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Original Article

INCIDENCE OF CENTRAL DIABETES INSIPIDUS AMONG THE PATIENTS UNDERGOING PITUITARY TUMOR SURGERY THROUGH TRANS SPHENOIDAL APPROACH.

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Abstract

Background: Diabetes insipidus (DI) is a common complication following pituitary surgery. This condition can be transient or permanent and the signs and symptoms of this disorder can be mimicked by the normal postoperative course.

Objective: This study was carried out to find out the incidence of central diabetes insipidus (DI) among the patients undergoing pituitary tumor surgery through trans-sphenoidal approach either endoscopic or microsurgical for the first time.

Study Design: Cross sectional observational study

Methods: Patients with central (Neurogenic) diabetes insipidus prior to surgery, co-morbidities like diabetes mellitus, kidney diseases, electrolyte imbalance, recurrent cases were excluded from this study. Patients were followed up to 7th postoperative day by recording and analyzing findings of postoperative serum electrolytes, urinary specific gravity, hourly urinary volume for establishing diabetes insipidus.

Results: 76.9% of patients developed diabetes insipidus and 70.0% of patients did not develop diabetes insipidus those who underwent pituitary tumour surgery by trans-sphenoidal endoscopic approach; 23.1% of patients developed diabetes insipidus and 30.0% of patients did not develop diabetes insipidus those who underwent pituitary tumour surgery by trans-sphenoidal microsurgical approach.

Conclusion: Prediction of DI help us in pre-operative counseling and post-operative management of the patients as well as to reduce complications related morbidity after pituitary tumor surgery.

Key Word : Diabetes Insipidus, Pituitary Tumor Transsphenoidal .

Introduction

The pituitary gland is a remarkable organ that is located at the base of the brain at the center of the skull base. The most common pituitary- related pathologies that are surgically treated are pituitary tumors (mostly adenomas) and pituitary apoplexy. Transcranial approaches to the sella for treating pituitary pathologies have been in existence since the late 19th century. In the early 1900s, Hirsch described a trans nasal approach to the sella turcica that was refined by Gushing, who standardized the trans labial, transseptal, transsphenoidal approach to the pituiary gland. Recently, given the technologic enhancements in endoscopic visualization and instrumentation, the endonasal endoscopic transsphenoidal approach has gained popularity for addressing pathology of the pituitary gland[1].

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Results

Demographic and calculus data of 50 patients are summarized in Table- I. Their mean (SD) age was 39 (12.7) years (ranging from 16 to 65 years) presented with mean serum creatinine level of 1.63 (0.26) mg/dl, of those 07 patients had serum creatinine level of >2.0mg/dl. Twenty eight (56%) patients required open surgery, 12 patients (24%) treated by ESWL while 10 patients (20%) needed surgery with ESWL. Preoperative stenting was done in 08 patients for the stone at lower calyxes and ureter (Table-II). Follow up after 3rdmonth, overall 27 patients (54%) showed improvement,19 patients(38%) showed stabilization and 04 patients (8%) showed deterioration in their renal function (Table-III). Stone clearance was achieved in 38 patients (76%), while 12 patients had residual fragments. Seven out of 12 patients of residual fragment at lower calyces cleared with ESWL after 3rd month and 05 patients had sent to Urologist for ancillary procedure in the form of PCNL, ureteric catheterization or stenting etc. Of seven factors assessed age <40 years, duration of symptoms <6 months, stone burden <5 cm2 and single urinary stone were found statistically significant; while associated disease, associated urinary infection and residual fragments had no significant impact on renal functional outcome after 3rd month of treatment (Table-IV). Renal recoverability was also assessed by the impression made from pre and post treatment graph of DTPA isotope renogram (normal functioning or mild, moderate and severe impairment), though it was not statistically tested (Table-V & VI).

There are two subtypes of DI: nephrogenic and central (neurogenic). Nephrogenic DI occurs when there is an inadequate response to AVP in the renal tubules, leading to an inability to concentrate urine; this can be caused by certain drugs, hypercalcemia, and primary kidney diseases[2]. Central diabetes insipidus (DI) is a significant postoperative complication of pituitary tumor resection.

Most cases of DI after pituitary surgery have been reported as transient, resolving within the first few days postoperatively. Nevertheless, studies report permanent DI ranging from 0.5% which constitutes a noteworthy risk[3]. The overall incidence of any postoperative (transient or permanent) DI in trassphenoidal pituitary surgery series has been reported to range from 1.6 to 31%[4].

Polyuria is common after transsphenoidal surgery; however it is not always due to DI. In fact, the most common cause of polyuria in the postoperative setting is diuresis of intravenous fluids administered in the perioperative period. Other causes of postsurgical polyuria include hyperglycemia and diuretic administration. These should be considered and excluded before treatment of DI is initiated.

Unfortunately, there are a wide range of measurements that have been used to establish a diagnosis of DI in the literature. For example, various authors have reported different thresholds of elevated urine output that should raise suspicion for DI, such as 30 ml/kg/day, >250-500ml/hr for 3 consecutive hours and 2.5-18 L/day. Urine specific gravity <1.005 is often used as a diagnostic parameter of DI[5]. Urine osmolality <300 mOsm/kg and serum osmolality >300 mOsm/kg are also thought to be diagnostic of DI[5]. In addition, one should be suspicious of DI when serum sodium increases to levels >140-145 mequiv/L[5,6].

Transient DI is commonly seen after transsphenoidal pituitary surgery. With a transnasal microsurgical approach, the rate of transient DI has been reported between 1.6 and 45.6%6. The incidence of temporary DI following a transnasal endoscopic approach has been reported between 2.5 and 15.2%[7]. Similar studies have shown that the rate of DI is roughly the same between transnasal microscopic resection and transnasal endoscopic resection[8].

Materials and Methods

This cross sectional type of observational study was carried out in the department of Nerurosurgery, Bangabandhu Sheikh Mujib Medical University July, 2013 to June, 2014 on 33 consecutive patients who underwent surgical intervention for pituitary tumor for the first time through trans sphenoidal approached either endoscopic or microsurgical technique. Patients with central (Neurogenic) diabetes insipidus prior to surgery, co-morbidities like diabetes mellitus, kidney diseases, electrolytes imbalance, recurrent cases were excluded from this study. All patients are evaluated by detailed history, thorough general and neurological examination. Patients are followed up to 7th postoperative day. Findings of postoperative serum electrolytes, urinary specific gravity and hourly urinary volume were recorded and analyzed for establishing diabetes insipidus. Data collection sheet was used to collect necessary information. Informed written consent was taken from each participant or guardian before data collection. Data was processed by computer program and results were described in frequencies or percentage.

Results

The age range was from 24 to 70 years. Mean age of the patients was 40.51±10.58 years. Maximum patients (73.4%) were in between 21 to 50 years. Most patients were male with a male female ratio was 1.53:1.

Table-I
Distribution of patients according to age (n=33)

Age	Frequency	Percentage
<30	6	18.2
31-40	15	45.5
>40	12	36.4
Total	33	100.0
Mean ± SD	40.51 ± 10.58	
Range (Min -Max)	24-70	

Table -2
Distribution of patients according to gender (n=33)

Gender	Frequency	Percentage
Male	20	58.6
Female	13	41.4
Total	33	100.00

Table - 3
Distribution of patients according to pre operative image finding (diameter of tumour) (n=33)

Tumor diameter (mm)	N(%)	Mean ±SD	Min -Max
<30	12(36.4)	21.91 ± 4.10	15-25
≥30	21(63.6)	35.28±5.36	30-50
Total	33(100.00)	30.42±8.15	15-50

Table - 4
Distribution of patients according to operative procedure (n=33).

Preoperative image finding	Frequency	Percentage
Trans sphenoidal endoscopic	24	72.7%
Trans sphenoidal Microsurgical Approach	9	27.3
Total	33	100.0

Table - 5
Distribution of patients according to increased and normal Na+ concentration (n=33)

Normal Na+ concentration	Frequency	Percentage
<145	19	57.6
≥145	14	42.4
Total	33	100.0

Table - 6
Distribution of patients according to development of diabetes insipidus (DI) (n=33).

Develop ment of DI	Frequency	Percentage
Absent	20	60.6
Present	13	39.4
Total	33	100.00

Table - 7
Distribution of patients according to postoperative day of development of diabetes insipidus (DI) (n=13).

Postoperative Day of development of DI	Frequency	Percentage
First	10	76.9
Second	3	23.00

Table - 8
Development of diabetes insipidus (DI) in age groups

Age	Diabetes insipidus (DI)		
	Present n (%)	Absent n (%)	p value
<30	3(23.1)	3 (15.0)	
31-40	5 (38.5)	10(50.0)	
>40	5 (38.5)	7(35.0)	
Total	13 (100.0)	20 (100.0)	0.764

Table - 9
Development of diabetes insipidus (DI) in gender groups

Gender	Diabetes insipidus (DI)		
	Present n (%)	Absent n (%)	p value
Male	5(39.5)	15(75.00)	
Female	8(60.5)	5(25.00)	
Total	13(100.0)	20(100.00)	0.035

Table - 10
Development of diabetes insipidus (DI) in tumour size groups

Tumour diametei (mm)	Diabetes insipidus (DI)		
	Present n (%)	Absent n (%)	p value
<30	4 (30.8)	8 (40.0)	
>30	9 (69.2)	12 (60.0)	
Total	13 (100.0)	20 (100.0)	0.590

Table- 11

Distribution of patients according to development of diabetes insipidus (DI) in patients having Na+ concentration ≥145 mmol/L

Development of DI	Frequency	Percentage
Present	13	92.9
Absent	1	7.1

Most of the patients (92.9%) having Na+ concentration ≥ 145 mmol/L had DI.

Table -12

Development of diabetes insipidus (DI) in operative procedures

Operative procedure	Diabetes insipidus (DI)		p value
	Present(%)	Absent n (%)	
Transs phenoidal Endoscopic Approach	10(76.9)	14(70.00)	0.712
Trans sphenoidal Microsurgical Approach	3(23.1)	6 (30.0)	
Total	13 (100.0)	20 (100.0)	

Fisher exact test was done to measure the level of significance.

76.9% of patients developed diabetes insipidus and 70.0% of patients did not develop diabetes insipidus those who underwent pituitary tumour surgery by trans-sphenoidal endoscopic approach; 23.1% of patients developed diabetes insipidus and 30.0% of patients did not develop diabetes insipidus those who underwent pituitary tumour surgery by trans-sphenoidal microsurgical approach. There was no significant deference between the approaches were found. Fisher exact test was done and p-value was 0.7[12].

Discussion

Incidence of DI in our study is 39.4% which is similar to other study and DI occurred in 86.3% of the affected patient on the second postoperative day6. It was found that 71.2% of the patients manifested DI within 24 hours of undergoing surgical intervention9. In our study we found that 76.9% of the patients developed DI on the first postoperative day and 23.0% of the patients developed DI on the second postoperative day. Our observation is in agreement with reports of postoperative DI generally occurring within 24 hours of the surgical procedure.

It was found that DI is commonly seen after trassphenoidal pituitary surgery. With transnasal microsurgical approach the rate of development of DI ranges between 1.6% and 45.6%. In our study 23.1% of patients develop DI who underwent transsphenoidal microsurgical approach for surgical removal of pituitary macroadenoma which was within range according to above studies[6].

It was found that the incidence of DI following a transnasal endoscopic approach between 2.5% and 15.2%. In our observation we found that 76.9% of the patients developed DI who underwent pituitary tumour resection by transsphenoidal endoscopic approach. Our incidence of DI is much more than that of Jho HD's findings[7].

Development of hypernatraemia within five days postoperatively was strongly associated with postoperative DI (transient or permanent) (p=<0.0001). Of the 14 patients who had a serum sodium level >145mmol/L within the first five days postoperatively, all 14 met criteria for DI. In our study among the 33 patients 13 of them developed hypernatraemia (serum sodium level >145mmol/L) within first two days postoperatively and all the 13 met the criteria for DI. So, in our study we also found that there was a strong association between postoperative hypernatraemia with DI[10].

Some authors have shown that DI is more common after the resection of macroadenoma. The circumstance is likely to be caused by the more aggressive gland and stalk manipulation required during resection as well as changes in sellar and suprasellar anatomy in patients with macroadenoma[11].

It was found in their that among the patients who had a pituitary adenoma and no preoperative DI, 69.4% had macroadenomas. Microadenomas were found in 30.6% of patients[11]. Diabetes insipidus was more likely to be diagnosed in patients with microadenomas (21.6% developed postoperative DI) than with macroadenomas (14.3% developed postoperative DI) (p=0.049). They found that adenoma size had no impact on the development of persistent DI. In our study all the 33 patients had macroadenoma. Among them 63.6% had tumour diameter >30mm and 36.4% had tumour diameter <30mm. In >30mm tumour diameter group 69.2% developed postoperative DI and <30mm tumour diameter group 38.8% developed postoperative DI (p=0.590). It was statistically insignificant. So, we could predict that large tumour size has no impact on the development DI. But we could not compare with microadenomas because in the perspective of our country we only found macroadenomas.

Trans-sphenoidal surgery, include more than 95% of the surgical indications in the sellar area and approximately 96% of all pituitary adenomas (Jho et al., 2012). However, a recent meta-analysis by Goudakos et al. found that postsurgical DI was less frequent in

those who underwent endoscopic surgery compared to those who had microsurgical resection (15% vs. 28%, p =0.03)12. In our study approach did not influence much the postoperative diabetes insipidus (p=0.0712) which does not correspond with meta-analysis of Goudakos et al[12].

Conclusion

Post operative DI after pituitary tumour surgery is a burning issue for the neurosurgeon because some time it is an independent predictor for the morbidity of the patients. Early prediction of this notorious complication is helpful for post operative management of the patient. Along with thirst and polyuria, hypernatraemia may be the confirmatory for the diagnosis of DI. It may be the single predictor for DI diagnosis. This will help us in preoperative counseling and postoperative management of the patients as well as to reduce complications related morbidity after the pituitary tumour surgery.

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