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CASE REPORT

Delayed Respiratory Arrest in a Patient Following Interscalene Block: A Case Report with an Overview of Complications Associated with Interscalene Approach to Brachial Plexus Block

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ABSTRACT

Interscalene brachial plexus block is a commonly used anaesthetic technique for surgery on shoulder joint and on arm. The present report describes a case where an Interscalene block given in an elderly lady with ipsilateral flail chest. The patient landed in apnea 50 minutes after initiation of block.

The article also discusses a brief overview of side effects and complications associated with interscalene approach to brachial plexus block, along with tips to avoid these complications.

Interscalene approach to the brachial plexus is the most proximal approach to brachial plexus and is utilised commonly for procedures performed on or near the shoulder joint and arm [1]. This method of regional anaesthesia saves the patients from pain, nausea and vomiting, which are associated with general anaesthesia. Although interscalene approach to brachial plexus block is quite safe, a wide variety of complications have been reported with it.

We report a case where a 56-year-old lady with flail chest and shoulder injury was undergoing a surgical toilet and debridement, with application of external fixator on left humerus upper shaft involving left shoulder joint, under interscalene block. The patient landed in cardiorespiratory arrest about half an hour in the procedure and nearly 50 minutes after the block was administered.

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Case Report

A 56-year-old female, 156 cm tall, weighing 56 kg, with ASA (American Society of Anesthesiologists) status III, was admitted to the hospital after having met with a road traffic accident.

The patient was a known case of chronic obstructive airway disease (COAD), had a chest injury with fracture of ribs 4–8 on left side, leading to a flail segment on left side, and compound Fracture left upper 1/3 humerus extending to involve the left shoulder joint. The patient was examined, investigated and excluded for any pneumothorax. Chest X-Ray had signs of COAD and fracture 4–8 ribs left side, and was otherwise unremarkable. The patient had a breath holding time of ~20 seconds. No other systemic abnormality was documented on

history and examination and investigations otherwise were in the normal limit.

In view of the respiratory status and chest injury to patient it was decided to perform the surgery under interscalene approach to brachial plexus block.

Before starting with the procedure, patient was examined by a thoracic surgeon who advised strapping of the flail segment during the perioperative period. Accordingly, flail segment was strapped before taking up the patient.

The patient was placed supine with neck turned to other side. Block was performed using a 21 G, 25 mm needle. The needle was introduced on the left side in the interscalene grove, at the level of cricoid cartilage. After eliciting paraesthesia and negative aspiration, block was induced with 20 ml of 2% lignocaine with 1:200,000 epinephrine and 20 ml of 0.5% of bupivacaine, with negative aspiration performed initially and at every 10 ml in between. Pain experienced by patient gradually abolished. Adequacy of sensory effect was tested by pinprick after 20 minutes and was found to be adequate.

Patient was provided oxygen by nasal cannouae at 3 lpm and injection midazolam 2 mg iv.

At this point, the surgical team was allowed to proceed with the procedure. After about 20 minutes in the procedure, it was noticed that the patient's voice had diminished in intensity and over the next 10 minutes the patient gradually landed in aphonia. Respiration and other vital parameters were normal till this time. About 5 minutes later, the patient suddenly landed in apnoea and her heart rate started decreasing and she became unconscious. The patient was given injection atropine 0.6 mg iv and intubated immediately, and positive pressure ventilation was instituted. Patient's heart rate rose and settled in the normal range for the remainder of the procedure. The patient was ventilated with 100% oxygen initially for 20 minutes and then with O_2:N_2O in a 1:1 ratio. Her vitals signs remained stable otherwise throughout the rest of surgery; no further arrhythmia was documented. Additional midazolam 2 mg iv was provided with intubation. Patient's spontaneous respiratory efforts resurfaced over next 30 minutes and from then onwards patient's respiration was assisted. In the next 30 minutes, the patient had sufficient respiratory efforts to maintain the ventilation and was left on spontaneous ventilation on Ayer's T Piece with O_2 at 4 lpm. By the time the surgical procedure was finished, the patient was awake and fully following verbal commands and was extubated.

Detailed examination of the patient in postoperative, and a day later, failed to reveal any persistent neurological deficit. The patient was discharged after 7 days.

Discussion

Shoulder procedures are associated with severe pain. Interscalene brachial plexus block is an effective and reliable method of providing anaesthesia, with the persistent effect providing for some postoperative pain relief. Further, the technique is free from other side effects associated with general anaesthesia and also provides for good operating conditions with reduced blood loss, excellent muscle relaxation, reduced cost of treatment, etc. The performance of interscalene block with a standard technique and drug application is associated with a high success rate and with very few long-term complications.

The major acute complications/side effects associated with interscalene block are respiratory depression (due to associated ipsilateral phrenic block), intravascular injection that may lead to seizures and cardiac arrest, pneumothorax, epidural and spinal anaesthesia, Horner's syndrome (ipsilateral cervical sympathetic block), and hoarseness and dysphagia (ipsilateral recurrent laryngeal nerve block) [2].

The case we described was of a young elderly lady with coexistent COAD and a flail segment; the patient required an urgent surgical intervention, as she had a compound fracture with intra-articular extension. Because of the respiratory status and coexistent flail segment in the patient, we wished to avoid general anaesthesia in her. Only interscalene approach to brachial plexus was suitable for her, as the surgery involved working on and in close proximity with the shoulder joint.

The performance of block was easy, as described by Winnie's technique. And the sensory block was well established in the expected time. The surgery progressed well in the initial stage without any problem. However, about 40 minutes later, the problem started progressing to the extent where respiratory assistance was required. Subsequently, after another 30 minutes, spontaneous respiratory efforts were evident again and sufficient strength was restored over the next 30 minutes. Subsequently, the patient had complete recovery without any residual deficit.

The course of events in this case suggests delayed migration of local anaesthetic agent in the central neural space. However, whether the extension was into the extradural or subarachnoid space could not be commented on with certainty.

The central migration of the local anaesthetic agents in interscalene block is a known entity, and, though infrequently seen, cases have been documented in this regard. However, it usually occurs much earlier than in the case discussed. Also in the literature available, no case reported had coexistent acute chest injury. Further, the temporary strapping performed beforehand did provide the cover during assisted respiration.

Central neuraxial anaesthesia has been reported as the complication of interscalene block despite locating the brachial plexus easily with paraesthesia. This has usually been characterised by the fall of blood pressure and heart rate, extension of sensory and motor block outside the dermatomes expected for interscalene block, with or without involvement of the phrenic nerves. The patient may or may not retain the consciousness. The complication can present after interscalene block at varied time intervals, immediately following block to those delayed by up to 1 hour.

The central migration of drug can be to the spinal, epidural or subdural space, and indeed it may be difficult to identify the exact cause for the complication. However, the subdural spread can be suspected if the spread of block outside the brachial plexus is much patchy in distribution and is associated with minimal sympathetic block, and the interval between the initial block and onset of symptoms is too long [3]. Spinal and epidural spreads are associated with relatively denser block with more profound sympathetic block. The motor component of the block is more in case of spinal spread.

This central neuraxial block can occur as a result of a direct deposition of drug in the central neuraxial space in spinal, epidural or subdural space. It can occur because of faulty technique with the needle being directed more anteriorly; even with the correct direction, the needle may pass directly through the intervertebral foramen into either of the central neuraxial space, especially when probing for brachial plexus in depth. At times sudden movement by the patient during placement of block may redirect the needle and alter the tissue relationship [4],[5], and the drug is then deposited directly in the central neuraxial space. In this scenario, the central neuraxial block usually occurs immediately after the performance of block when the drug goes to subarachnoid space or after few minutes in the case of cervical epidural spread. Apart from the time of onset, the degree and spread of sympathetic and motor block are also more in case of spinal than epidural spread of drug.

Alternatively, the block may be correctly placed in the interscalene space, but the drug may spread in to the central neuraxial space via a rent created in dura, formed during the performance of block [6], or along the perineural space following an intraneural injection [7]. Or the drug may also track proximally after an intraneural injection through the nerve, dissecting neural fascicles into the subarachnoid space or in the substance of spinal cord [5].

Subsequent to the migration of drug in the central neuraxial space, the patient may became apnoeic and required respiratory assistance. The requirement to induce of general anaesthesia depends on the effect on consciousness and the ability to intubate. The patient usually requires ventilation for the time period of the motor block. The consciousness may return earlier than the recovery of motor function, in which case supplementary sedation may be required in later stages. However, at times the phrenics may escape the central neuraxial extension of the block; in this case, patient may keep on

breathing spontaneously despite a high spinal and should be carefully observed for the respiratory status [6]. This complication may be associated with significant effect on haemodynamics ranging from profound fall of blood pressure to bradycardia and cardiac arrest, which should be actively sought for and aggressively managed accordingly. These patients may subsequently develop a headache similar to postdural puncture headache in characteristics, providing a further clue to the likely mechanism of the phenomenon [6].

Use of in situ catheter for continuation of interscalene block in postoperative period for provision of analgesia can also be complicated by migration of catheter in the central neuraxial space, causing high spinal or epidural blockade with its use. This is especially when the catheter is inserted too deep in the space and with blind placement of catheter [8]. Therefore, aids to resuscitation should always be at hand, for even 1 ml of 1% lignocaine can lead to b/l phrenic involvement.

When the central neuraxial block occurs as the result of an intraneural injection or direct intrathecal injection, the course is further complicated by the possibility of persisting neurological damage because of the neural injury suffered. Further, as the intraneural injection is very painful, it provides good safety margin against this complication when the block is performed in an awake patient. However, if the block is performed in a patient under general anaesthesia or under deep sedation, this safety margin is lost. Deep sedation may indeed aggravate the injury on account of an unpredictable response under sedation [4],[9].

It has been suggested that the distance from skin to subarachnoid space may get as short as 2″ during performance of interscalene block. Further, as interscalene block is a relatively superficial block, most of the complications occur when a deeper placement is attempted. The use of smaller needle of 1–1.5″ in size may provide some protection against accidental direct subarachnoid injection [5],[7].
The emergence of nerve stimulator and ultrasound guidance had made performing the regional blocks easier and more successful, and the anaesthetist need not depend upon eliciting the paraesthesia for performing the block. However, with it has come the hazard of performing the block under deeper sedation or under general anaesthesia, whereby the chances of neural injury as a result of placement of intraneural injection have increased. Though it is useful in locating the nerves, a nerve stimulator does not distinguish an intraneural from a perineural needle position [4],[9]. Use of ultrasound assistance may help in avoiding the neural injury, as the needle insertion usually is some distance away from nerves and the intraneural injection can be visualised. However, the technique is operator dependent and requires use of ultrasonogram, which may not be available at all locations.

Interscalene block almost always involves the ipsilateral phrenic nerve, leading to hemiparesis of diaphragm, which can be documented as de novo flattening of ipsilateral hemidiaphragm on a chest X-ray; further, this involvement of phrenic is independent of the amount of drug used and cannot be prevented by procedures like manual application of pressure above the injection site to prevent proximal spread of drug. It is now presumed to be due to the rostral spread of drug to involve C3–5 nerve roots; spread of local anaesthetic agent along the anterior surface of scalene muscle can also play a part in this [10],[11],[12]. The paresis may occur within 5 minutes of performing the block and may last for up to 9 hours in case of a longer-acting agent. This may cause up to 25% reduction in the pulmonary function. Most of the hemiparesis goes unrecognised because of lack of complaint of any symptom in the patients who have no underlying lung disease. However, in patients with severe respiratory involvement, this may cause respiratory distress and discomfort to the extent that artificial ventilation may be needed [13],[14].

Rarely the patient may land in apnoea, following an otherwise perfectly located brachial plexus even with the help of a nerve stimulator. The irritation of phrenic nerve by needle may result in reflex paraesthesia in shoulder region, while the plexus lies posterior to this site. This aspect should always be guarded against. And any paraesthesia localised to shoulder should be interpreted with caution. Further, while using

nerve stimulator, if the patient's forearm is resting on abdomen then sudden contraction of diaphragm due to neural stimulation may be misinterpreted as the contraction of arm muscles, and hence ideally the arm and forearm should be by the side of body so as to minimise this risk [14].

Horner's syndrome due to involvement of stellate ganglion occurs frequently with interscalene block. This is due to the close relationship of stellate ganglion with the brachial plexus at the site of block [15]. However, it does not cause much problem and usually recovers after the effect of block wears off.

With interscalene block the ipsilateral recurrent laryngeal nerve may be involved in the block. This may cause some hoarseness of voice usually and no further trouble; however, in patients with prior affection and paresis of the contralateral vocal cord, there may occur severe stridor and respiratory compromise, and hence before giving interscalene block, the patient should always be examined preoperatively for the status of vocal cord function, preferably with indirect laryngoscopy, and any past history of hoarse voice or thyroid or neck surgery should be carefully enquired into, to avoid this complication [15],[16],[17]. These patients should be specifically evaluated for this aspect in the preoperative assessment. If there is any suspicion, then they should undergo a proper ENT evaluation.

Rarely, manipulations during the performance of an interscalene block and the increased flow in the blood vessels of the blocked extremity can lead to a thromboembolic episode, especially in patients predisposed to it. This group of patients include those who had a central venous catheter on the side, pacemaker and malignancy and those who are receiving concurrent therapy for lower limb deep vein thrombosis. This thromboembolic phenomenon can cause sudden-onset hypoxia in these patients [18].

One case of a persisting brachial plexus block lasting for >18 months has also been reported [19]. This could have occurred as a result of direct traumatisation of the plexus during block or operation or due to the toxicity of injected bupivacaine, distension of plexus or cervical syndrome or aseptic plexitis. However, the pattern of lesion and lack of pain during localisation and injection suggest towards a traumatisation during surgery.

Intravascular injection of local anaesthetic agent may occur especially when the needle direction is anterior, as it may enter the vertebral artery and then the injection of local anaesthetic will lead to immediate convulsions even with newer relatively safer drugs. An inadvertent intravascular injection may occur despite a negative aspiration test and negative result for test dose, as in the case of injection of drug in a minor vein or due to intravascular migration of drug, leading to toxicity of local anaesthetic agent. So wherever possible, ideally, one should go for an incremental injection technique, with sufficient time delay allowed between the doses so as to avoid this potential hazard even with the safer of newer drugs [20].

There has been a single report of Tapia's syndrome (ipsilateral palsy of X and XII cranial nerve) associated with interscalene block, which was diagnosed later as the hoarseness and Horner's syndrome, which are relatively commonly seen during interscalene block. It has been suggested that if a patient develops hoarseness with performance of interscalene block, he/she should be examined for tongue protrusion and deviation; in case these are present the procedure should be abandoned and patient subjected to carotid angiography for need of anticoagulation, as the condition may arise as a result of spontaneous dissection of carotid artery, especially in males in their forties [21]. Close proximity of brachial plexus to the vertebral artery, the jugular veins and carotid and subclavian vessels may result in injury to these vessels and in haematoma formation. Fortunately, it is not very common.

Pneumothorax is one of the dreaded complications of brachial plexus block by supraclavicular approach; however, the incidence is much less with interscalene block. There has been an overall reduction in the incidence of pneumothorax to the point where it has now become a rare complication (0.2%), which can be attributed to the improvement in technique and needles now used for the block [22].

Quite a few patients undergo shoulder surgery in semi-sitting or sitting posture. They may experience sudden bradycardia and hypotension sometimes progressing to cardiac arrest. There is some evidence that this may be due to Bezold Jarisch reflex, which occurs due to the combination of reduced ventricular volume and a hypercontractile ventricle secondary to sympathetic stimulation. It can be prevented by providing anxiolytics, intravenous fluids and metoprolol or other ß blocker. The best preventive measures for this catastrophe are vigilance and prompt treatment of bradycardia, hypotension and anxiety [2],[23],[24].

Nerve injuries sustained during brachial plexus block is a recognised complication, but apart from neural injuries sustained during performance of block, other factors like positioning of patient during block and surgery and surgical injury may also be involved. Though pain, dysthesia, paraesthesia, etc. are commonly reported after surgery with brachial plexus block, few persist for long term and they usually resolve spontaneously; there is no complication associated with the use of catheter. However, diagnosis of sulcus ulnaris syndrome and carpal tunnel syndrome must be excluded in case of persisting paraesthesia [22].

Oldman et al. reported that a shoulder surgery performed under general anaesthesia resulted in a complication of pneumothorax in the postoperative period. They further stated that if the surgery had been performed under brachial plexus block the occurrence of pneumothorax could easily have been blamed on regional anaesthesia. Hence, one should be wise and rational in ascribing any complication in the postoperative period to regional anaesthetic technique. This certainly does not mean that regional anaesthesia is absolutely free of complication; on the contrary, it has its own share of complications and side effects which should be accounted for, but not everything always is due to it [25].

Conclusion

We all are aware that no procedure is absolutely safe and adequate for all patients, and interscalene approach to brachial plexus block is no exception from this rule. However, if following precautions are observed while performing interscalene block, then the complications associated with it can be minimised.

1. Always perform the block on an awake patient or patient under very light sedation <ramsay 3.

2. Any increase in pain, especially severe pain, should warn the anaesthetist of an intraneural injection and the adjustment in needle position should be made accordingly.

3. Avoid performing the block in an uncomfortable non-cooperative patient. General anaesthesia can be the alternative anaesthetic technique in these patients and then other approaches for postoperative analgesia can be adopted.

4. Always use a short bevelled needle ~25–35 mm in size, as most of the complications associated with block are encountered when one probes deeper for locating the brachial plexus.

5. Needle should be entered in the interscalene groove with a posteroinferior direction.

6. As interscalene block is a superficial block, inability to localise brachial plexus at 1–1.5″ should prompt one that the needle may be in wrong plane and one should withdraw and re-enter rather than going more deep.

7. Each patient before undergoing interscalene block must be evaluated for the status of contralateral phrenic and recurrent laryngeal nerve function and if suspected should have a proper ENT examination.

8. Successful initiation of block and surgery does not guarantee outcome, as late complications can occur and constant vigilance and management of respiratory and circulatory system are mandatory.

9. There should be greater education and training for the nerve blocks to the trainee anaesthetist so that persons experienced in its performance are doing it, because complications are less in informed and experienced hands.

10. The greater use of ultrasonographic guidance may further increase the safety of procedure.

11. The physician should ensure that the patient does not move unexpectedly during the procedure and be prepared for it.

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