Does Low-Field Intraoperative Magnetic Resonance Improve the Results of Endoscopic Pituitary Surgery? Experience of the Implementation of a New Device in a Referral Center

Sergio García[1], Luis Reyes[1], Pedro Roldán[1], Jorge Torales[1], Irene Halperin[2], Felicia Hanzu[2], Cristobal Langdon[3], Isam Alobid[3], Joaquim Enseñat[1]

■ OBJECTIVE: **To assess the contribution of low-field intraoperative magnetic resonance (iMRI) to endoscopic pituitary surgery.**

■ METHODS: **We analyzed a prospective series of patients undergoing endoscopic endonasal surgery for pituitary macroadenomas assisted with a low-field iMRI (PoleStarN30, 0.15 T [Medtronic]). Clinical, radiologic, and surgical variables were analyzed and compared with our fully endoscopic historic cohort operated on without iMRI assistance. A bibliographic review of pituitary surgery assisted with iMRI was conducted.**

■ RESULTS: **Thirty patients (57% female; mean age, 55 years) were prospectively analyzed. The most frequent tumor subtype was nonfunctioning macroadenoma (50%). The average Knosp grade was 2.3 and mean tumor size was 18 mm. Surgical and positioning time were 102 and 47 minutes, respectively. Hospital stay and complication rates were similar to our historical cohort for pituitary surgery. Mean follow-up was 10 months. Complete resection (CR) was achieved in 83% of patients. Seven patients (23%) benefited from iMRI assistance and achieved a CR in their surgeries. All patients except 1 experienced hormonal activity remission. iMRI sensitivity and specificity was 0.8 and 1, respectively. Although not statistically significant, CR rates were globally 11.5% superior in iMRI series compared with our historical cohort. This difference was independent of cavernous sinus invasiveness grade (CR rate increased 12.5% for Knosp grade 0–2 and 8.1% for Knosp grade 3–4).**

■ CONCLUSIONS: **Low-field iMRI is a useful and safe assistance even in advanced surgical techniques such as endoscopy. Its contribution is limited by the intrinsic features of the tumor. Further randomized studies are required to confirm the cost-effectiveness of iMRI in pituitary surgery.**

INTRODUCTION

As in other fields of neuro-oncology, the goal of pituitary surgery is to achieve the maximum extent of resection (EoR) and maintain low morbidity and mortality. In functioning pituitary tumors, hormonal response allows an early confirmation of complete resection (CR). However, in nonfunctioning adenomas, this goal is not so critical and, given their nature, the existence of remnants at an early stage might be difficult to assess.

Key words
- Endoscopic
- Extent of resection
- Intraoperative magnetic resonance
- Low field
- Macroadenoma
- Pituitary

Abbreviations and Acronyms
ACTH: Adrenocorticotropic hormone
CR: Complete resection
CS: Cavernous sinus
EoR: Extent of resection
GH: Growth hormone
iMRI: Intraoperative magnetic resonance imaging
MRI: Magnetic resonance imaging
PR: Partial resection
PT: Placement time
S: Sensitivity
Sp: Specificity
SR: Subtotal Resection
ST: Surgical time

From the Departments of [1]Neurosurgery, [2]Endocrinology, and [3]Rhinology, Hospital Clínic de Barcelona, Barcelona, Spain

To whom correspondence should be addressed: Sergio García, M.D. [E-mail: iskender_brave@hotmail.com]

Citation: World Neurosurg. (2017) 102:102-110.
http://dx.doi.org/10.1016/j.wneu.2017.02.094

*Journal homepage: **www.WORLDNEUROSURGERY.org***

*Available online: **www.sciencedirect.com***

Table 1. Summary of Cases

Age (years)	Sex	Initial Diagnosis	Hormone	Diameter (mm)	Knosp Grade	Reoperation	First Look	Further Resection	Extent of Resection*	Length of Stay (days)
69	F	NFA		20	2		CR	No	CR	3
76	F	NFA		24	4		CR	No	CR	3
74	F	NFA		30	4	Yes	PR	Yes	PR	3
80	F	Acromegaly	GH	15	0		CR	No	CR	3
49	F	Cushing	ACTH	12	1		CR	No	CR	2
48	M	NFA		37	4	Yes	PR	Yes	PR	6
43	M	Acromegaly	GH	29	2		CR	No	CR	3
47	M	Acromegaly	GH	18	2		CR	No	SR	3
68	M	Pituitary apoplexy	IGF	25	2		PR	Yes	CR	6
72	M	NFA		15	3		CR	No	CR	3
58	F	NFA		40	2		CR	No	CR	2
55	M	Cushing	ACTH	21	4		PR	Yes	CR	4
57	M	NFA		16	4	Yes	CR	No	CR	2
60	M	Acromegaly	GH	10	4		PR	Yes	PR	4
65	M	Acromegaly	GH	11	0		CR	No	CR	3
49	M	NFA		32	1		PR	Yes	CR	3
67	M	NFA		18	4		PR	Yes	PR	3
45	F	Cushing	ACTH	14	1		CR	No	CR	3
48	F	Acromegaly	GH	13	1		CR	No	CR	3
58	F	NFA		11	3		CR	No	CR	3
65	F	Acromegaly	GH	13	0		CR	No	CR	3
42	F	Amenorrhea	PRL	15	1		CR	No	CR	3
50	M	NFA		25	4	Yes	PR	Yes	CR	3
74	F	NFA		19	2		PR	Yes	CR	3
75	F	NFA		16	2		CR	No	CR	3
64	F	NFA		18	3		PR	Yes	CR	3
67	F	NFA		18	2		PR	Yes	CR	3
43	M	Pituitary apoplexy		20	2		CR	No	CR	3
47	F	Acromegaly	GH	12	2		CR	No	CR	3
59	F	Cushing	ACTH	27	2		CR	No	CR	3
Total										
54.6				A = 18.3	A = 2.3	4	19 CR	11 FR	25 CR	A = 3.2

F, female; NFA, nonfunctioning adenoma; CR, complete resection; PR, partial resection; GH, growth hormone; ACTH, adrenocorticotropic hormone; M, male; IGF, insulinlike growth factor; Prl, prolactin; A, Average; FR, further resection.
*Based on 3-month magnetic resonance imaging.

Recently, many groups specialized in skull base surgery have evolved from traditional microsurgery to a neuroendoscopic approach in the treatment of sellar region tumors. Although endoscopy has proved to be an excellent tool for the removal of pituitary tumors with extrasellar extension,[1-4] its resective capacity is occasionally limited by morphologic or anatomic constraints.

Neuronavigation improves intraoperative orientation, ensuring the identification of vascular and nervous structures, especially in reoperations, and contributes to locating intrasellar microadenomas.[5] Intraoperative imaging emerged as an attempt to alleviate the problems related to the loss of precision of neuronavigation systems during a surgical procedure. The