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CASE REPORT

The progression and resolution of local anaesthetic resistance following a scorpion sting: case report

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A 35-year-old female presented for an elective caesarean section. The patient reported multiple failed or delayed onset spinal anaesthetics. On further enquiry, she had been stung by a scorpion as an adolescent. There are case reports documenting the incidence of local anaesthetic resistance following scorpion stings. The incidence of local anaesthetic failure appears highest near the scorpion sting and progressively diminishes. A diagnostic dermal local anaesthetic infiltration test may be done if a patient reports a history of failed regional anaesthesia and a previous scorpion sting to aid in planning an appropriate anaesthetic approach.

Keywords: local anaesthesia, resistance, scorpion sting

Case report

A 35-year-old female presented for elective caesarean section at 38 weeks gestation, indicated by four previous caesarean sections. Her anaesthetic history is outlined in Table I. The patient had a history of chronic hypertension controlled by methyldopa 500 mg three times daily without target organ damage. Upon further investigation, the patient reported having suffered a scorpion sting at the age of 17 in Zeerust, North West Province, South Africa. It was a single incident with three stings to the right side of her face. The scorpion type was not identified.

In consultation with the obstetricians and anaesthetists, the decision was made to proceed with the elective caesarean section under spinal anaesthesia, allowing 20 minutes before assessing failure. Factors such as the risk of airway complications, the benefits of spinal anaesthesia, and the fact that the surgery was elective were considered in this decision. If an adequate block was not achieved, the plan was to convert to balanced general anaesthesia, document the modified Bromage scale on emergence, and assess the need for multimodal analgesia intra- and postoperatively. The patient was counselled comprehensively and consented to this plan. The modified Bromage scale is described in Table II.

The patient was optimally positioned for spinal anaesthetic insertion. American Society of Anesthesiologists (ASA) standard monitors were attached, and two intravenous lines were placed. A single-attempt spinal anaesthetic was performed by an anaesthetist sufficiently experienced in the technique. The drug and dose combination included 10 mg (2 ml) of hyperbaric bupivacaine 0.5% and 10 µg (0.2 ml) of fentanyl. The patient was then positioned supine with a left lateral tilt. The sensory level was tested using temperature with an ice pack, and the motor level was tested using the modified Bromage scale. At 10 minutes after administering the spinal anaesthetic, a sensory level of T6 and a Bromage score of 3 were achieved. The block level was assessed to be adequate, and surgery commenced uneventfully.

Upon completing the caesarean section, the patient was transferred to recovery, where she was monitored for 30 minutes. Sensory and motor levels were tested again, and the block receded adequately. The Bromage score was 2 at

Table I: Timeline of the patient's anaesthetic history and clinical assessment

Age (years)	Time interval between spinal anaesthetic and scorpion sting (years)	Indication for spinal anaesthetic	Clinical assessment
21	4	Emergency caesarean section for fetal distress	No neurology (Bromage 1) Spinal repeated Sufficient sensory and motor level to proceed with the operation (Bromage 4)
23	6	Elective caesarean section for previous caesarean section	No neurology (Bromage 1) Spinal repeated Sufficient sensory and motor level to proceed with the operation (Bromage 4)
27	10	Elective caesarean section for two previous caesarean sections	Some neurology noted initially (Bromage 2) Progressed to adequate sensory level at 40 minutes (Bromage 4)
28	11	Elective caesarean section for three previous caesarean sections	Some neurology noted initially (Bromage 2) Progressed to adequate sensory level at 30 minutes (Bromage 4)

Table II: Modified Bromage scale[1]

Grade	Criteria	Degree of block
1	Free movement of legs and feet	None
2	Just able to flex knees with free movement of feet	Partial 33%
3	Unable to flex knees but with free movement of feet	Partial 66%
4	Unable to move legs or feet	Complete paralysis

30 minutes post-anaesthetic administration and regressed to 1 at 240 minutes. No formal antibody testing was done.

Discussion

Spinal anaesthetic failure is a known complication of neuraxial anaesthesia.[1-3] This complication is concerning as it exposes patients to pain and emotional distress. Repeat spinal attempts increase the likelihood of local anaesthetic toxicity, and a high or inadequate spinal may necessitate conversion to general anaesthetic, exposing the patient to additional risk.[4] Common causes for spinal anaesthetic failure are shown in Table III.

As seen in this case report, a failed spinal anaesthetic may ensue if a patient has resistance to local anaesthetic agents.[5] Local anaesthetic resistance explains why an inadequate block may occur despite the correct administration of an adequate dose of local anaesthetic.[6] Marti et al.[7] identified five patient groups with true anaesthetic resistance, as shown in Table IV.

Scorpions are classified as arthropods, and roughly 2 000 species have been identified worldwide.[8] They are venomous invertebrates belonging to the class of Arachnida.[8] Southern Africa is home to approximately 130 species.[8] Scorpions found in South Africa belong to two families: the medically relevant Buthidae family, and the relatively harmless Scorpionidae family.[9] The most common non-life-threatening scorpions are known to produce pain at the sting site with no significant systemic effects.[9] In this case, the patient recalled being stung at home. The Plain Pygmy-Thicktail is most common in houses.[9] Other common scorpion species are mostly found outdoors, under rocks, or on hard soil but may venture elsewhere on warm nights.[9]

The sodium channel comprises one alpha-subunit coupled with one or two beta-subunits.[10] Each alpha-subunit has four domains, each of which has six transmembrane segments.[10] Local anaesthetics act by binding to the alpha-subunit on the sixth segment of the fourth domain.[10] Binding of the local anaesthetic causes action potential inhibition by slowing the sodium channel inactivation.[10] The relationship between local anaesthetic resistance and scorpion envenomation is believed to be related to the action of the scorpion venom on sodium channels.[1,2]

Scorpion venom is a complex mixture containing inorganic salts, low-molecular-weight organic molecules, mucus, and small basic proteins.[11] These small basic proteins are neurotoxic peptides, which work on ion channels to exert their toxic effect.[11] The peptides can be classified as sodium channel toxins, potassium channel toxins, and calcium channel toxins.[11] Sodium channel toxins found in scorpion venom have been identified as polypeptides and are categorised as alpha or beta toxins based on their binding site on the sodium channel receptor.[11]

Alpha toxins bind to sodium channel receptors and inhibit the sodium current by slowing the sodium channel's inactivation.[10] Beta toxins bind to sodium channel receptor domain four and modify the channel's activation process through hyperpolarisation.[1] Panditrao et al.[1] hypothesised that resistance to local anaesthetics following scorpion envenomation is related to the common binding site of local anaesthetics and antibodies to beta toxins. The antigen-antibody response may lead to competitive antagonism at this common binding site.[1]

However, the theory of scorpion venom pharmacology has been criticised based on the principles of stoichiometry and requires further elucidation and research.[7] Marti et al.[7] state that the concentration of local anaesthetic at the sodium channel binding site exceeds the number of plasma antibodies. This means that interrupting the local anaesthetic effect of plasma antibodies via competitive antagonism is unlikely.[7]

Between 2005 and 2014, over 52 000 scorpion stings were reported to the Tygerberg Poison Information Centre.[8] Most victims (65%) reported no or minor symptoms, such as localised pain.[8] Positive morphological identification of the scorpion species was low (2%).[8] Common scorpions endemic to the North

Table III: Common causes of failed spinal anaesthetic[5]

Poor technique	Patient factors	Drug-related errors
Poor patient positioning	Anatomical spinal abnormalities	Inaccurate drug dosing
Incorrect insertion of the spinal needle	Obesity	Inadequate drug action
Pseudo lumbar puncture	Local anaesthetic resistance	Drug identification errors

Table IV: Identified patient groups with local anaesthetic resistance[7]

Genetic	Acquired
Patients with mutation A572D in the SCN5A gene, encoding the voltage-gated sodium channel	Regular opioid consumers
Ehlers–Danlos syndrome	Patients who had previously experienced scorpion stings
Red-haired patients with MC1R mutation	

West Province that have painful but not systemically dangerous stings include the Plain Pygmy-Thicktail (Pseudolychas ochraceus), Common Lesser-Thicktail (Uroplectes carinatus), and Orange Lesser-Thicktail (Uroplectes planimanus).[9] There is a paucity of data regarding the incidence of stings by specific scorpion species, and few patients are followed up after scorpion envenomation. The incidence of species-specific scorpion venom-induced local anaesthetic resistance in South Africa is presently unknown.

In India, Kosam et al.[2] compared a group of 20 patients who had been stung by a scorpion to 20 patients with no history of scorpion envenomation.[2] Researchers found that the patients in the control group had a 100% success rate with adequate spinal anaesthetic blocks.[2] In contrast, seven patients had been stung within six months, of whom five had failed spinal blocks.[2] The remaining two patients had a delayed onset of either sensory or motor blocks.[2] Of the patients that were exposed to venom, seven were stung 6–12 months before receiving a spinal anaesthetic, and all seven had delayed local anaesthetic onset of either sensory or motor blocks.[2] The remaining six patients were stung more than 12 months before receiving a spinal anaesthetic, with four of these patients having had adequate blocks and two having had delayed onset blocks.[2]

Panditrao et al.[1] studied 70 patients presenting for elective surgery under spinal anaesthesia in India. It was found that the group ($n = 35$) that had previously been stung by scorpions had a longer average time of sensory block onset (2.31 ± 1.68 minutes) and a longer time of motor block onset (2.91 ± 1.80 minutes). Comparatively, the average times of sensory block onset and motor block onset in patients in the control group were slightly longer (1.63 ± 0.84 and 1.80 ± 0.83 minutes, respectively).[1]

Local anaesthetic resistance following a scorpion sting is reported in various types of regional anaesthesia and different local anaesthetic agents.[1-3] Should a patient present with a history of multiple failed regional anaesthesia, dermal local anaesthetic testing may be used to assess local anaesthetic resistance.[12] Dermal local anaesthetic testing is performed by subcutaneous injection of a local anaesthetic to the forearm, and numbness tests are performed via pin prick.[12] Adjacent skin is compared to the infiltrated area, and patients report if there is a difference in sensation.[12]

There is a paucity of data in South Africa substantiating the degree to which true local anaesthetic resistance contributes to failed spinal anaesthesia. There is no data on the incidence of scorpion venom-induced local anaesthetic resistance. The limitation in this case was that no dermal testing was performed to confirm local anaesthetic resistance.

Conclusion

This case report highlights the importance of identifying patients with a scorpion sting history, which places them at an increased risk of local spinal anaesthetic resistance.[8] Failed regional anaesthesia is more common in South Africa, and correlating failures to scorpion envenomation could help foresee possible complications. This case report focused on local anaesthetic resistance following a scorpion sting in neuraxial anaesthesia; however, evidence suggests that all types of regional anaesthesia may be affected by this phenomenon.[1-3] Increased awareness of this potential risk can aid the clinician in optimising anaesthetic planning and management.[13]

Learning points

- There is a relationship between scorpion envenomation and developing local anaesthetic resistance, which is higher closer to the time of the sting and multiple previous stings.[1-3]
- A diagnostic dermal local anaesthetic infiltration test may be done if a patient reports a history of failed regional anaesthesia and a previous scorpion sting to aid in planning an appropriate anaesthetic approach.[12]

Conflict of interest

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Ethical approval

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