

**Case Report**

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# Remifentanyl-Induced Respiratory Failure in PACU after a Brainstem Tumor Debulking: Acute Diagnostic Dilemma



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## Abstract

A 66 year old man developed sudden apnea and unresponsiveness after a large cerebellopontine angle tumor debulking. Based on the findings of a focused neurologic exam, the patient was emergently mask ventilated with subsequent return of spontaneous ventilation minutes later and recovery without further complications. Remifentanyl bolus from residual infusion in an IV line was suspected due to rapid return to baseline and acute neurologic findings. We review remifentanyl and highlight a challenging diagnostic dilemma in an acutely apneic patient after major neurosurgery.

**Keywords:** Remifentanyl; Neuroanesthesia; Post-op respiratory failure; Neurologic Emergencies

## Key Messages

- A focused neurologic exam can affect emergent management.
- A high index of suspicion and staff education are necessary for those involved in the care of patients receiving remifentanyl.

## Introduction

Remifentanyl is a potent, ultra short-acting  $\mu$ -opioid receptor agonist with a rapid onset of action in 30-60 seconds, peak analgesic and respiratory effects within 2.5 minutes (min), and rapid clearance ( $T_{1/2} = 3$  min) [1]. It is commonly used as part of a balanced anesthetic in many anesthesia practices as well as in the intensive care unit. Its use is particularly prominent in neuroanesthesia, where precise hemodynamic control is as important as a crisp, quick emergence of anesthesia to facilitate neurologic evaluation. Respiratory depression is a common severe adverse effect of opioids that may be most prevalent with remifentanyl [2].

## Case History

A 66 year old man with a large acoustic neuroma presented for cerebellopontine (CP) angle tumor resection (Figure 1). Neuromonitoring of cranial nerves IX, X, XI, XII, somatosensory evoked potentials and motor evoked potentials was used during the case, while the patient received an intravenous anesthetic consisting of propofol 100mcg/kg/min and remifentanyl at 0.3mcg/kg/min. Neuromuscular blockade was not used for the case. The surgery progressed without complication, and the

patient was stable throughout. The case lasted 7.5 hours, and propofol and remifentanyl were discontinued 60min and 15min prior to conclusion of case, respectively. The patient was able to spontaneously ventilate, protrude tongue, and demonstrate intact cranial nerves IX and X with gag reflex prior to extubation.

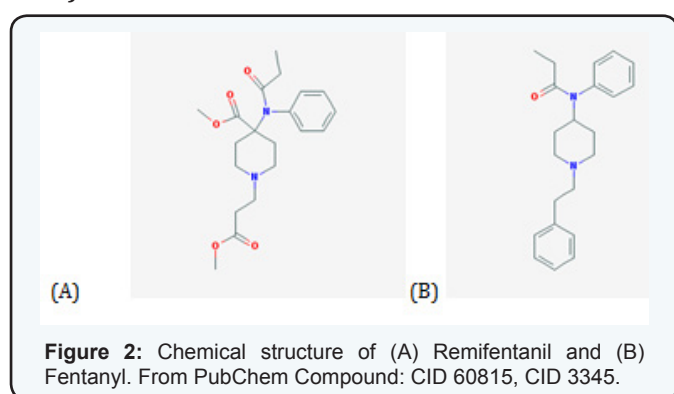


**Figure 1:** Magnetic resonance image of patient's acoustic neuroma.

In the PACU, the patient was awake and following commands. Shortly after administration of flush through a secondary peripheral IV, the patient acutely closed his eyes, becoming unresponsive and apneic. Rapid physical exam to check for increased intracranial pressure given the setting of recent intracranial surgery demonstrated the patient's pupils were actually pinpoint. The patient was then mask-ventilated until spontaneous ventilation returned several minutes later. Pinpoint pupils and rapid recovery makes a remifentanyl bolus from residual infusion in the second IV line the most likely etiology. Patient recovered without further difficulty and was discharged home 3 days later.

## Discussion

### Remifentanyl review



Remifentanyl is a potent selective  $\mu$ -opioid agonist. Its major distinction from other fentanyl analogues is its rapid onset and short duration of action with a terminal elimination half-life of 3-10 min, usually negating the need for Naloxone reversal [3]. The rapid onset of action is directly related to the rapid blood brain equilibration time of 1-2 minutes, while the short duration of action is a result of its unique structure of ester linkages making it susceptible to hydrolysis by blood and non-specific esterases (Figure 2). This rapid extra-hepatic metabolism makes its pharmacokinetics reproducible and dependable. Time to spontaneous movement, following commands, and extubation are all shorter than when compared with other opioids such as fentanyl and morphine. These pharmacokinetic and pharmacodynamic characteristics make remifentanyl a nearly ideal analgesic in the operating room. However, due to its short duration of action, patients receiving remifentanyl frequently require rescue analgesia in the postoperative period for pain management [4].

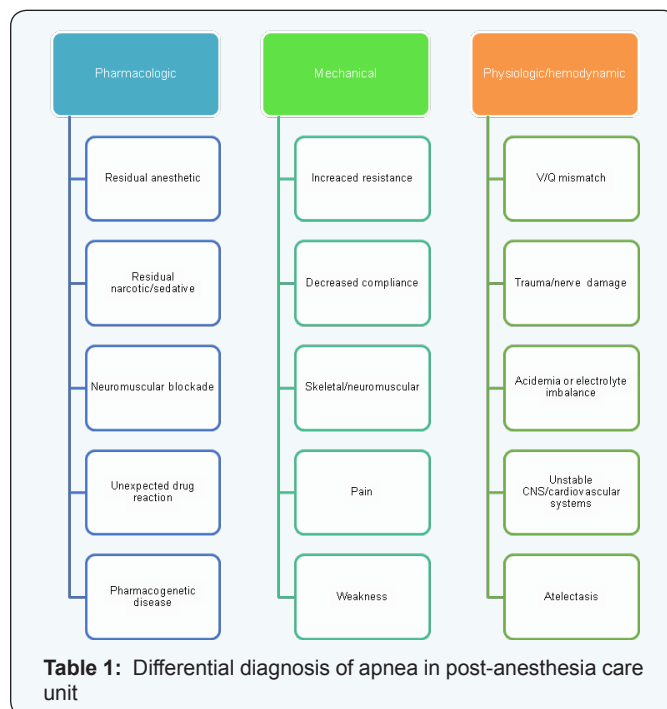
Remifentanyl is rapidly metabolized regardless of the duration of infusion and is used commonly in clinical situations requiring a rapid offset with the benefit of minimal side effects such as respiratory depression [5]. While the risk for respiratory depression still exists, the ability to rapidly titrate the drug based on response allows for an overall lower rate when compared to most other opioids. In neuroanesthetic cases, it is commonly used in conjunction with propofol as part of a total intravenous anesthetic. It is easily titratable, facilitates

stable hemodynamics, and minimally affects neuro-monitoring. Perhaps most importantly, this total intravenous anesthesia combination can allow for rapid emergence and the ability to perform post-operative examination for neurological status shortly after conclusion of the case [2].

### Clinical experience

Rapid bolus of remifentanyl can result in potentially life threatening respiratory depression, hemodynamic changes, or muscle rigidity. Respiratory depression has been documented in case reports after bolus in laboring patients with patient controlled analgesia [6] as well as in non-obstetric patients receiving remifentanyl [7]. This appears to be even more pronounced and observed at lower doses in patients greater than 60 years old. Even infusions as low as 0.05mcg/kg/min have been reported to cause changes in ventilatory drive in healthy volunteers. Muscle rigidity, likewise, is a concerning complication of opioids that can lead to decreased ventilation and compliance resulting in hypoxia and hypercapnia. It is suggested that difficult ventilation may be primarily due to vocal cord closure. Remifentanyl, however, primarily affects respiratory drive by activating opioid receptors on the respiratory neurons in the brainstem. By depressing the respiratory drive, the arterial carbon dioxide not only increases but increases in oxygen consumption and intracranial pressure are to be expected [8]. Muscle rigidity however can be prevented with pretreatment or concurrent administration of neuromuscular blockade [9].

### Apnea



Our case brings up the challenge and importance of differentiating causes of sudden apnea and mental status change in the immediate post-operative period. The differential for postoperative respiratory failure is large and includes

pharmacologic, hemodynamic and mechanical causes (Table 1). In addition to those listed, the patient's comorbidities may be one of the most fundamental things to consider. In the setting of recent intracranial surgery, both opioid overdose and intracranial pathology and dysfunction such as increasing intracranial pressure and seizures are important considerations. Cerebellopontine angle procedures are technically challenging and carry significant risk for postoperative bleeding, increasing intracranial pressure, venous insufficiency and cranial nerve palsy. Physical exam, including neurological exam, may be the most useful and potentially life-saving in this case.

**Prevention**

Prevention is a keystone of patient care, and the use of more dilute concentrations of remifentanyl and initiating rapid resuscitation with possible muscle relaxation have been identified as ways to decrease the chance of similar events from occurring (Table 2). Remifentanyl is a very useful opioid in a variety of settings for controlling autonomic responses during procedures and allowing for rapid recovery [2,5]. However, its dangers as a bolus should be known to healthcare providers and ancillary staff so appropriate identification and supportive care can be initiated as soon as a problem is identified.

**Table 2:** Patient safety after opioid infusions.

Continuous monitoring in post-anesthetic care units
Use of lowest concentration of opioid possible for infusions
Flush residual opioid from infusion lines prior to extubation
If possible, discontinue lines used for infusion
Educate support staff for signs of sudden opioid overdose
Rapid initiation of ACLS with readily available equipment (may include neuromuscular blockade) if needed

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**References**

- Babenco HD, Conard PF, Gross JB (2000) The pharmacodynamic effect of a remifentanyl bolus on ventilatory control. *Anesthesiology* 92(2): 393-398.
- Dahan A, Aarts L, Smith TW (2010) Incidence, reversal, and prevention of opioid-induced respiratory depression. *Anesthesiology* 112(1): 226-238.
- Gesztesi Z, Mootz BL, White PF (1999) The use of a remifentanyl infusion for hemodynamic control during intracranial surgery. *Anesth Analg* 89(5): 1282-1287.
- Komatsu R, Turan AM, Orhan-Sungur M, McGuire J, Radke OC, et al. (2007) Remifentanyl for general anaesthesia: a systematic review. *Anaesthesia* 62(12): 1266-1280.
- Hogue CW, Bowdle TA, O'Leary C, Duncalf D, Miguel R, et al. (1996) A multicenter evaluation of total intravenous anesthesia with remifentanyl and propofol for elective inpatient surgery. *Anesth Analg* 83(2): 279-285.
- Bonner JC, McClymont W (2012) Respiratory arrest in an obstetric patient using remifentanyl patient-controlled analgesia. *Anaesthesia* 67(5): 538-540.
- Shaikh N, Hanssens Y, Louon A (2011) Remifentanyl apnea: Case report and review of the literature. *J Anaesthesiol Clin Pharmacol* 27(4): 553-555.
- Fukuda K. Opioids (2005) In: Miller (ed.), *Miller's Anesthesia* 781.
- Nakada J, Nishira M, Hosoda R, Funaki K, Takahashi S, et al. (2009) Priming with rocuronium or vecuronium prevents remifentanyl-mediated muscle rigidity and difficult ventilation. *J Anesth* 23(3): 323-328.



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