Case Study

A Death too Fast - Suxamethonium Chloride Poisoning: A Case Report

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How to cite this article: Razuin R., Siti Nabihah M., Rupashini T. A Death too Fast - Suxamethonium Chloride Poisoning: A Case Report. Indian Journal of Forensic Medicine and Toxicology/Volume 19 No. 1, January - March 2025.

Abstract

Introduction: Suxamethonium chloride (SUX) is a short acting depolarizing muscle relaxant commonly used for medical procedures to induce respiratory paralysis. The case report aims to highlight the important postmortem findings associated with SUX poisoning.

Case report: A female adult health-care worker in her thirties was found dead in her bedroom at home. There were two empty ampoules of IV/IM Suxamethonium Chloride 100 mg/2 ml found next to the body.

Results: The autopsy revealed an adult female with multiple needle injection marks. Gross examination of the lungs showed markedly congested lungs and froth in the airways. The liver showed foci of petechial haemorrhages and confluent haemorrhages. Other internal organs showed diffuse vascular congestion. Microscopically, significant pathological changes were seen in the lungs and kidneys with areas of pulmonary infarction and acute tubular necrosis. SUX was not detected from the toxicological analysis. Correlating the circumstantial evidence at the scene of death, autopsy and microscopic findings, the cause of death was certified as SUX poisoning.

Conclusions: We wished to demonstrate the autopsy and histopathological findings associated with acute SUX poisoning culminating in death due to respiratory paralysis.

Keywords: Suxamethonium chloride; Muscle relaxant; Poisoning; Autopsy

Introduction

Suxamethonium chloride (SUX) is a short-acting anticholinergic neuromuscular blocking agent commonly used as an anaesthetic agent in medical setting. As a muscle relaxant, its use will result in respiratory paralysis which will in turn be compensated by mechanical ventilation.[1,2] A

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Submission date: May 31, 2024 **Revision date:** August 7, 2024 **Published date: December 3,2024**

therapeutic dose of SUX may result in apnea and death in the absence of mechanical respiratory support.[1,2]

In forensic casework, anaesthetic agent misuse by the manner of homicide or suicide is rarely encountered. As such, SUX poisoning as a result of intentional self-harm purposes usually involved health-care workers (HCW).[1,3] While death was usually fast, data regarding pathological findings and SUX analysis from the postmortem samples were insufficiently published.[1] In this case report, we wish to highlight the important postmortem findings associated with SUX poisoning. Unfortunately, this case also involved a HCW who had access to the medication and based on the police investigation, the circumstance surrounding the death was intentional self-harm.

Case presentation

A female adult in her thirties was found unconscious and unresponsive in her bedroom. She was single and staying with family members. In the fateful night, her elder brother noticed that she was quiet when she got home from work and immediately went to her bedroom. Later, when she did not join the family for dinner, he knocked on her bedroom door. As there was no response, he forced open the door and found her lying in bed with needles and syringes strewn next to the body. There were two empty ampoules of IV/IM Suxamethonium Chloride 100 mg/2 ml found next to the body (Fig. 1A). Death was pronounced at the scene by a paramedic team responded to the distress call. The body was brought to the Forensic Department for a medico-legal autopsy. At the mortuary, preliminary history obtained from the next-of-kin showed that she had no underlying medical illness.

Results

Autopsy findings

Autopsy showed an obese adult female, measuring 156 cm in length and 99 kg in weight, with body mass index of 40.7 kg/m^2. The face was markedly congested. The pupils were fixed and dilated. The conjunctiva was also distinctly congested. Blood-stained fluid was noted emanating from the nostril. The nail beds of both the fingernails and toenails showed prominent bluish discolouration. Multiple needle injection marks were present at the upper limbs; two at the dorsum of the right hand, two at the right wrist, nine at the dorsum of the left hand, three at the left wrist and one at the left antecubital fossa. All the injection marks were accompanied by large surrounding bruises, ranging from 2 x 3 to 3 x 4.5 cm (Fig. 1B). Multiple linear, horizontal scars at the anterior aspect of both forearms were observed. Urinary and fecal incontinence were present.

Internal examination showed an intact skull with normal brain anatomy. The cerebral blood vessels were congested. The internal thoracic organs showed normal heart weight of 290 gm. The left anterior descending coronary artery showed an intramyocardial bridging of 3 mm depth. There was no evidence of past or recent ischaemic change of the myocardium. The major tributary of the coronary arteries showed patent lumens. The right and left lungs weighed 455 gm and 355 gm respectively. Both lungs were markedly congested (Fig. 1C). Serial cut sections of the lungs showed vascular congestion and oedema bilaterally (Fig. 1D). The tracheal showed blood-stained froth, in keeping with pulmonary oedema. There was no apparent area of infarction or haemorrhage noted on gross inspection. Examination of the other internal organs such as the spleen, kidneys, and intestines generally showed vascular congestion. The liver showed scattered petechial haemorrhages of the surface, with large area of prominent yellowish discoloration and confluent petechial haemorrhages at the inferior surface of the left lobe (Fig. 1E).

Postmortem blood specimen was obtained for laboratory investigations, however, there was no urine sample available for collection during autopsy. Forensic toxicology analysis from the blood sample showed presence of ethyl alcohol 212 mg/100 ml. Common drugs were not detected.

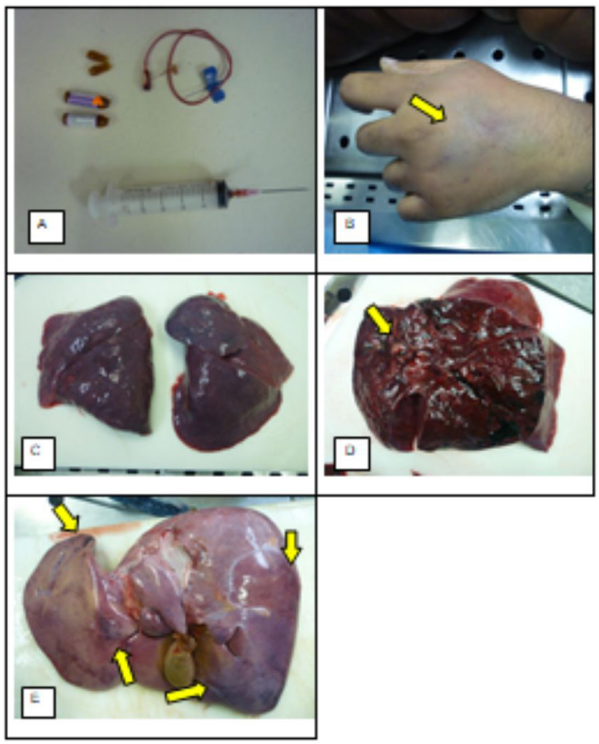

Fig. 1A Medical apparatus found at the scene; a syringe with needle, a butterfly needle and two empty ampoules of Suxamethonium Chloride 100 mg/2 ml. B Needle puncture marks with swollen haematoma at the back of the left hand (yellow arrow). C Markedly congested lungs. D Cut sections of the left lung shows diffuse vascular congestion with froth within the airways (yellow arrow). EInferior surface of the liver shows prominent yellowish discolouration at the left lobe with scattered areas of confluent petechial haemorrhages (yellow arrows).

Microscopic findings

Representative tissue samples from the brain, heart, lungs, liver, kidneys, and spleen were obtained for microscopic examination. Routine hematoxylin and eosin (H&E) staining showed non-specific changes such as marked vascular congestion,liver steatosis and acute tubular necrosis (Fig. 2). Significant pathological changes were discovered in the lungs, as it showed areas of pulmonary infarction, in the background of prominent congestion and oedema (Fig. 3).

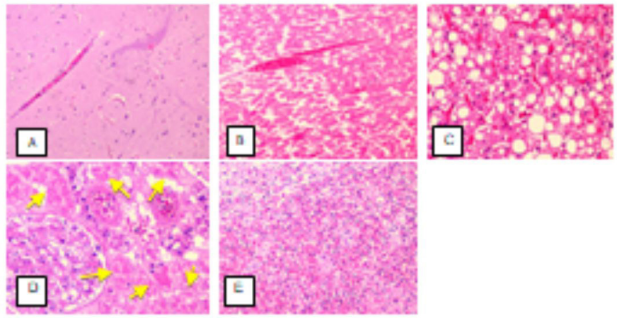

Fig. 2 Histological findings in the brain (A), heart (B), liver (C), kidney (D) and spleen (E) showing congestion. Other findings seen in the liver and kidney include fatty changes and acute tubular necrosis (yellow arrows).

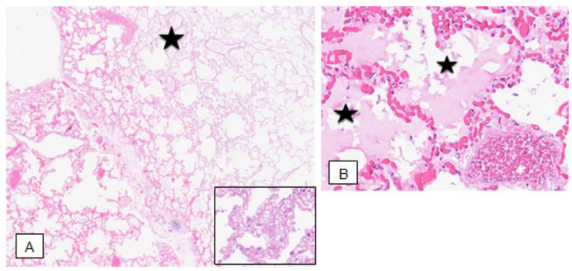

Fig. 3A Histology findings of the lungs showing features of infarction (black star) with pneumocyte ghost cells (inset). B Pulmonary oedema (black stars) with marked vascular congestion of the alveolar capillaries and blood vessels.

Correlating the circumstantial evidence at the scene of death, autopsy findings and the microscopic examination result, the cause of death was certified as suxamethonium chloride poisoning. In our opinion, SUX had been introduced into the body at more than commonly prescribed dosage, therefore causing respiratory paralysis and death.

Discussion

SUX is a nicotinic acetylcholine (ACh) receptor agonist which resembles the endogenous neurotransmitter ACh. Its function at the postsynaptic ACh receptors in the skeletal muscle will cause depolarization of the endplate membrane, causing paralysis.[1,4] As a short-acting muscle relaxant, it has rapid onset, short duration of action and also fast recovery. Therefore, it is usually used

in medical procedures requiring rapid muscle relaxation such as endotracheal intubation and as an adjunct to general anesthesia during surgery.[1,5,6] SUX is usually presented in 20 mg/mL or 100 mg/mL injectable solutions. The usual dosage for intravenous loading dose is between 0.3-1.1 mg/kg and for intramuscular loading dose is 3-4 mg/kg.[4,5] There was no documented lethal level of SUX or its metabolites from blood or urine samples. However, a fatal intoxication case reported that 8.1 μg/ml SUX present in the urine.[7] After absorption into the body, SUX cannot be metabolized effectively and results in continuous muscle fibre depolarization, causing paralysis.[6] Therefore, its side effects include apnea, bradycardia, tachycardia, hypotension, hypertension, hyperkalemia and hyperthermia.[5]In this case report, two empty ampoules of SUX 100mg/2mL were found with the deceased in which an estimated 200 mg of SUX had been introduced into the body. The recommended dosage for her body weight was between 29.7 mg to 108.9 mg. The injection of 200 mg was more than doubling the recommended dose and unsupported by mechanical ventilation, fatal outcome was inevitable.

Upon administration of SUX, paralysis occurs about 1 minute after the injection and lasts for approximately 7 to 12 minutes. The paralysis which persists, may inhibit respiratory function, leading to ischaemia and hypoxia of the brain.[1,6] Acute SUX poisoning may cause death in less than 30 minutes after the injection.[1] In general, acute SUX poisoning have non-specific features at autopsy. The main pathological changes include haematoma at the injection site, visceral congestion, severe pulmonary oedema and petechial haemorrhages at the heart and lungs.[1] Cerebral oedema with features of ischaemic neurons may also be present. The internal organs such as the liver, spleen, kidneys and intestines usually show varying degrees on congestion.These features are in keeping with apneaas a result of prolonged respiratory paralysis.[1]

In this case, most of the autopsyfindings were in keeping with the previous reports. The external examination showed large bruises at the injection sites. The internal organs showed marked vascular congestion. The lungs showed pulmonary oedema and congested blood vessels. Microscopically, acute pulmonary infarction was seen, most likely contributed by the respiratory paralysis. Prolonged ischaemia of the kidneys resulted in acute tubular necrosis. These features were not reported in the literature.

Suxamethonium chloride toxicity is difficult to establish due to its quarternary structure and high hydrolytic susceptibility. The detection window in blood is within 10 minutes after injection, while its metabolite, succinylmonocholine (SMC) can still be observed within 6 hours. In freshly excreted urine, it is still detectable within 2 to 6 hours.[8]Therefore, SMC analysis from urine sample has the best chance to confirm a diagnosis of SUX poisoning. In this case, only postmortem blood sample was available for analysis and SUX or its metabolite was not detected. The negative result was not unexpected as the body was received at the mortuary approximately 7 hours after her demise and the blood sample was collected during postmortem examination, approximately 37 hours of postmortem interval. According to the detection window, SUX and its metabolites would have been fully degraded by then.

Conclusions

On hindsight, the cause of death in this case was elusive. Vital evidence was obtained from the scene of death and autopsy findings. In this case report, we wished to demonstrate the autopsy and histopathological findings associated with acute SUX poisoning. Respiratory paralysis was unmistakably the causative factor leading to acute pulmonary infarction and death.

Ethical Considerations

Compliance with ethical guidelines

We seek for waiver of ethical review and approval since the data was observatory in nature and the research involved no risk to the deceased subject. Consent for publication could not be obtained because the next-of-kin was uncontactable.

Funding

This study did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Authors' contributions: Conceptualization and Supervision: Razuin; Methodology: Razuin, Muhammad Afif;

Data collection and analysis: All authors; Original draft writing: All authors; Review and editing: Razuin.

Conflict of interest: The authors declared no conflict of interest.

Acknowledgement: The authors would like to thank the Director General, Ministry of Health Malaysia for the permission to publish this manuscript.

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