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## CLINICAL INFORMATION

# Inadvertent injection of succinylcholine as an epidural test dose



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### KEYWORDS

Succinylcholine;  
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Diazepam

### Abstract

**Background and objectives:** Epidural action of neuromuscular blocking agents could be explained under the light of their physicochemical characteristics and epidural space properties. In the literature there are few cases of accidental neuromuscular agent's epidural administration, manifesting mainly with neuromuscular blockade institution or fasciculations. **Case report:** We report a case of accidental succinylcholine administration as an epidural test dose, in a female patient undergoing scheduled laparotomy, under combined general and epidural anesthesia. Approximately 2 min after the succinylcholine injection the patient complained for shortness of breath, while mild fasciculations appeared in her trunk and face, managed by immediate general anesthesia institution. With the exception of a relatively longer duration of neuromuscular blockade compared with intravenous administration, no neurological or cardiovascular sequelae or other symptoms of local or systemic toxicity were observed. **Conclusions:** Oral administration of diazepam seems to lessen the adverse effects from accidental epidural administration of succinylcholine. The meticulous and discriminative labeling of syringes, as well as keeping persistent cautions during all anesthesia procedures remains of crucial importance.

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### PALAVRAS-CHAVE

Succinilcolina;  
Administração  
epidural;  
Acidental;

### Injeção inadvertida de succinilcolina como uma dose teste epidural

### Resumo

**Justificativa e objetivos:** A ação epidural de agentes bloqueadores neuromusculares pode ser explicadas à luz de suas características físico-químicas e propriedades do espaço epidural. Na

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Agentes bloqueadores neuromusculares;  
Fasciculações;  
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literatura existem poucos casos sobre a administração acidental em espaço epidural de agente neuromuscular, manifestando-se principalmente com a instituição de bloqueio neuromuscular ou fasciculações.

*Relato de caso:* Relatamos um caso de administração acidental de succinylcholine como uma dose teste epidural em uma paciente submetida à laparotomia programada, sob anestesia combinada geral e peridural. Aproximadamente dois minutos após a injeção de succinylcholine, a paciente queixou-se de falta de ar, enquanto fasciculações leves apareceram em seu tronco e rosto, tratadas com a instituição imediata de anestesia geral. Exceto pela duração relativamente longa do bloqueio neuromuscular em comparação com a administração intravenosa, sequelas neurológicas ou cardiovasculares ou outros sintomas de toxicidade local ou sistêmica não foram observados.

*Conclusões:* A administração oral de diazepam parece diminuir os efeitos adversos da administração epidural acidental de succinilcolina. A meticulosidade e discriminação dos rótulos das seringas, bem como os cuidados persistentes mantidos durante todos os procedimentos de anestesia continuam sendo de importância crucial.

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## Background and objectives

In the history of regional anesthesia techniques, a variety of anesthetic drugs and other substances have been accidentally injected into epidural space, with consequences ranging from no clinical symptoms to irreversible neurological deficit.<sup>1-4</sup> In the literature there are few reports of accidental epidural administration of different types of non-depolarizing neuromuscular blocking (NMB) agents, treated properly and thus the patients had an uneventful course.<sup>5-8</sup>

In the unique case of accidental epidural administration of succinylcholine, 125 mg of the depolarizing NMB agent have been injected during a combined spinal and epidural anesthesia. This was implicated with the appearance of spasms, which were initially located at the lower limbs and thereafter were expanded in the rest of the trunk, up to the patient's face.<sup>9</sup> We report a case of accidental epidural administration of succinylcholine, which has obscure pharmacokinetics and pharmacodynamics after epidural administration, as well as for high or low accidentally administered doses.

## Case report

A 63-yrs-old, 64 kg, ASA physical status I, female patient was scheduled to undergo elective total abdominal hysterectomy due to uterine fibroids. The anesthesia plan involved combined general and epidural anesthesia. Patient was informed appropriately and had given consent to receive the specific model of anesthesia. She received orally 5 mg of diazepam the night before operation and was premedicated with 10 mg (peros) of the same agent 1 h before being transported to the operation room.

Following the application of standard monitoring equipment, the patient was placed in the lateral decubitus position. Then the epidural space was located at L3-4

interspace using an 18 gauge Tuohy needle and the "loss of resistance to air" technique and a 20 gauge catheter was inserted into it. After stabilizing the catheter, the administration of a test dose of 3 mL lidocaine 2% was planned, but accidentally 3 mL of succinylcholine (75 mg) were injected, as the depolarizing NMB agent availability is a standard practice in our department. Succinylcholine and lidocaine 2% solutions were alike, both prepared in 5 mL syringes.

Approximately 2 min after the succinylcholine administration the patient complained for shortness of breath and feeling of discomfort, while mild fasciculations appeared in her trunk and face. At this point the mistake was perceptible and assisted ventilation was instantly initiated via facemask with 100% oxygen. In order to assess the depth of the possible neuromuscular blockade a train-of-four (TOF) ulnar nerve stimulation was applied, which showed 40% reduction in TOF response. Thereafter, we proceeded to induction to general anesthesia, achieved by 200 µg fentanyl and 140 mg propofol administration, without any additional NMB agent. Maintenance of anesthesia was achieved by 1 MAC of sevoflurane. Up to this point, the patient's vital signs remained stable. To accelerate systemic absorption of succinylcholine, 2 mL (8 mg) of dexamethasone in 8 mL 0.9% NaCl were injected through the epidural catheter.<sup>10</sup> After epidural succinylcholine injection, complete recovery of the TOF response occurred at 5 min. As soon as the mistake was apparent the surgeons and the patient's relatives were informed and it was decided to continue the operation. Consequently 12 mg of intravenous cisatracurium were administered in order to conduct the operation. Epidural anesthesia plan was discarded and substituted by intravenous opioid administration.

By the end of the operation, 115 min later, TOF examination indicated complete recovery from neuromuscular blockade. The extubation of the trachea was performed with the patient fully awake with adequate spontaneous ventilation.

Neurological assessment after recovery from a specialist revealed no signs of even sensory or motor blockade and neurotoxicity. The patient stayed in the postanesthesia care unit for 4 h; she was fully awake and oriented, with no clinical evidence of muscle weakness and pain, headache, discomfort, abnormal body temperature, or other metabolic, mental, or hemodynamic alterations.

The daily neurological examination was free of complications and showed no biochemical or electrolytic alterations. The patient was discharged home 7 days later, after she was officially informed about the incident, as well as a complete hospital incident report was filled in. Follow-up examination at 2 weeks and 1 and 3 months after surgery did not reveal any neurological, cardiovascular or other complications.

## Conclusions

Drugs after epidural administration redistribute by the diffusion from spinal cord meninges, due to special characteristics of epidural space. Dura and arachnoid meninges represent the main and primary permeability fragment in epidural drug administration and drugs epidural action depends on their coefficient of lipidsolubility.<sup>11</sup> Therefore, hydrophilic drugs contrarily to lipophilic ones have better action in epidural than in intrathecal infusion. Moreover, dura mater due to its increased number of vessels is an important place for drug metabolism, as it contains multiple enzymic systems.<sup>11</sup>

NMB agents can induce excitement and seizures when they are injected into the central nervous system,<sup>12–14</sup> while their acute intrathecal administration cause dose-dependent increase in intracellular calcium concentrations and activation of nicotinic acetylcholine receptors or glutamate receptors in the rat brain<sup>12</sup> The reports about non-depolarizing NMB administration, like pancuronium in a dose of 4 mg, vecuronium in a dose of 10 mg and cisatracurium in a dose of 8 mg,<sup>5–7</sup> into the epidural space, are restricted either before induction or during general anesthesia, so it is generally considered that some clinical manifestations were possibly not sufficiently observed. In a single case of accidental epidural infusion of 40 mg rocuronium, shortness of breath and a reduction in TOF response of 25%, occurred.<sup>8</sup>

Succinylcholine is the only depolarizing muscle relaxant in clinical use today and as all neuromuscular agents is watersoluble. It acts through stimulation of nicotinic receptors in parasympathetic and sympathetic ganglia.<sup>9</sup> Its popularity is attributed to its rapid onset, low lipid solubility and short duration of action. According to Mazze et al.,<sup>15</sup> the time to apnea for patients receiving intramuscular succinylcholine was approximately 3.5 min, 5-fold higher than intravenous and 3 fold higher than intralingual time. Notably, apnea was less distinct with intramuscular administration of succinylcholine than with the other two routes. However, the time needed for complete recovery after intralingual, intravenous and intramuscular succinylcholine administration was 7, 5 and 9 min, respectively.<sup>15</sup> Since there is no indication for epidural administration of succinylcholine, the evidence for the exact time of its onset and duration is lacking. However, it

seems that it mimics the pharmacokinetics of intramuscular administration.<sup>15</sup>

Interestingly, there are two reports suggesting the intentional epidural injection of a small (30–40 mg) dose of succinylcholine, with a view to identify a possible epidural catheter misplacement. According to them, when an epidural catheter is placed properly, a small dose of succinylcholine results only in minor deterioration of tidal volume, while in an intravenously placed epidural catheter the same dose causes apnea.<sup>16,17</sup>

To the authors' knowledge, it is the first time that a moderate dose of succinylcholine epidural administration, without any other previous concomitant anesthetic interventions, is reported.<sup>9</sup> It is assumed that, the time elapsed from accidental epidural injection to general anesthesia induction was sufficient enough for succinylcholine to reveal its clinical signs, while the operation lasted long enough to detect any prolongation in neuromuscular blockade.

In the single reported case of accidental epidural administration of 125 mg succinylcholine, the patient experienced intense fasciculations and spasms, which were initially located at the lower limbs and thereafter were expanded in the rest of the trunk, up to the patient's face.<sup>9</sup> The subtle clinical presentation in our case, involving only mild fasciculations in the trunk and face and shortness of breath, could possibly be attributed to relatively lower dose of succinylcholine injected epidurally.

Another possible reason could be the premedication with diazepam. There are data showing that, 10 mg of diazepam administered orally 90 min before intravenous succinylcholine administration can reduce the intensity of fasciculations.<sup>18</sup> Nevertheless, there is no reference regarding the impact of concomitant intravenous or peros administered benzodiazepines in cases of epidural injection of NMB agents. Beyond their effect on clinical presentation, the combination of these two factors also deterred from any permanent neurological complications, which in accordance with the previous reports.

In order to dilute the concentration of succinylcholine and limit the inflammatory response, dexamethasone and normal saline were flushed into the epidural space.<sup>10</sup> Albeit, this practice is commonly reported in cases of inadvertent epidural injection of drugs, its rescue utility under these circumstances is questionable.<sup>6</sup>

Finally, it is apparent that the meticulous and discriminative labeling of syringes, as well as keeping persistent cautions during all anesthesia procedures remains of crucial importance.

## Conflicts of interest

The authors declare no conflicts of interest.

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