CASE REPORT

Clinical Case Reports Open Access WILEY

Central diabetes insipidus after total abdominal hysterectomy and bilateral salpingo-oophrectomy: A case report

Aarti Maharaj[1] | Kundan Jana[1] | Brent Boodhai[2] | Kalyana C. Janga[1] | Elie Fein[1] | Sheldon Greenberg[1]

[1]Division of Nephrology, Maimonides Medical Center, Brooklyn, New York, USA

[2]Department of Internal Medicine, Maimonides Medical Center, Brooklyn, New York, USA

Correspondence
Aarti Maharaj, Division of Nephrology and Hypertension, 953 49th street, Room 611, Maimonides Medical Center, Brooklyn, NY-11219, USA.
Email: amaharaj@maimonidesmed.org

Abstract

Postoperative polyuria due to diabetes insipidus (DI) is commonly reported complication of pituitary surgery. However, central DI postabdominal surgery is rare and related to unmasking of pre-existing DI or prolonged surgery with significant intraoperative blood loss. A thorough workup needs to be performed to exclude central DI in such patients.

KEYWORDS
central diabetes insipidus, hysterectomy, postoperative polyuria, prolonged surgery

1 | INTRODUCTION

Postoperative polyuria is a well-documented complication of prolonged surgeries. The increased sympathetic drive during surgery leads to stimulation of vasopressin and aldosterone. This stimulation, coupled with the large amounts of intravenous fluid patients receive during surgery, promotes fluid retention.[1] Decrease in the levels of vasopressin and aldosterone after surgery causes release of retained fluids leading to polyuria. However, polyuria can also be caused by diabetes insipidus (DI). While postoperative DI can be transient or permanent depending on the extent of injury to the pituitary gland, it is most commonly associated with pituitary surgeries.[2] Very few cases of DI after abdominal surgeries have so far been reported. Here, we report the case of a 48-year-old woman who developed central DI (CDI) due to prolonged abdominal surgery with significant intraoperative blood loss.

2 | CASE PRESENTATION

A 48-year-old woman was presented with a one-year history of heavy, irregular vaginal bleeding. She was hemodynamically stable at presentation, and physical examination was unremarkable. Bimanual examination revealed the cervix to be thin and dilated to 8 cm, with a large mass protruding from the external os suspicious for an aborting myoma. Initial laboratory investigations are summarized in Table 1. A total abdominal hysterectomy (TAH) and bilateral salpingo-oophorectomy (BSO) were planned, and she was optimized with blood transfusions, IV fluids, and tranexamic acid.

Her surgical course was complicated by left ureteral injury requiring left intravesical ureteral reimplantation and left ureteral stent placement. Serum osmolality increased from 287 mosm/kg, on admission, to 322 mosm/kg. Urine electrolytes at this time showed urine osmolarity

TABLE 1 Laboratory values of the patient during course of hospitalization

		POD #1	POD #3	POD #5	At discharge
Urinalysis	Urine osmolality (mosm/kg)	93	218	264	315
	Urine sodium (mmol/l)	23	72	117	53
	Urine potassium (mmol/l)	9	16	15	16
	Urine chloride (mmol/l)	30	87	99	98
	Urine creatinine (mg/dl)	23.5	27.2	12.9	67.3
	Urine-specific gravity	1.005			
Metabolic Profile	Glucose (mg/dl)	88	123	99	96
	BUN (mg/dl)	2.86	7.62	5.62	3.56
	Creatinine (mg/dl)	0.7	1	0.5	0.5
	Serum sodium (mmol/l)	144	156	140	139
	Serum potassium (mmol/l)	3.4	3.6	3.6	4
	Serum chloride (mmol/l)	112	122	113	109
	Serum albumin (g/dl)	3.8			
	Serum osmolality (mosm/kg)	291			

Abbreviations: BUN, Blood urea nitrogen; POD, postoperative day; units in parentheses.
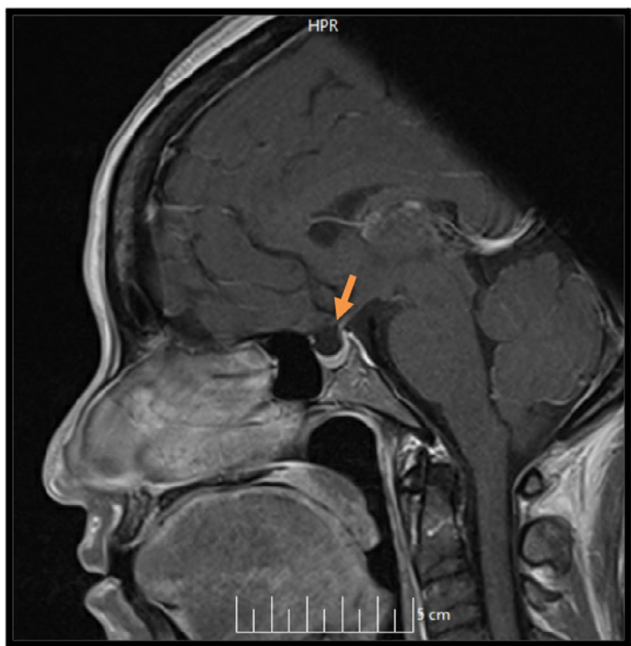

FIGURE 1 Sagittal view of the MRI brain highlighting loss of the pituitary bright spot (orange arrow)

of 93 mosm/kg, urine sodium of 23 mmol/L, urine chloride 30 mmol/L, urine potassium of 9.0 mmol/L, and urine creatinine of 23.5 mg/dl. Twenty-four urinary outputs on postoperative day 1 were 7.1 and 11.9 L on postoperative day 2. She was extubated on postoperative day 2. Renal ultrasonography (day 4 postoperation) showed adequate placement of the left ureteral stent with left hydronephrosis.

Given the timeline of events, it was unclear whether the polyuria was secondary to ureteral injury and postobstructive diuresis, versus DI. She was treated with 2 mcg of intravenous desmopressin for two consecutive days. There was a marked reduction in 24-h urine output to 4.2 L and increased urine osmolarity (315 m Osm/kg). Brain MRI showed the absence of the posterior pituitary bright spot, consistent with posterior pituitary dysfunction, and suggestive of CDI (see Figure 1). Further investigation revealed normal ACTH, cortisol, TSH, and IgG levels. She was encouraged to drink to meet the demand of her thirst level and was treated with desmopressin when, (1) her urine output was more than 300 ml/h for three consecutive hours, and (2) serum sodium was more than 145 mmol/L. She was discharged on desmopressin 0.1 mg daily.

3 | DISCUSSION

Diabetes insipidus is a form of polyuria-polydipsia syndrome and is characterized by excessive hypotonic polyuria (>50 mL/kg body weight/24 h) and polydipsia (>3 L/day).[3] It is characterized by the body's inability to retain free water and typically presents with polyuria, insatiable thirst, and symptoms associated with dehydration. It is a rare disease with a prevalence of 1 in 25,000 individuals or about 0.004% of the global population, with no gender predilection.[4,5]

Diabetes insipidus may occur due to four fundamentally different defects in the physiological control of water balance including (1) impaired antidiuretic hormone (ADH) secretion (CDI), (2) impaired renal response to ADH (nephrogenic DI), (3) excessive fluid intake (primary polydipsia), or (4) increased metabolism

of ADH (gestational DI).[3] The diagnostic challenge for the clinician is to confirm the presence of polyuria and to distinguish between the various disease processes. The reliable distinction between the different etiologies of DI is imperative since the treatment differs substantially. In this case report, we focus on CDI, which was diagnosed after TAH and BSO, complicated by ureteral injury.

Central DI is the most common type of DI. It results from inadequate synthesis of ADH by the supraoptic or paraventricular nuclei in the hypothalamus or impaired release of ADH from the posterior pituitary gland.[3] Acquired factors such as iatrogenic postneurosurgery (20%), hypothalamo-neurohypophyseal axis lesions (20%), and head trauma (16%) account for the majority of cases.[6] The inherited/familial causes account for 1% of CDI cases. Additionally, a large proportion of the CDI cases (30%–50%) is idiopathic and has been associated with autoimmune destruction of the hormone-secreting cells in the hypothalamic nuclei.[7]

While most of the postoperative DI cases reported have been associated with pituitary/cranial surgery, cases of DI after abdominal surgery are very rare. The diagnosis of an isolated posterior pituitary dysfunction was made after gynecological surgery in one case,[8] whereas one patient was reported to have developed DI after liver transplantation surgery.[9] The cause of DI in the latter case has not been clearly delineated. Other causes reported include cobalt-induced DI from hip prosthesis and propofol-induced DI.[10,11]

Our patient developed CDI, as evidenced by the MRI findings and response to desmopressin, after surgery. The surgery itself was prolonged and had a complicated course with extensive blood loss (more than 2 L) requiring multiple transfusions. The patient was having heavy, irregular menstrual bleeds for more than a year before surgery. Coupled with this, the large amounts of blood loss during surgery could have contributed to posterior pituitary ischemia leading to impaired synthesis and release of ADH.

The presence of intraoperative ureteral injury, with subsequent development of hydronephrosis, created suspicion for postobstructive diuresis as the culprit of patient's polyuria. Therefore, the key step in identifying DI in this case was the presence of hypotonic urine (urine osmolarity of 90 mosm/kg).

The indirect water deprivation test has been documented as the gold standard for diagnosing DI. It involves depriving the patient of fluids and regularly measuring the patient's urinary excretion, urine osmolality, plasma sodium, and plasma osmolality. The fluid deprivation is continued for seventeen hours until plasma concentration is greater than or equal to 150 mmol/L or until there is a 3%–5% loss of the patient's body weight.[12] After exogenous

administration of synthetic ADH or desmopressin, the patient's urine osmolarity is measured and compared to the osmolarity before desmopressin. At the end of water deprivation, the urine osmolarity for healthy individuals should be above 800 mosm/kg, with no increase in urine osmolarity following desmopressin administration. Both nephrogenic and CDI will have urine osmolarity below 300 mosm/kg after water deprivation.[13] Although the indirect water deprivation test was not officially performed for this patient, after fourteen hours of fasting, she was noted to have urine osmolarity of 93 mosm/kg. The response to desmopressin differentiates nephrogenic DI and CDI. After desmopressin, urine osmolality will increase more than 50% for CDI and less than 50% for nephrogenic DI. Our patient's urine osmolarity increased from 93 to 315 mosm/kg after administration of desmopressin, pointing to a diagnosis of CDI.

Further workup in patients with CDI includes biochemical evaluation of a morning plasma measurement of pituitary hormones (growth hormone, ACTH, TSH, FSH, and LH) and hormones from their target organs. An MRI of the sella and suprasellar regions with gadolinium would identify any anatomical pituitary or hypothalamic disruptions (macroadenomas, empty sella, and infiltrative diseases). The normal posterior pituitary demonstrates hyperintensity on T1 images (also known as the "bright spot"), suggested to be due to phospholipid-rich granules storing AVP and oxytocin.[14] As seen in this case, the absence of this bright spot could indicate an absence of posterior pituitary function (see Figure 1).

To avoid the main adverse effect of hyponatremia, the minimum desmopressin dose required to control symptoms should be started. A retrospective review has shown that 27% of CDI patients show mild hyponatremia on routine electrolyte testing and 15% develop more severe hyponatremia over long-term follow-up.[15]

In conclusion, accurate diagnosis of DI and ascertaining the underlying cause pose a challenge in present clinical practice. The appropriate diagnosis is critical to ensure improved quality of life for the patient. The first step in approaching patients with polyuria-polydipsia syndrome is appropriate medical history and examination, baseline laboratory assessment using serum electrolytes, and urine osmolarity. The indirect water deprivation test, although cumbersome, can provide a diagnosis with increased accuracy. There is also promising potential for the utility of copeptin levels in the future. Most ambulatory patients remain eunatremic due to the compensatory thirst mechanism associated with DI. However, desmopressin remains widely used in the treatment of DI. It is recommended to start with the lowest dose of desmopressin to achieve symptom control without precipitating hyponatremia.

ACKNOWLEDGEMENT
None.

CONFLICT OF INTEREST
None.

AUTHOR CONTRIBUTIONS
AM and KJ reviewed the literature and wrote the manuscript; BB contributed in the direct management of the patient discussed in the case as well write up of the case presentation and discussion; KCJ, EF, and SG conceptualized the idea and were involved in the treatment of the patient; all authors read and approved the final version of the manuscript.

ETHICAL APPROVAL
None.

CONSENT
Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

DATA AVAILABILITY STATEMENT
It is included in the case report.

ORCID
Kundan Jana https://orcid.org/0000-0002-7804-9344

REFERENCES
1. Kristof RA, Rother M, Neuloh G, Klingmuller D. Incidence, clinical manifestations, and course of water and electrolyte metabolism disturbances following transsphenoidal pituitary adenoma surgery: a prospective observational study. *J Neurosurg*. 2009;111(3):555-562. doi:10.3171/2008.9.JNS08191
2. Schreckinger M, Szerlip N, Mittal S. Diabetes insipidus following resection of pituitary tumors. *Clin Neurol Neurosurg*. 2013;115(2):121-126. doi:10.1016/j.clineuro.2012.08.009
3. Robertson GL. Diabetes insipidus. *Endocrinol Metab Clin North Am*. 1995;24(3):549-572.
4. Kalra S, Zargar AH, Jain SM, et al. Diabetes insipidus: the other diabetes. *Indian J Endocrinol Metab*. 2016;20(1):9-21. doi:10.4103/2230-8210.172273
5. Christ-Crain M, Bichet DG, Fenske WK, et al. Diabetes insipidus. *Nat Rev Dis Primers*. 2019;5(1):54. doi:10.1038/s41572-019-0103-2
6. Adams NC, Farrell TP, O'Shea A, et al. Neuroimaging of central diabetes insipidus-when, how and findings. *Neuroradiology*. 2018;60(10):995-1012. doi:10.1007/s00234-018-2072-7
7. Maghnie M, Cosi G, Genovese E, et al. Central diabetes insipidus in children and young adults. *N Engl J Med*. 2000;343(14):998-1007. doi:10.1056/NEJM200010053431403
8. Adali E, Kucukaydin Z, Adali F, Yildizhan R. Isolated impairment of posterior pituitary function secondary to severe postpartum haemorrhage due to uterine rupture. *Gynecol Endocrinol*. 2011;27(8):541-542. doi:10.3109/09513590.2010.501877
9. Pal A, Malik A, Goyal N. Postoperative diabetes insipidus in liver transplantation - a case report. *Indian J Anaesth*. 2019;63(6):497-498. doi:10.4103/ija.IJA_895_18
10. Shaheen A, Dobish M, Gleason V, Setren A, Stem J, Kohl BA. A 61-year-old woman develops polyuria after hip revision. *J Surg Case Rep*. 2016;2016(5):rjw079. doi:10.1093/jscr/rjw079
11. Soo J, Gray J, Manecke G. Propofol and diabetes insipidus. *J Clin Anesth*. 2014;26(8):679-683. doi:10.1016/j.jclinane.2014.02.012
12. Refardt J, Winzeler B, Christ-Crain M. Diabetes insipidus: an update. *Endocrinol Metab Clin North Am*. 2020;49(3):517-531. doi:10.1016/j.ecl.2020.05.012
13. Refardt J. Diagnosis and differential diagnosis of diabetes insipidus: update. *Best Pract Res Clin Endocrinol Metab*. 2020;34(5):101398. doi:10.1016/j.beem.2020.101398
14. Brooks BS, el Gammal T, Allison JD, Hoffman WH. Frequency and variation of the posterior pituitary bright signal on MR images. *AJR Am J Roentgenol*. 1989;153(5):1033-1038. doi:10.2214/ajr.153.5.1033
15. Behan LA, Sherlock M, Moyles P, et al. Abnormal plasma sodium concentrations in patients treated with desmopressin for cranial diabetes insipidus: results of a long-term retrospective study. *Eur J Endocrinol*. 2015;172(3):243-250. doi:10.1530/EJE-14-0719