Journal of Clinical Neuroscience 43 (2017) 240–246

Contents lists available at ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Technical note

Preservation of hormonal function by identifying pituitary gland at endoscopic surgery

Stefan Linsler [a,*], Renate Hero-Gross [b], Bettina Friesenhahn-Ochs [c], Salman Sharif [d], Frank Lammert [c], Joachim Oertel [a]

[a] Klinik für Neurochirurgie, Universitätsklinikum des Saarlandes, Homburg, Deutschland, Germany
[b] Gesundheitszentrum am Markplatz, Praxis für Endokrinologie, Homburg, Deutschland, Germany
[c] Klinik für Innere Medizin II, Gastroenterologie, Hepatologie, Endokrinologie, Diabetologie und Ernährungsmedizin, Universitätsklinikum des Saarlandes, Homburg, Deutschland, Germany
[d] Department of Neurosurgery, Liaquat National Hospital and Medical College, Karachi, Pakistan

ARTICLE INFO

Article history:
Received 4 April 2017
Accepted 19 June 2017

Keywords:
Pituitary surgery
Endoscopy
Hypopituitarism
Hormonal dysfunction

ABSTRACT

Objective: The endonasal endoscopic approach has been established for perisellar tumor surgery with a higher resection rate and reduced complications. We analyzed the potential to identify the pituitary gland under endoscopic view, at surgery and see its relation to postoperative hormonal insufficiency in endonasal endoscopic procedures.

Methods: Between January 2011 and January 2014, 70 cases of pituitary adenomas with preoperative intact pituitary function underwent endoscopic endonasal transsphenoidal procedures for intrasellar pathologies. Endocrinologists and neurosurgeons followed these patients prospectively. Special attention was paid to intraoperative identification of gland tissue, surgical complications, degree of resection and postoperative hormonal insufficiency.

Results: The pituitary gland was identified in 57 out of 70 procedures (81.4%). Eleven percent (8 of 70 patients) had persistent pituitary insufficiency. Two of these 8 patients belonged to the group with pituitary gland identification (2 out of 57); thus, when the pituitary gland was identified during the procedure postoperative hormonal insufficiency was seen in 3.5% of cases. Failure of pituitary gland identification presented with hormonal insufficiency of 46.2%. In analysis with Fisher's exact test, there was a high significant correlation between the identification of the pituitary gland intraoperatively and normal pituitary function postoperatively ($p < 0.005$). On follow up radical tumor resection was seen in 88% (62 of 70 patients).

Conclusions: This study indicates that identification and preservation of pituitary gland tissue and function is possible in endoscopic transsphenoidal surgery. This preservation of gland tissue is a positive predictor of postoperative normal pituitary function.

1. Introduction

The microsurgical transsphenoidal approach was investigated and established over almost a century of research [1]. It used to represent the "gold standard" for surgical treatment of sellar lesions for neurosurgical community [2–6]. However, further developments of endoscopic techniques and its applications in neurosurgery influenced also transnasal approaches [7–16]. Continuous efforts to improve surgical techniques are still being made [17–24]. Many publications on endonasal endoscopic surgery stress the less invasive nature of this technique, [25–27] providing a wider field of view. Additionally, angled telescopes allow inspection of retrocarotid, intracavernous and suprasellar space [28]. Endocrinologic results similar to those obtained by traditional transsphenoidal microscopic surgery were reported initially [23,29–32]. Recently, publications point to a better endocrinologic outcome for functioning adenomas when using endoscopy

Abbreviations: CSF, cerebrospinal fluid; CT, computer tomography; MRI, magnetic resonance imaging; AIDA, Advanced Image and Data Acquisition; GH, growth hormone; IGF-1, Insulin-like growth factor; ACTH, adrenocorticotropic hormone; LH, luteinizing hormone; FSH, follicle stimulating hormone; OGTT, oral glucose tolerance test.

* Corresponding author at: Klinik für Neurochirurgie, Universität des Saarlandes, 66421 Homburg/Saar, Germany.
E-mail address: stefan.linsler@uks.eu (S. Linsler).

http://dx.doi.org/10.1016/j.jocn.2017.06.045
0967-5868/

compared with the results reported in the literature using the traditional technique [33–35].

Preservation and restoration of pituitary function after surgery have been attempted over time [28–34]. However, there is a lack of detail reporting about pituitary insufficiency following endoscopic endosellar procedures in the literature. Only very recently Laws et al. reported on a large series of endoscopic procedures and its related postoperative hormonal function [36]. Evidence that the high magnification of the endoscope correlates with an improved identification of pituitary gland tissue and a decrease of postoperative hormonal insufficiency is missing.

Thus, the authors report the results of endonasal endoscopic surgery of pituitary adenomas with special attention to intraoperative gland tissue identification, endocrinological outcome and postoperative hormonal function.

2. Clinical material and methods

2.1. Patient's criteria

Between January 2011 and January 2014, 99 patients with intra- or perisellar pituitary adenomas underwent transnasal procedures via an endonasal endoscopic transsphenoidal approach at the Department of Neurosurgery of Saarland University. All procedures were performed by one of the authors. All patients with preoperative hormonal deficiencies were excluded. Seventy out of 99 patients were included in this study. The patient population consists of 29 males and 41 females. The mean age at surgery scored 55.5 years with a range of 21–87 years. An interdisciplinary team of neurosurgeons and endocrinologists followed up all patients.

2.2. Perioperative management

All patients underwent preoperative endocrine and visual function evaluations including formal visual field testing. Postoperative visual evaluations were performed only in patients who showed preoperative visual impairment or presented visual symptoms postoperatively. Pre- and postoperatively, all patients had endocrine evaluations by one of the authors. The postoperative visits were performed during the patients' in-hospital stay within the first week after surgery and six weeks after surgery, followed by a variable time schedule depending on their clinical and hormonal findings. Preoperative and postoperative magnetic resonance imaging after 3–6 months was obtained as a routine. Pituitary gland and pituitary stalk was identified – if possible- in preoperative MR imaging by neuroradiologist. All patients received a perioperative "stress dose" of hydrocortisone.

2.3. Endoscopic surgical technique

All surgical procedures were performed via mononostril transsphenoidal approach to sellar region as described before [25,26]. The sellar region was inspected with the endoscope after tumor removal, and the pituitary gland was identified intraoperatively by the neurosurgeon as shown in Fig. 1. Sellar packing was performed with gelfoam and fibrin glue routinely. The steps of the endoscopic procedure are illustrated in Fig. 1 in detail.

The endoscopic equipment consists of a series of various rigid-rod lens Hopkins telescopes, a Xenon cold light source, a digital one-chip camera, a high-resolution video monitor screen and a digital recording system (AIDA). All equipment was provided by Karl Storz Company, Tuttlingen, Germany. All procedures were video recorded. The surgical technique was carefully analyzed by another neurosurgeon blinded to endocrinological outcome. Special attention was paid to identification of the pituitary gland, to complications and to surgical radicality. The identification of the pituitary gland tissue was documented by the performing neurosurgeon (SL, JO).

2.4. Neurosurgical and endocrinological follow up

All patients were prospectively followed up for this study in the outpatient clinic until December 2016. The mean follow-up period was 42 months (range 3–61 months).

Follow-up examinations in outpatient clinic were performed at six weeks, 4–6 months and then on a yearly basis postoperatively. This schedule was altered depending on their clinical and hormonal findings. Postoperative magnetic resonance imaging was performed after 4–6 months and then on a yearly basis.

Patients were routinely seen by an endocrinologist for medical treatment, or for remission in case of secreting adenomas, and for control of pituitary function.

The criterion for remission in prolactinomas was the normalization of the postoperative serum prolactin level checked at least 6 weeks postoperatively and after withdrawal of any dopamine agonists within the same period. Remission in acromegaly was assessed by normalization of both serum GH and IGF-I and the suppression of GH (<1 ng/ml) after OGTT [37]. Normalized or suppressed serum ACTH and cortisol levels and 24-h urinary free cortisol concentrations were required to assess the remission in Cushing disease [38]. Insulin tolerance test was performed on patients who did not show evidence of corticotropic axis insufficiency after surgery before stopping hydrocortisone medication.

The thyrotropic axis evaluation included serum levels of the thyroid hormones free T4 (normal range, 10.3–24.5 pmol/l) and T3 (normal range, 0.9–2.6 nmol/l) and/or free T3 (normal range, 2.4–6.4 pmol/l), as well as thyroid-stimulating hormone (TSH; normal range, 0.4–4.0 mU/l). The gonadotropic axis evaluation in women included serum levels of luteinizing hormone (LH; pre-menopausal normal range, 1.1–14.7 IU/l; post-menopausal normal range, 11.3–39.8 IU/l), follicle stimulating hormone (FSH; pre-menopausal normal range, 2–22 IU/l; post-menopausal normal range, 23–135 IU/l), and estradiol (pre-menopausal normal range, 100–900 pmol/l; post-menopausal normal values, <163 IU/l). In men, LH (normal range, 0.8–7.6 IU/l) and testosterone (normal range, 10–28.1 nmol/l) were evaluated. Secondary hypogonadism was diagnosed if testosterone was low in combination with normal or low LH. The function of the neurohypophysis was evaluated by urine osmolality, serum and urine sodium, and by daily fluid balancing. Diagnostic criteria for central diabetes insipidus included [39]: serum sodium greater than 142 mmol/l and serum osmolality greater than 300 mOsm/kg [40], urine specific gravity less than 1.010 or urine osmolality less than 300 mOsm/kg [41], urine output greater than 300 cm^3/h for at least 3 consecutive hours or greater than 30 cm^3/kg/day.

Special attention was paid to pituitary insufficiency and hormonal medication, radicality of tumor resection and recurrence during follow up. These data were correlated to intraoperative identification of pituitary gland tissue

2.5. Statistics

The illustration and analysis of data were performed using SPSS (SPSS, version 22.0, IBM Corporation, NY, US) and Excel (Microsoft Corp., version 2007, Redmond, US). The patient cohorts were compared using Whitney-U-Test. Fisher's exact test was applied to compare differences between values in the groups. Additionally, multivariate analysis was performed. The significance level was set at $p < 0.05$.