of 25% and decrease of  $FEV_1$  of 13%. Though the epidural anesthesia did change these parameters significantly, the decreases were not detrimental in the clinical setting [5]. In comparison, with patients undergoing cholecystectomy with GA alone, there was a decrease in  $FEV_1$  by 55% [6].  $FEV_1$  is reflective of the ability to cough, which is an important postoperative measure of lung function and in the clearance of secretions. During the recovery period from GA,  $FEV_1$  is further compromised by residual muscle relaxant, which decreases the patient's ability to cough. Conversely, when employing NA as the sole anesthetic, muscle relaxant is avoided and thus eliminates the dramatic negative impact on  $FEV_1$ .

Even when NA is employed in the setting of GA, patients were able to perform VC and  $FEV_1$  tests one hour after extubation, while patients with GA alone could not [5]. This is significant in that it suggests the earlier return of baseline pulmonary function.

After abdominal surgery, there is a reduction in VC by at least 60%. Using thoracic epidural anesthesia has shown improvements of Functional Residual Capacity (FRC) from 21.7 % to 15.9% and reduced the diminished VC from 63% to 45%. The mechanism behind this include superior pain control and the minimization of opioid pain medication, as well as improved diaphragmatic function secondary to the blockade of reflexes that inhibit diaphragm function after an abdominal surgery [7]. In turn, patients are able to take deeper breaths, cough, and participate in physiotherapies, such as incentive spirometry [7]. Pulmonary gas exchange is also impaired when using GA due to intrapulmonary shunting secondary to atelectasis and V/Q mismatch. This is shown on computerized tomography as collapsing of lung fields that occurs immediately after GA and intubation (Figure

1). Theoretically, regional atelectasis may result when employing neuraxial techniques. This is secondary to both decreased muscle tone and diaphragm movement. However, there is evidence that GA with the addition of NA had no increase of V/Q mismatch or gas exchange impairment [6]. Additionally, even when high thoracic epidural anesthesia is used, there is no difference in arterial-alveolar gradient or in the measure of direct shunt [5].

Patients with severe COPD already have a diminished  $FEV_1$ . There is concern that NA decreases VC and further depresses  $FEV_1$ . Nonetheless, the data suggests that the reduction in  $FEV_1$  in patients with COPD compared to those free of pulmonary disease (8-10%) is much less [5].

More recently, Guay published an article comparing the effects of NA and GA on perioperative and postoperative morbidity and mortality, including death, chest infections, myocardial infarction and serious adverse event outcomes. All Cochrane Reviews that were included in this study spanned from the use of NA with or without GA to GA alone in adult patients with intermediate or high cardiac risk. Notable was the reduction in 0 to 30 day mortality in the setting of NA in comparison with GA and a decreased risk of pneumonia with NA compared to GA [3]. Another advantage of epidural anesthesia is that it blunts the stress response, during and after surgery, and decreases the resulting inflammatory and coagulation pathways associated with it. In turn, there is a reduction in the likelihood accompanying sequelae, such as thromboembolic complications, myocardial ischemia and infarction, impaired pulmonary function, ileus, fatigue, postoperative infection and postoperative confusion [7].

Determining the appropriate patient population to direct NA as the primary anesthetic is significant. It appears from our review that given the pulmonary benefits, patients with severe lung disease may benefit from this strategy. Thus, determining the chances of a postoperative pulmonary complication would be of help. Canet performed a prospective, multicenter, observational study with intents of developing a predictive index for postoperative pulmonary complications. Seven statistically significant independent predictors including low preoperative arterial oxygen saturation, acute respiratory infection in the previous month, age, preoperative anemia, upper abdominal or intrathoracic surgery, surgical duration of two or more hours, and emergent surgery [8]. This gave rise to the ARISCAT risk index, which developed a point system using the seven independent risk factors determined by the study. The incidences of pulmonary complications correlate as 1.6% in low scoring patients, 13.3% in intermediate scores and 42.2% in high scores. Utilizing this assessment may be useful in deciding the patients that can benefit from NA as opposed to GA [8].

Ultimately, the literature analyzing the use of NA with the complete avoidance of GA is greatly limited. In our search, two other cases were reported where GA was avoided and regional or combined lumbar spinal-thoracic epidural anesthesia was used with successful outcomes and no adverse pulmonary events; yet, neither utilized a neuraxial technique as the primary anesthetic [2,9]. Much of the research in this area includes a population which has undergone epidural anesthesia in combination with general anesthesia. In addition, many of the studies are small in sample size and outdated [10]. Large randomized multicenter studies are needed to determine if there is a true benefit in using NA to avoid pulmonary compromise in patients with severe COPD.

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