

Acute hyperventilation leading to hypocalcaemia during spinal anaesthesia

N Kumar¹ MD, S Podder² MD, T Sinha³ MD, GD Puri⁴ MD

1 and 3. Senior Resident, 2. Assistant Professor, 4. Professor. Department of Anaesthesia & Intensive Care, Postgraduate Institute of Medical Education and Research, Chandigarh – 160012, India

Summary

The most common cause of hypocalcaemia under general anaesthesia is acute mechanical hyperventilation, but hypocalcaemia during spinal anaesthesia has not been reported. This case report describes the development of hypocalcaemia due to hyperventilation in a patient undergoing appendicectomy under spinal anaesthesia. The diagnostic features of hypocalcaemia and its treatment are explained in detail.

Key Words: Hypocalcaemia, Spinal anaesthesia.

Introduction

Hypocalcaemia during anaesthesia is a rare entity. Acute onset hypocalcaemia has variable presentations, many of which can be life threatening. The signs and symptoms of hypocalcaemia are characteristic¹, thus can be treated in emergency conditions without waiting for the result of ionized serum calcium measurement. We present a case in which the patient developed hypocalcaemia under spinal anaesthesia.

Case history

A 30 year old male (weight – 65 kg, height – 170 cm) with familial neurofibromatosis, presented for appendicectomy. As the patient was anxious and refused general anaesthesia, spinal anaesthesia was planned. Preoperative investigations were within normal limits.

Under standard monitoring, spinal anaesthesia was performed in the right lateral position in L2-3 space using a 26G Quincke needle. 3.5ml of 0.5% heavy bupivacaine was injected in the subarachnoid space. The desired level of block to T6 was obtained and surgery was allowed to commence. Pethidine 30mg IV was given to control shivering and midazolam 2mg IV was used to sedate the patient. Thirty minutes after the insertion of the spinal, midway through the surgery, the patient became restless, complaining of perioral numbness and of inability to breathe. On examination, the level of sensory block had increased to T4. Chest wall movement was adequate, oxygen saturation was 100% and systolic BP was 100mmHg. The patient was reassured and 1 mg midazolam was given intravenously for further sedation. However, the patient became more restless, dyspnoea and tachypnoea persisted and his speech became slurred. On auscultation,

his chest was clear. Trousseau's sign² was noticed on the left hand, where the sphygmomanometer cuff was placed and inflated for measurement. A blood sample for the measurement of ionized calcium and blood gases was drawn. An infusion of 20 ml of 10 percent calcium gluconate in 100ml of 5% dextrose was given over 20 minutes. The Trousseau sign disappeared five minutes after calcium administration and patient improved symptomatically. After 20 minutes, a second infusion of calcium gluconate was begun and surgery was completed without further complication.

The patient was transferred to the recovery room in a fully conscious and haemodynamically stable state while receiving the calcium gluconate infusion. The intraoperative ECG did not show a prolonged QT interval. The intraoperative ionized calcium level was low (0.6mmol/L) and blood gases showed a respiratory alkalosis (PaO₂ = 160mmHg, PaCO₂ = 22mmHg (2.9kPa, pH = 7.57 and HCO₃ = 18mmol/l). Subsequent calcium concentrations were within the normal range. An endocrinologist was consulted, who did not detect a pathological cause for the episode of hypocalcaemia.

Discussion

The most common cause of decreased total serum calcium is hypoalbuminaemia.¹ This is artifactual as ionized calcium remains normal. The ionized calcium may be roughly estimated by the following formula. Corrected calcium (mmol/L) = Serum calcium (mmol/L) + 0.8 [4-Serum albumin (gm/dl)]. Ionized calcium should be measured whenever true hypocalcaemia is suspected. Binding between calcium and protein is enhanced when serum pH increases, resulting in decreased ionized calcium. An increase from a pH of 7.4 to 7.6 may decrease ionized calcium by 0.25 mmol/L and precipitate tetany.

Respiratory alkalosis secondary to hyperventilation is probably the most common cause of acute ionized hypocalcaemia¹, and this appears to be the case in the operating room.³ However, it has not been reported during spinal anaesthesia. Many patients complain of difficulty in breathing following spinal anaesthesia probably because of loss of proprioceptive sensation from intercostal and abdominal muscles.

Correspondence:

Dr. Subrata Podder, Assistant Professor, Department of Anaesthesia & Intensive Care. Postgraduate Institute of Medical Education and Research Chandigarh – 160012, India
Tel: 91- 172- 745743, Email: Podder_s@yahoo.co.in

In addition, high intercostal paralysis is accompanied by a feeling of suffocation⁴, leading to tachypnoea, hyperventilation and consequent respiratory alkalosis and hypocalcaemia. This is the most likely mechanism in this anxious patient, in whom the level of sensory blockade extended to T4. The manifestations of hypocalcaemia were the presence of Trousseau's sign, irritability, and circumoral paraesthesia. Trousseau's sign presents as carpal spasm secondary to ulnar and median nerve ischemia in response to the inflation of the sphygmomanometer cuff to 20mm Hg above systolic blood pressure.² We did not observe obvious QT interval prolongation although this lacks sensitivity for the diagnosis of hypocalcaemia.⁶

Emergency treatment of hypocalcaemia is elemental calcium, 100 to 300mg (10 to 30 ml of 10% calcium gluconate) diluted in 150 ml of 5% dextrose over 10 minutes. This usually increases the ionized calcium concentration by 0.5 to 1.5 mmol/L.

Although in the operating theatre, it is possible to raise serum CO₂ level by the use of rebreathing of exhaled carbon oxide. The use of semi open systems (Mapleson A to F) with appropriate flow or circle with absorber excluded and a low flow of gases would have achieved it.⁸ The resulting decrease in pH leads to a normalization of ionized calcium level. However, we were not able to use it because of the difficulty encountered in providing a tight mask fitting in a restless patient.

In conclusion, a high level of sensory and motor blockade under spinal anaesthesia can produce such respiratory discomfort (hyperventilation) in anxious patients. This hyperventilation can result in respiratory alkalosis that increases calcium binding to albumin causing hypocalcaemia. Acute hypocalcaemia is an emergency that requires prompt attention. If symptoms of neuromuscular irritability are

present and carpopedal spasm is elicited on physical examination, treatment with intravenous calcium is indicated until the signs and symptoms of hypocalcaemia subside.⁹ Acute onset hypocalcaemia should be suspected and treated accordingly in patients undergoing spinal anaesthesia without waiting for the calcium level.

References

1. Reber PM, Heath H 3rd. Hypocalcaemia emergencies. *Med clin North Am* 1995; 79: 93-106
2. Lebowitz MR, Moses AM. Hypocalcaemia. *Semin Nephrol* 1992;12:146-158
3. Kaye AD, Grogono AW. Fluid and electrolyte physiology. In: Miller RD, ed. *Anesthesia*. Newyork, Churchill Livingstone 2000:1586-1612.
4. Vandam LD. Complications of spinal and epidural anesthesia. In: Orkins FD, Cooperman LH, eds. *Complications in anesthesia*. Philadelphia: JB Lippincott 1983: 75-105.
5. Chakrabarti S, Murugesan A, Arida EJ. The association of neurofibromatosis and hyperparathyroidism. *Am J Surg* 1979;137:417-420
6. Rumancik WM, Denlinger JK, Narworld MR, et al : the QT interval and serum ionized calcium. *JAMA* 1978; 240:366-368.
7. Baran DT. Disorders of mineral metabolism. In: Irwin RS, Rippe JM, eds. *Manual of Intensive Care Medicine*. Philadelphia: Lippincott Williams & Wilkins. 2000:495-497.
8. Jeff Andrews J. Inhaled anesthetic Delivery systems. In: Miller RD, ed. *Anesthesia*. Newyork, Churchill Livingstone 2000:191-194.
9. Bringhurst FR, Demay MB, Kronenberg HM. Hormones and disorders of mineral metabolism. In: Wilson JD, Foster DW, Kronenberg HM, Larsen PR, eds. *Williams textbook of endocrinology*. Philadelphia: WB Saunders, 1998:1155-1209.

Joint travel fellowship, SASA Congress, Sandton City, 2004



Rules for the Medex / Janssen-Cilag Prize

These rules have been drawn up by the South African Society of Anaesthesiologists with representatives from Medex and Janssen-Cilag. They are included in the by-laws of the Society.

1. The participant must be recognized by the HPCSA as a Specialist Anaesthetist.
2. The subject of the paper must be an original presentation and related to Vascular Access or Pain Management and Patient Safety. It need not be based on original research.
3. The Congress Scientific Committee will select the best papers to compete for the award.
4. The recipient must be resident in Southern Africa (neighboring states included).
5. The recipient must undertake to spend at least 2 of the 5 years following the year of the award practicing anaesthesia in Southern Africa.
6. The award will be made regardless of the social, cultural or racial background of the recipient.
7. The recipient shall not have been awarded the prize in the preceding 5 years.
8. Each candidate will be allowed at least 25 minutes for the presentation and 10 minutes for discussion.
9. The intention to participate, the title, and, if required, the full text of the presentation must be submitted to the Congress Organisers before the specific dates prescribed by them.
10. A panel of 3-5 judges will be appointed by the Organizing Committee to judge the presentation at the Congress, and each judge should be aware of and have access to a copy of these rules.
11. The award shall be made on the following basis:
 - 11.1 Applicability to Rule 2 above Vascular Access or Pain Management and Patient Safety;
 - 11.2 Originality of the presentation and contribution to new anaesthetic knowledge.
12. The award shall consist of a return airfare and daily subsistence for a period of 2 weeks in the United States. During this period the recipient will visit the Medex premises in USA and the Janssen-Cilag premises in New Jersey and should visit areas or individuals concerned with his/her special interests in anaesthesia.
13. A report on the trip will be given at the Medex / Janssen-Cilag Alumni Dinner at the Congress immediately following the year in which the prize was won.

**For further information contact
Geoff Gomez at Medex - 082 416 1247**