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The Diagnosis of Fentanyl-Induced Chest Wall Rigidity: A Case Report

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Background: Fentanyl is a widely used opiate drug because of its rapid-acting sedative and analgesic effects. Fentanyl is often used for procedural sedation due to its favorable pharmacokinetics.

Case Report: We report the case of a woman who developed the uncommon complication of fentanyl-induced chest wall rigidity or wooden chest syndrome following the administration of low-dose fentanyl during an elective pain procedure in the absence of commonly described risk factors. Her clinical presentation included total body muscle rigidity along with difficulty with ventilation. Her condition was ultimately reversed with prompt administration of intravenous naloxone.

Conclusions: Our case reveals that fentanyl-induced chest rigidity is a rare but important adverse event that can potentially occur to any patient. An understanding and awareness of this phenomenon is necessary for all health care providers who may utilize fentanyl for procedural sedation in their practices.

Key words: Wooden chest syndrome, conscious sedation, fentanyl, ambulatory surgery, chest wall rigidity

BACKGROUND

Fentanyl is a widely used opiate drug because of its rapid-acting sedative and analgesic effects (1). Fentanyl-induced chest wall rigidity, otherwise known as wooden chest syndrome (WCS), is a lesser-known complication characterized by chest wall muscle rigidity, jaw clenching, stiff limbs, and episodes of breath-holding (2). Assisted ventilation efforts are subsequently met with high resistance due to decreased chest wall compliance. WCS is an alarming adverse effect that can lead to respiratory failure if not addressed in a timely manner. This case reports a woman who develops fentanyl-induced chest wall rigidity used for conscious sedation in the setting of a previously well-tolerated outpatient pain procedure and in the absence of commonly associated risk factors, such as extremes of age, critical illness, and high-dose administration.

Written Health Insurance Portability and Accountability Act authorization has been obtained from the patient for the publication of this case report.

CASE PRESENTATION

A 52-year-old, 141 lb woman presented for a right C3/C4, C4/C5 facet level medial branch radiofrequency ablation for chronic axial neck pain secondary to cervical facet arthropathy. Her past medical history consisted of chronic migraines for which she received Botox injections one month prior. The patient had successfully undergone the same procedure 6 months ago and with the same amount of intravenous (IV) sedation given. She denied any previous issues associated with sedation or the procedure.

The patient was placed in the prone position during the procedure. Time out was performed to verify patient, indicated procedure and laterality, allergies, and any special circumstances. Sedation medications of 2 mg of midazolam and 50 mcg of fentanyl were administered after verbal confirmation. Anteroposterior view of the spine was obtained with fluoroscopy, and entry sites were marked over the skin and lidocaine 1% was used to anesthetize the skin and subcutaneous tissues. A 20G 3.5-inch curved tip, insulated, radiofrequency

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needle was introduced, and the needle was placed onto the lateral aspect of the midarticular pillar at C3 on the right. Correct placement was confirmed with a lateral fluoroscopic view. At that time, the patient's blood pressure (BP) was noted to be 118/70, heart rate 55, and oxygen saturation (O2 Sat) 99%. Subsequent needles were placed in identical fashion at the C4 and C5 levels. During needle placement at C5, the patient endorsed increased procedural pain; therefore, a second bolus of 50 mcg fentanyl was given.

Two minutes after the second bolus was given, the patient was noted to desaturate into the 60s with subsequent hypotension with mean arterial pressure in the 50s. The patient was also nonresponsive. The procedure was immediately aborted, and the patient was turned supine. Physical examination at this time was significant for hand and jaw clinching, extended limb posturing, facial cyanosis, and apnea. Supplemental O2 was increased to 6 L nasal cannula and further airway support was attempted with a bag valve mask; however, ventilation was unsuccessful due to chest and abdominal rigidity. Oral airway insertion was met with resistance due to inability to open the patient's mouth. At this time, 0.4 mg of IV naloxone was given. Sixty seconds after administration, the patient's muscle rigidity improved, and she became alert with improved Sat and BP. She was taken to the postanesthesia care unit for post-op monitoring for 2 hours and discharged home uneventfully.

The patient approved reporting of the case.

CONCLUSIONS

Fentanyl has become one of the most-used drugs in anesthesia and has risen in popularity since the 1950s due to its potency, limited side-effect profile, and wide range of administration techniques (3). Most often used intravenously in the intraoperative setting, it is a valuable medication for treating pain in modern medicine. Given its potent and rapid-acting effects, clinicians should monitor for complications of fentanyl overdose with great care.

WCS is an acute and potentially fatal respiratory complication of opioid use if not addressed in a timely manner. Fentanyl is a lipophilic synthetic opioid with high-binding affinity for the m-opioid receptor (MOR). While the mechanism behind WCS is not clearly elucidated, studies suggest that agonism at the MOR in the locus coeruleus of the brainstem results in activation of a-adrenergic receptors (4). Subsequent dopaminergic pathway activation may lead to skeletal muscle contraction and rigidity seen in WCS, making assisted ventilation more difficult (4,5). In our case, her decreased chest wall compliance would not allow for positive pressure ventilation using an AMBU bag. Her stiffened jaw also created resistance with oropharyngeal airway insertion. Resistance to ventilation efforts can abruptly cause respiratory failure in the patient, so interventions to reduce chest wall tone should be done quickly and effectively.

The most common option for management of WCS is IV naloxone, an opioid antagonist often used in narcotic overdose. Side effects of naloxone, such as withdrawal symptoms, worsening laryngospasm, and pulmonary edema, should be considered when deciding a treatment plan for WCS (2,5). Our patient's muscle rigidity improved rapidly after administrating IV naloxone and was discharged home with no further issues. If WCS symptoms do not improve after giving naloxone, neuromuscular blocking agents, such as rocuronium or succinylcholine, can serve as interventions to decrease muscle tone (2,5).

Development of WCS is more commonly seen in cases of critical illness, of high-dose or rapid fentanyl administration, with populations at the extremes of age, such as neonates and geriatric patients, or with concomitant use of medications affecting dopamine levels (6). Critically ill patients' conditions cause variability in fentanyl's metabolism and pharmacokinetics (7) and increase their sensitivity to the drug. Both neonates and elderly patients have lower clearance for fentanyl from the body (7,8). This middle-aged patient developed WCS with slow, low-dose fentanyl administration (1.56 mcg/kg total given over the course of 15 minutes) even though she lacks the aforementioned risk factors and has tolerated similar doses of fentanyl just 6 months prior. Interestingly, too, she developed facial rigidity and stiffness despite receiving Botox injections for her migraines just one month ago, which suggests the idea that the phenomena are not linked to acetylcholine at the neuromuscular junction.

Our case emphasizes that fentanyl-induced chest rigidity is a rare but important adverse event that can occur to all patients, even in the absence of common risk factors. Furthermore, prior tolerance of fentanyl administration does not exclude the possibility. While an understanding and awareness of this phenomenon is more common for anesthesiologists, other interventionalists, such as physiatrists and neurologists, should

be aware of this and its subsequent management who may utilize fentanyl for procedural sedation in their interventional practices. It is also important to have medications to treat this phenomenon readily available in settings where fentanyl is used.

Patient Perspective

We informed the patient of this intraoperative event following her procedure. Although she did not know about WCS previously, she understood our reason to abort her ablation when this complication occurred. She was greatly appreciative of the attentive and efficient care she received while under sedation and agreed that this phenomenon should be made more aware to interventionalists using fentanyl for procedural sedation.

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