Intraoperative Central Diabetes Insipidus during Aneurysmal Clipping Surgery: An Unusual Phenomenon

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Abstract

Central diabetes insipidus (DI) is a known complication associated with pituitary surgeries occurring in postoperative period. However, development of DI following aneurysmal subarachnoid hemorrhage (SAH) is rarely reported. We describe here a case of intraoperative DI in a patient undergoing aneurysmal clipping surgery that posed a challenge for both diagnosis and management. A 55-year-old female, diagnosed with SAH due to ruptured left middle cerebral artery (MCA) aneurysm, was posted for aneurysmal clipping. A preoperative sudden rebleeding led to neurological deterioration and patient was taken up for the evacuation of hematoma and aneurysmal clipping. Intraoperatively, 2 hours into surgery, polyuria (700–1,000 mL/hour) was noted. Arterial blood gas analysis revealed severe hypernatremia with increased serum osmolality and urine-specific gravity showed hypo-osmolar urine. Possibility of mannitol induced diuresis, overzealous administration of intravenous fluid, and other causes of DI were ruled out. Medical management of DI was initiated and after 45 minutes, urine output was reduced and serum sodium measurements showed decreasing trend indicating responsiveness to treatment. Postoperatively noncontrast computed tomography head showed temporal bleeding with MCA infarct, infarct in thalamic, and hypothalamic region with hydrocephalus. Intraoperative development of central DI was attributed to the evolving ischemic injury to the hypothalamus at the time of rebleeding that was not apparent in preoperative scan. DI resolved postoperatively after 18 hours of medical management. Development of DI during aneurysmal surgery was unexpected and unanticipated. The cause of intraoperative DI was found to be preexisting ischemic injury of hypothalamic region that subsequently evolved to infarct which was not evident in preoperative scan. A careful observation of preoperative scans and vigilant monitoring may help in early diagnosis and management of such complication in perioperative period.

Keywords

► central diabetes insipidus
► intraoperative
► subarachnoid hemorrhage
► intracranial aneurysm

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Introduction

Central diabetes insipidus (DI) is one of the known complications associated with pituitary surgeries mostly occurring in the postoperative period. Even though it has infrequently been linked to aneurysmal clipping surgery, its prevalence is still primarily in postoperative period. There is no description of its intraoperative development in such surgeries as yet. We describe here a case of intraoperative DI in a patient undergoing aneurysmal clipping surgery that posed a challenge for both diagnosis and management.

Case Report

A 55-year-old female, diagnosed with subarachnoid hemorrhage (SAH) with modified Hunt and Hess grade 3 due to ruptured left middle cerebral artery (MCA) aneurysm 2 days back, was posted for aneurysmal clipping. Preoperatively, the patient developed sudden neurological deterioration and an urgent noncontrast computed tomography (CT) scan was done that showed a rebleeding with massive intracranial hemorrhage and left MCA territory infarct (Fig. 1A). The patient was immediately taken up for craniotomy and aneurysmal clipping in the theater where standard neurosurgical monitoring along with arterial blood pressure and central venous pressure (CVP) was instituted. A standard anesthetic management protocol was followed with general anesthesia induction with 1mg midazolam, 100µg fentanyl, 250mg thiopentone, and 6mg vecuronium. After induction, 60g (1gm/kg) of 20% mannitol was given over 30 minutes for brain relaxation. Anesthesia was maintained with propofol infusion 75 to 100µg/kg/min, vecuronium infusion (0.1mg/kg/h), and fentanyl boluses (1µg/kg/h). Goal-directed intravenous fluid administration was done with maintenance of blood gas parameters and normoglycemia. Almost 2 hours after the surgical incision, a high urine output (700–1,000mL) was observed for about 10 minutes, which further increased to 100 to 150mL per minute. Arterial blood gas analysis revealed raised serum sodium (~165 mEq/L) with increased serum osmolality (303 mOsm/L) as compared to preoperative and post-induction baseline serum sodium value of 142 and 138mEq/L, respectively. Urine-specific gravity was found to be 1.005 (hypo-osmolar urine). The hemodynamic measurements were mean arterial pressure (MAP) of 80 to 85mmHg, CVP of 1cm H2O, and pulse pressure variation (PPV) of 18 to 22. Since, all these findings were consistent with DI—intravenous vasopressin infusion started at 5mU/kg/h and titrated within 1 to 10mU/kg/h and maintenance fluid shifted to 0.45% normal saline. After 45 minutes urine output reduced to approximately 200 to 250 mL/h and serum sodium decreased to 155mEq/L and subsequently, vasopressin dose was titrated to maintain serum sodium around 155mEq/L till the end of surgery. Postoperatively, patient shifted to neurosurgical intensive care unit on mechanical ventilation with vasopressin infusion. A CT scan done during this time revealed residual temporal hematoma with infarct in MCA territory and cerebellum and hypodensity in left thalamic region (Fig. 1B). The vasopressin infusion was tapered off within 18 hours following resolution of polyuria and hypernatremia. Patient was electively ventilated for 48 hours. As the patient improved neurologically with Glasgow coma scale of E4V1M5, weaning from mechanical ventilation was initiated. However, the patient developed pulmonary complications and unfortunately succumbed on 5th postoperative day.

Discussion

The sudden onset of intraoperative polyuria in aneurysmal clipping surgery may pose a diagnostic dilemma for the anesthesiologist. The common causes of intraoperative polyuria are overzealous fluid administration, intraoperative use of mannitol, uncontrolled hyperglycemia, anesthetic agent-induced DI with certain differentiating features (Table 1). Osmotic diuresis due to mannitol leads to increased sodium excretion with high urinary osmolality and specific gravity (> 1.005) and decreased serum sodium levels. The patient had no history of diabetes and maintained normoglycemia throughout the perioperative period. Also, common anesthetic agents that can precipitate DI like dexmedetomidine, sevoflurane, and ketamine were not used during anesthetic management. The bedside urine-specific gravity of this patient was found to be less than 1.005 with severe hypernatremia and increased serum osmolality favoring central DI. Following this, we chose to give vasopressin infusion as it has more rapid onset and shorter action (t1/2 10–15 min) contrary to routinely used desmopressin. Also, 0.45% normal saline was initiated and after 45 minutes, urine output was reduced and serum sodium measurements showed decreasing trend further indicating responsiveness to treatment and supporting central DI as the cause of polyuria.

Transient DI is an uncommon complication of SAH that is more often reported with ruptured anterior communicating artery aneurysm and mostly in postoperative period. DI after aneurysmal SAH may be caused by damage to the supraoptic and paraventricular nuclei in the anterior
hypothalamus. These nuclei receive their blood supply from small penetrating branches arising from the anterior cerebral and anterior communicating artery. Intraoperative development of central DI in this patient was attributed to the evolving ischemic injury to the hypothalamus at the time of rebleeding that was not apparent in preoperative scan. However, in postoperative CT scan (6 hours post-procedure) infarct in thalamic/hypothalamic region was evident and was the probable cause of intraoperative manifestation of central DI in this patient with SAH. The likely mechanism of occurrence of transient central DI in spite of ischemic injury to hypothalamic region could be a partial injury to hypothalamus resulting in infarct that led to initial transient DI with subsequent stabilization. The hypothalamic nuclei are present bilaterally and, in this patient, it is evident that there is more hypodensity on the left side than on the right side suggestive of incomplete or partial insult that probably led to transient DI. Alternatively, it could be penumbra zone that recovered following treatment.

**Conclusion**

Development of DI during aneurysmal surgery was unexpected and unanticipated. Initially, common causes of polyuria were considered and ruled out. The cause of intraoperative DI in this case was found to be pre-existing ischemic injury of hypothalamic region that subsequently evolved to infarct which was not evident in the preoperative scan. We suggest carefully observing preoperative scan with cautiously monitoring urine output and electrolytes in the perioperative period may enable anticipation, prompt diagnosis, and management of intraoperative DI.

**Conflict of Interest**

None declared.

**References**


**Table 1** Common causes of polyuria with their differentiating features

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<th>Hemodynamics</th>
<th>Serum osmolarity</th>
<th>Serum Na⁺</th>
<th>Urine osmolarity</th>
<th>Urine specific gravity</th>
<th>Urinary spot Na⁺</th>
<th>Serum glucose</th>
<th>Precipitating drug</th>
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<td>Fluid overload</td>
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<td>Intraoperative mannitol</td>
<td>Hypotension, ↓ CVP, ↑ PPV</td>
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<td>N/ ↓</td>
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Abbreviations: CVP, central venous pressure; DI, diabetes insipidus; PPV, pulse pressure variation.