Endoscopic endonasal pituitary surgery: experience of the Local Health Unit of Algarve

Original Article

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Abstract

Objectives: To conduct a case analysis of patients with pituitary adenomas who underwent endoscopic endonasal transsphenoidal surgery.
Study design: Retrospective descriptive study.
Material and Methods: Patients with pituitary adenomas (n=30) who underwent endoscopic endonasal transsphenoidal surgery at ULS do Algarve, Faro Unit, between 2016 and 2022, were evaluated for gender, age, symptoms, size, extent and histology of the lesion, recurrence/persistence rate, and complications.
Results: The main clinical presentation of the patients was decreased visual acuity. Gonadotrophic pituitary adenoma was the most common pathology. Transient diabetes insipidus was the most frequent postoperative complication. We achieved a resolution rate in terms of tumor resection and chiasmatic compression mass effect in 83% of cases, with most persistences classified as residual lesions.
Conclusions: The removal of pituitary adenomas using the endoscopic endonasal transsphenoidal approach proved to be effective and safe, with low morbidity and high tumor remission rates.
Keywords: Pituitary adenomas; Endoscopic endonasal transsphenoidal surgery

Introduction

Pituitary adenomas account for approximately 15% of all intracranial tumors[1] and have an estimated prevalence of 16.7% in the general population[2]. The majority are benign neoplasms arising from the anterior portion of the pituitary gland, the adenohypophysis[3]. Although histologically benign, these tumors are classified as functioning when they cause symptoms due to endocrine dysfunction, or non-functioning when they do not cause endocrine dysfunction. Depending on the cell type involved, the tumor may induce hormonal hyperfunction through excessive hormone

secretion or hypofunction due to compression of the functional portion of the pituitary gland[3,4]. As these tumors grow, they may compress adjacent structures within the parasellar and suprasellar spaces, or invade the cavernous sinus and extend into the suprasellar cistern, often with neurovascular involvement[3,4]. The transsphenoidal approach to the sella turcica was first described by Schloffer in 1907[5] and later popularized by Cushing, who performed a substantial number of pituitary tumor resections using this technique[4]. In the 1960s, the introduction of the surgical microscope by Hardy led to the transsphenoidal sublabial approach becoming the standard method for pituitary tumor removal[6]. In the 1990s, advancements in endoscopic paranasal sinus surgery techniques[7] enabled the possibility of using an endoscopic endonasal approach to pituitary tumor resection. In 1992, Jankowski was the first to describe the removal of a pituitary adenoma using the endoscopic endonasal transsphenoidal approach[8]. This technique was subsequently refined by Jho and Carrau, who demonstrated its advantages over the conventional microscopic method[9,10]. The endoscopic approach offers several technical advantages, including panoramic and magnified visualization, improved lighting within the deep cavities, and enhanced identification and dissection of anatomical structures at the skull base. Additionally, angled endoscopes enable the visualization and resection of extraluminal lesions, thus reducing morbidity and surgical risk[11].

This descriptive retrospective study aimed to evaluate the characteristics of patients with pituitary adenomas who underwent endoscopic endonasal transsphenoidal surgery at the Algarve Local Health Unit (ULS Algarve) between 2016 and 2022. Additionally, we evaluated the surgical outcomes and complications of this approach.

Materials and Methods

This retrospective descriptive study included patients with a postoperative histological diagnosis of pituitary adenoma who underwent endoscopic endonasal transsphenoidal surgery performed by the neuro-otologic surgery team of Faro Hospital between January 2016 and December 2022. A total of 30 patients were included in the study. Patients who had undergone a previous surgical intervention for pituitary adenoma were excluded. All patients underwent preoperative magnetic resonance imaging (MRI), which was used to characterize the size (> 1 cm vs. < 1 cm) and extent of the adenomas. The following variables were analyzed for each patient: sex, age, presenting symptoms, tumor size and extent, histological data, recurrence/persistence rate, and postoperative complications. Patients were followed up for a minimum of one year. The recurrence/persistence rate was determined based on the follow-up MRI findings obtained between six months and one year postoperatively.

The procedure was performed under general anesthesia with the patient in the supine position, with the head slightly elevated and turned to the right. The endoscopic equipment was positioned above and behind the patient's left shoulder. The surgeon stood at the patient's right shoulder, the anesthesiologist and monitoring equipment were positioned on the left, and the nurse stood at the foot of the bed, with the instrument table to the right of the surgeon. Nasal decongestion was achieved using neurosurgical pads soaked in saline with diluted adrenaline (1:5000), which were temporarily placed in each nasal cavity. Neuronavigation was employed selectively. A 30° endoscope was used in all cases. The surgery was divided into two phases: nasal and sellar. Nasal phase: the two-handed technique was used. The middle turbinate was laterally mobilized to expose the superior turbinate, and the inferior third of the superior turbinate was excised with a microdebrider to identify the natural ostium of the sphenoid sinus. A nasoseptal flap was prepared using an electrocautery tool with a colored tip. The mucosal incision began at the superior edge of the sphenoid ostium and extended onto the septum, preserving the upper

olfactory mucosa of the septum. The anterior extent of the incision varied according to the anticipated dimensions of the dural defect. The inferior incision was made above the choana to preserve the vascular pedicle and extended anteriorly to meet the previously made superior incision. The mucosa below the incision was reflected inferiorly, while the superior portion was preserved as a rescue flap, created routinely for repairing large dural defects, if necessary. Using a Freer elevator, the cartilaginous and bony portions of the posterior nasal septum were resected to widen access to the sphenoid sinus. The sphenoid rostrum was carefully removed using a high-speed diamond drill. Subsequently, a total ethmoidectomy was performed using a microdebrider to laterally expose the lamina papyracea. A wide sphenoidotomy followed, involving the removal of inter- and intra-sinus septa to expose the clivus, sellar floor, carotid prominences, optic-carotid recesses, and sphenoidal plane. The sphenoid sinus mucosa was carefully dissected and removed, preserving the integrity of the underlying structures. Sellar phase: the three-hand technique was used. An assistant held the endoscope, allowing the surgeon to operate with two instruments and perform bimanual dissection. The sellar floor was removed with a high-speed diamond drill. The dura mater was incised to expose the sellar content, and every effort was made to preserve the normal pituitary tissue. The sellar tumor was excised using standard neurosurgical techniques. The endoscope was then inserted into the sella turcica for a thorough inspection and to identify and remove any residual tumor. In cases of macroadenomas with suprasellar or parasellar extension, the endoscope was directed toward these areas for tumor removal. Sellar reconstruction was performed in a systematic and sequential manner. A synthetic DuraForm® graft was placed using the underlay technique within the epidural space. Surgicel® absorbable hemostatic materials were then carefully applied over the graft to aid hemostasis and stabilization.

Finally, Tisseel® fibrin glue was used to seal the graft and hemostatic materials. In cases with significant intraoperative cerebrospinal fluid (CSF) leakage, multilayer sellar reconstruction was performed using DuraForm®, fat, fascia lata, and a pedicled nasoseptal flap. Postoperative monitoring included regular assessment of the hormone levels, particularly cortisol and antidiuretic hormone (ADH), as well as evaluation of the fluid balance and serum sodium. Patients were instructed to avoid blowing their nose and Valsalva maneuvers, maintain head elevation between 30° and 45°, and begin nasal irrigation within 24 to 48 hours. Informed consent was obtained from all patients prior to the surgery.

Results

This retrospective study included 30 patients: 13 men (46%) and 17 women (54%) (Table 1). The mean age at the time of surgery was 61.8 years, with a standard deviation of 13.4 years (Table 2).

All adenomas were classified according to their size and extent on imaging, and by hormonal activity based on postoperative immunohistochemical analysis (Figure 1). In total, 93% adenomas (n = 28) measured > 1 cm in the longest axis and were classified as pituitary macroadenomas (Figure 1A).

Table 1
Sex distribution of patients with pituitary adenomas who underwent endoscopic endonasal transsphenoidal surgery at ULS Algarve between 2016 and 2022
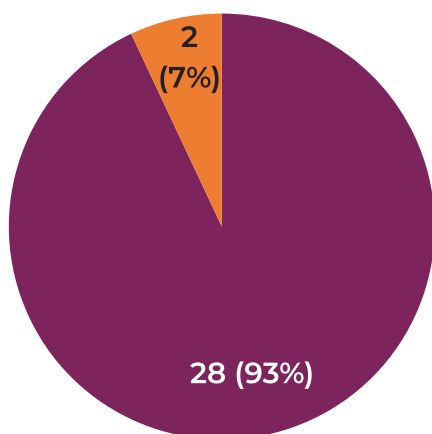
Sex	Year 2016-2022	%
Men	13	46
Women	17	54
Total	**30**	**100**

Table 2
Mean age of patients with pituitary adenomas who underwent endoscopic endonasal transsphenoidal surgery at ULS Algarve between 2016 and 2022

Mean age (years)	Standard deviation
61,8	13,4

A

Pituitary adenomas (size)

2 (7%)

28 (93%)

Total=30

- Pituitary macroadenoma >1cm
- Pituitary microadenoma >1cm

B

Pituitary adenomas (lesion extension)

6 (20%)

12 (40%)

12 (40%)
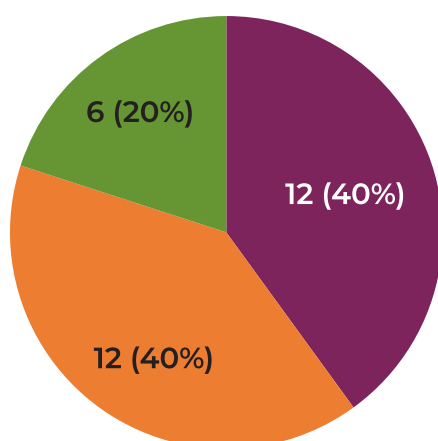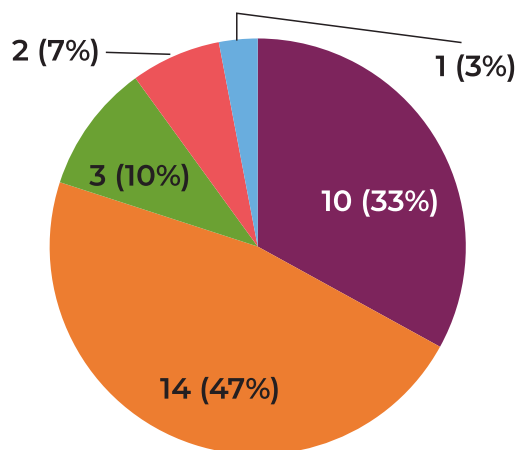
Total=30

- Sellar

Extrasellar extension
- Suprasellar
- Suprasellar + Parasellar

C

Pituitary adenomas (hormonal activity)

2 (7%)

1 (3%)

3 (10%)

10 (33%)

14 (47%)

Total=30

- Non-functioning
- Gonadotropic (FSH and/or LH)
- Somatotropic (GH)
- Corticotropic (ACTH)
- Plurihormonal (GH/TSH/PRL/ACTH/LH)

GH, growth hormone; ACTH, adrenocorticotropic hormone; TSH, thyroid stimulating hormone; FSH, follicle-stimulating hormone; LH, luteinizing hormone; PRL, prolactin.

Extrasellar extension was observed in 60% of cases (Figure 1B), with 40% (n = 12) extending exclusively to the suprasellar region. Suprasellar and parasellar extension with bilateral cavernous sinus involvement was observed in 20% of the tumors (Figure 1B). In terms of hormonal activity, the most frequent subtype was gonadotroph adenoma (n = 14, 47%), followed by somatotroph adenoma (n = 3, 10%), corticotroph adenoma (n = 2, 7%), and plurihormonal adenoma (n = 1, 3%) (Figure 1C). In this study, ten adenomas (33%) were classified as non-functioning (Figure 1C).

The most common clinical presentation was decreased visual acuity (n = 15, 50%), primarily due to bitemporal hemianopsia (n = 14, 47%). Other symptoms included headache (n = 8, 27%) and hormonal dysfunction (n = 6, 20%). Less frequent presentations were Cushing's disease (n = 2), acromegaly (n = 1), and incidental imaging findings (n = 1), accounting for 13% of cases (Figure 2). There were no postoperative complications in 60% of the patients (n = 18).

Initial presentation (symptoms)
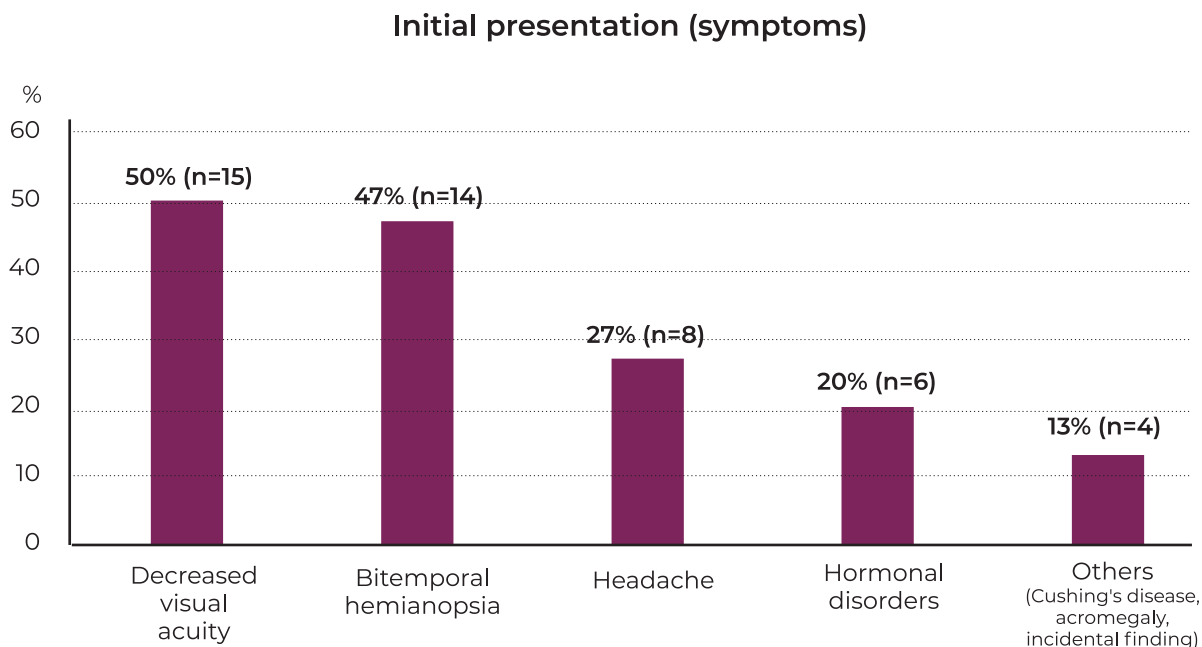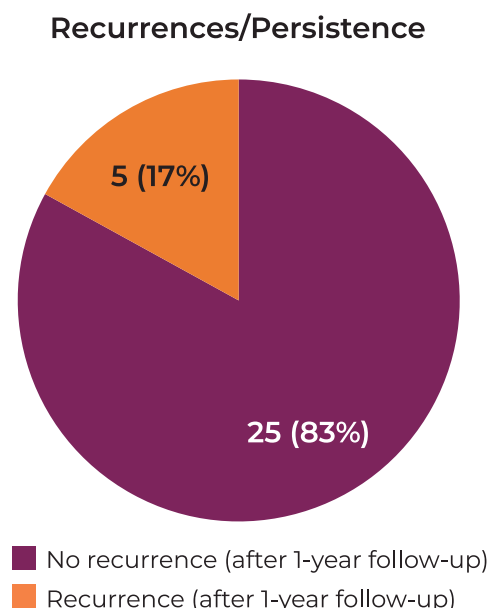

Figure 3
Postoperative complications in patients with pituitary adenomas who underwent endoscopic endonasal transsphenoidal surgery at ULS Algarve between 2016 and 2022

Postoperative complications
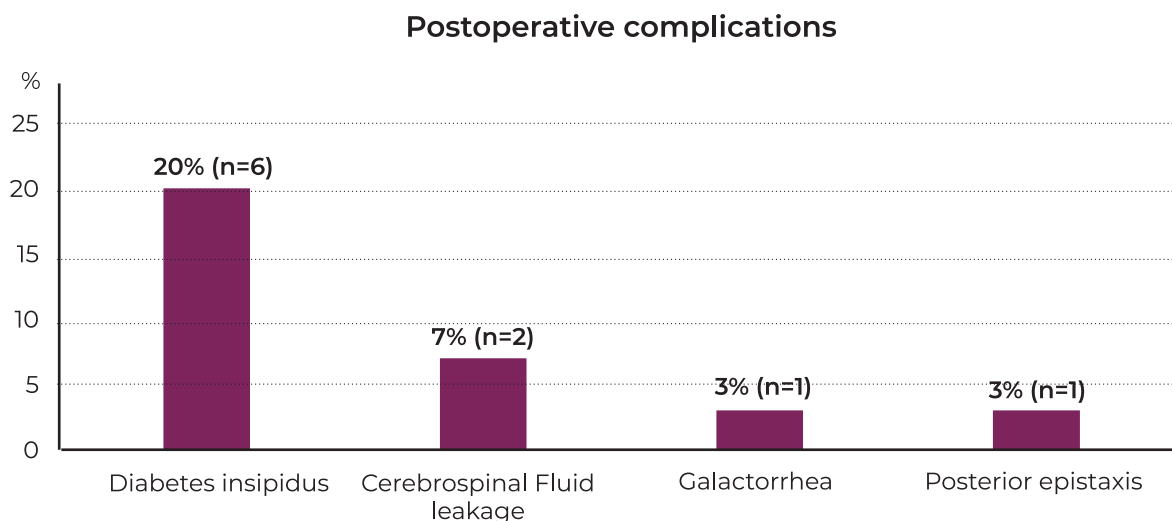
The two most common complications were transient diabetes insipidus (DI) (n = 6, 20%) and CSF leakage (n = 2, 7%), and no cases of infection were recorded (Figure 3). Less common complications included posterior epistaxis (n = 1, 2%) and galactorrhea (n = 1, 2%) (Figure 3). No procedure-related mortalities occurred. All patients with decreased visual acuity experienced postoperative improvement in the visual fields. All patients were followed for a minimum of one year, during which at least one follow-up MRI was performed. Tumor recurrence or persistence was identified in five cases (17%), most of which were classified as residual lesions without chiasmatic compression (n = 3) (Figure 4). There was no tumor recurrence in 83% of cases (n = 25) (Figure 4).

Recurrences/Persistence

5 (17%)

25 (83%)

- No recurrence (after 1-year follow-up)
- Recurrence (after 1-year follow-up)

Discussion

MRI enables the classification of pituitary adenomas by size as microadenomas (< 1 cm) or macroadenomas (> 1 cm)[3,4]. Most of the surgically treated tumors in our sample were macroadenomas (n = 28, 93%). This highlights the clinical relevance of tumor size, as the compression of anatomical structures adjacent to the sella turcica is a major indication for surgery, particularly due to its potential impact on the optic chiasm[12]. Decreased visual acuity, most commonly due to bitemporal hemianopsia and headache resulting from the tumor mass effect, were the two most prevalent symptoms in our sample, affecting 23 patients (77%). In addition to size, pituitary adenomas can be classified by hormonal activity into functioning and non-functioning subtypes, and also by the predominant hormone produced[4]. According to European epidemiological studies, prolactinomas (prolactin-producing tumors) are the most prevalent type of adenomas (32–66%), followed by adenomas that do not secrete hormones (14–54%), somatotroph adenomas (growth hormone [GH]-producing tumors) (8–16%), corticotroph adenomas (adrenocorticotropic hormone [ACTH]-producing tumors) (2–6%), and plurihormonal adenomas, a rare type identified in approximately 1% of cases, which produce hormones such as prolactin, GH, ACTH, and thyroid stimulating hormone (TSH)[3,4]. Despite being the most common type of hormone-producing adenoma, no prolactinomas were identified in our sample of 30 cases. This may be explained by the high efficacy of medical treatment with dopamine agonists, as these tumors require surgical intervention only when refractory to medical treatment[12]. Surprisingly, gonadotroph adenomas were the most frequent subtype (n = 14, 47%). This may be attributed to their postoperative immunohistochemical classification: tumors previously considered non-functioning often express gonadotropins (follicle-stimulating hormone [FSH], luteinizing hormone [LH], or subunits), whereas the expression of GH, ACTH, or prolactin is uncommon in these lesions[13]. Several studies have reported that 80% of corticotroph adenomas are microadenomas, and more than 50% may not be visualized on MRI[14]. Among the two microadenomas identified, both were corticotroph, expressing ACTH, and clinically consistent with Cushing's disease.

Postoperative complications may be related to the patient-specific anatomy, tumor volume, local invasion, extent of resection, tumor biology, or experience of the surgical team[16]. Most complications following endoscopic endonasal transsphenoidal resection are transient and resolve without additional interventions. Common symptoms include headache, nasal obstruction, nausea, vomiting, and epistaxis[16]. Long-term complications that may require ongoing management and persist beyond the recovery period include DI, hypopituitarism, CSF leakage, adrenal insufficiency, and optic nerve injury[15,16]. DI is the most common endocrine complication following the transsphenoidal removal of a pituitary adenoma[16] and may be transient

or permanent. Transient DI results from manipulation of the adenohypophysis or pituitary stalk, or ischemia due to sacrifice of pituitary arteries, and temporarily affects the vasopressin-producing neurons[16–18]. Transient DI occurred in 20% of cases (n = 6), being the most frequent postoperative complication in our sample and consistent with the rates in previous studies (2.5–20%)[17,18]. Persistent DI is an uncommon complication, with incidence rates ranging from 0.4–8.1%[19,20]. We identified no cases of permanent DI. All DI cases were identified between 24 and 48 hours and resolved within 3–5 postoperative days. CSF leakage was identified in two patients (7%) in the immediate postoperative period and was the second most common complication in our study cohort. Both cases were associated with the resection of large macroadenomas (~30 mm) with suprasellar and parasellar extension, including bilateral cavernous sinus involvement, but no reduction in the diameter of the cavernous segments of the internal carotid arteries. In these cases, an expanded transsphenoidal approach was required due to the size and extent of the sellar tumor, which involved exposure of the planum sphenoidale, tuberculum sellae, and parasellar segments of the internal carotid arteries. In both cases, dural reconstruction involved multilayer closure using DuraForm®, fat, fascia lata, and a pedicled nasoseptal flap. Following confirmation of a CSF fistula, the patients were initially managed conservatively. Considering the effectiveness of the reconstruction, there was no need for lumbar drainage or revision surgery. No cases of meningitis were recorded. CSF leakage after transsphenoidal approaches can significantly increase the morbidity due to the risk of infection and may necessitate reoperation if initial conservative treatment fails. Several factors have been associated with increased risk of postoperative CSF leakage, including patient sex, age, and body mass index (BMI), as well as comorbidities such as obstructive sleep apnea (OSA). Additional risk factors include tumor extension, prior surgery or radiotherapy, extent of dural opening in tumors involving the suprasellar cistern, intraoperative identification of CSF leakage, type of autologous or synthetic material used for dural reconstruction, and the surgeon's experience, particularly with reconstruction techniques that ensure watertight reconstruction[17,19]. CSF fistula rates in previous studies have been reported between 1.2% and 10%, which align with our results[16,17,19]. The decline in leakage rates in recent years is attributed to vascularized nasoseptal flap reconstruction of the sella turcica[21,22]. Pedicled nasoseptal flaps were used for dural defect reconstruction in all macroadenomas with extrasellar extension at the ULS Algarve (n = 18, 60%),

Among the 30 patients treated, 25 (83%) showed no evidence of recurrence or residual tumor on MRI performed after one year, indicating a surgical success rate of 83% for endoscopic endonasal transsphenoidal resection of pituitary adenomas. This is in line with previously reported rates of 80–90% for microadenomas and 40–70% for macroadenomas[17,18]. Only two of the five patients with a persistent lesion identified on MRI required adjunctive treatment with radiotherapy; the remaining three demonstrated no chiasmatic compression.

Conclusions

Over the past seven years, our accumulated experience with the endoscopic management of sellar lesions, including those with extrasellar extension, has enabled us to achieve outcomes comparable to those reported in the literature. Data from this case series indicate that the endoscopic endonasal transsphenoidal approach is a safe and effective technique for pituitary adenoma resection and is associated with low morbidity. Therefore, this surgical modality may be considered the most appropriate treatment option for these lesions.

Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Data Confidentiality

The authors declare having followed the protocols used at their working center regarding patient data publication.

Protection of humans and animals

The authors declare that the procedures were followed according to the regulations established by the Clinical Research and Ethics Committee and the 2013 Helsinki Declaration of The World Medical Association.

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Availability of scientific data

There are no datasets available, or publicity related to this work.

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