A reflection on endoscopic resection

A 72-year-old man of 67 kg underwent a transuretral prostate resection. Preoperative laboratory analysis showed a serum creatinine of 80 μmol/l, a sodium concentration of 136 mmol/l, potassium of 4.2 mmol/l and a glucose level of 5 mmol/l. The procedure as such was uncomplicated.

However, postoperatively patient complained about nausea, headache and impaired vision. Laboratory analysis now revealed creatinine of 75 μmol/l and a sodium concentration of 125 mmol/l. Four hours later the patient becomes comatose and develops bradycardia.

Question:
What is the cause of the hyponatraemia and how would you treat this hyponatraemia?
Answer to quiz case on the proceeding page:

The cause of this hyponatraemia is related to the fact that during transurethral resections (but also during transcervical operations or percutaneous lithotripsy) the wound bed is flushed with a hypotonic 1.5% glycine solution (osmolality 180 mosmol/kg). An electrolyte solution cannot be used for this purpose because of the danger of short circuit. Part of this irrigant solution is usually reabsorbed during the procedure (on average about 2 l). Glycine passes the cell membrane and blood–brain barrier only very slowly (halflife in plasma is in the range of hours). In other words glycine initially stays for a large part in the extracellular compartment.

Example

Suppose a total body water of 40 l (60% of body weight) of which 25 l is intracellular and 15 l extracellular volume. If 2 l of 1.5% glycine solution is reabsorbed 360 mosmol will be added to the extracellular volume. The total osmolar content of the extracellular volume will increase to \([15 \times 280] + 360 = 4560\) mosmol. Total plasma osmolality will decrease: \([40 \times 280] + 360 = 42\) (new total body water) \(\times\) new plasma osmolality. The plasma osmolality will thus decrease to 275.2 mosmol/kg. From these two assumptions the new extracellular volume can be easily calculated: 4560 (total osmols in ECV) : 275.2 (new plasma osmolality) = 16.6 l. This increase in extracellular volume will have implications for the plasma sodium concentration: 15 \(\times\) 140 = 16.6 (new ECV) \(\times\) new plasma sodium concentration. The calculated sodium concentration will thus decrease to 126.5 mmol/l. In conclusion, in the early phase after TURP there can be a pseudo-hyponatremia, with an increase in extracellular volume and a near normal plasma osmolality. The validity of these calculations could be experimentally confirmed in glycine-infused animals [1]. Note that such a temporary increase in ECV may compromise the cardiovascular system in some patients.

Nevertheless the patient becomes comatose. Although one might expect an increase in brain water during real hyponatraemia, this probably is not the case in this patient. The blood-brain barrier does not contain transporters for glycine and thus the hypotonic solution stays in the extracellular volume. However, the glycine itself can be toxic. It can act as an inhibiting neurotransmitter and it can be metabolized in the liver to ammonia and lead to hyperammonaemia. The correct diagnosis therefore is glycine intoxication. The appropriate treatment for this condition is haemodialysis.

There are a few alternatives to glycine solution as an irrigant for surgical procedures. In the past sorbitol solution has been proposed as an alternative. However, sorbitol is rapidly metabolized to fructose and glucose and subsequently to CO\(_2\) and water. This metabolic pathway may result in true hypo-osmolality and cerebral oedema. Another possible alternative is mannitol. Mannitol will also result in pseudo-hyponatremia but appears to be more safe with regard to brain toxicity. The drawback of this treatment however is that (due to the long halflife of mannitol in the circulation), the mannitol treatment is accompanied by prolonged volume overload.

Suggested reading:


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