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Importance of a Multidisciplinary Team Approach for Optimizing Pituitary Surgery Outcomes

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Abstract

Pituitary tumors including pituitary adenomas and related lesions such as craniopharyngiomas and Rathke's cleft cysts present with a wide range of hormonal and neurological signs and symptoms resulting in a variety of referral pathways. A multidisciplinary approach to the diagnostic evaluation and treatment plan is essential to optimise outcomes. The patient is seen by each member of the team, including neurosurgeon, endocrinologist, head & neck surgeon, nurse practitioner and in some instances neuro-ophthalmologist, oncologist, radiation oncologist and interventional neuro-radiologist. Appropriate investigations are undertaken and a further meeting arranged at which all opinions are discussed. A reasoned treatment regimen is recommended, taking into consideration the patient's wishes and overall medical condition. This manuscript describes the team approach currently employed in the Brain Tumor Center and Pituitary Disorders Program at Providence Saint John's Health Center & John Wayne Cancer Institute. When referring pituitary patients to this centre, health care professionals and patients alike are experiencing the positive benefits received from a patient-centred, multidisciplinary approach.

Keywords: *Pituitary, tumor, pituitary adenoma, transsphenoidal surgery, multidisciplinary team.*

Introduction

Patients undergoing endonasal transsphenoidal surgery have complex needs that require expert care and the coordination of a multidisciplinary team of healthcare professionals. Collaboration among health care disciplines is assumed to be an effective solution to many problems, including the quest for cost-effective quality care. Collaboration is a process of shared planning with joint responsibility for outcomes. Interdisciplinary care also involves coordination, joint decision making, communication, shared responsibility, and shared authority (Lough, Schmidt, Swain, Naughton, LeShan, Blackburn & Mancuso, 1996). This article provides a literature review of the topic as it relates to patients undergoing endonasal endoscopic pituitary surgery and presents an illustrative case.

Pituitary adenomas are one of the most common intracranial neoplasm, making up about 15% -20% of such lesions. Prolactinomas are the most prevalent subtypes, representing 40% - 50% of pituitary adenomas, followed by non-functional adenomas accounting for about 30%, and other functional adenomas secreting growth hormone, adrenocorticotropic hormone, or other hormones making up the remainder (Kovacs & Horvath 1987; Kontogeorgos, 2005).

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Pituitary adenomas may be classified based on an anatomical approach which classifies pituitary tumours by size based on radiological findings. Tumours are divided into microadenomas (i.e.; the greatest dimension is <10 mm) and macroadenomas (i.e., the greatest dimension is > 10 mm. An MRI scan is now considered the imaging modality of choice for the diagnosis of pituitary disorders because of its multiplanar capability and good soft tissue contrast enhancement. Sagittal gadolinium enhanced T1-weighted images, clearly displaying the anterior and posterior lobes and the stalk on the same plane, and coronal gadolinium enhanced images, displaying the relation between the pituitary and cavernous sinuses, are optimal for identifying a pituitary adenoma. A 3mm thin slice typically is used to obtain optimal resolution.

The goals of treatment of pituitary adenomas include relief of compression of surrounding

Tumor Type	Primary Therapy	Second line Therapy	Adjuvant Medical Therapy	Adjuvant Radiation therapy	Additional therapies
Endocrine inactive Macroadenoma	Surgical resection	Radiation therapy	Temozolamide for malignant recurrent tumors	Fractionated Stereotactic Radiotherapy for invasive tumors	
Prolactinoma	Dopamine Agonists (cabergoline or bromocriptine)	Surgical resection (refractory or intolerant to medications)	Temozolamide for atypical or malignant recurrent tumors	Fractionated Stereotactic Radiotherapy for invasive tumors	
Growth Hormone (acromegaly)	Surgical resection	Somatostatin analogues (octreotide or pasireotide)	Dopamine agonists or growth hormone antagonists (pegvisomant)	Fractionated Stereotactic Radiotherapy for invasive tumors	
Adrenocorticotropic Hormone (ACTH) (Cushing disease)	Surgical resection	Steroidogenesis inhibitors, (mitotane, metyrapone, ketoconazole, aminoglutethimide)	mifepristone	Fractionated Stereotactic Radiotherapy for invasive tumors	Hypophysectomy or bilateral adrenalectomy
Thyroid–stimulating hormone (TSH) (rare)	Surgical resection	Thyroid hormome inhibitors	Somatosatin Analogues	Fractionated Stereotactic Radiotherapy for invasive tumors	
Gonadotroph secreting Ovarian Hypersecretion syndrome (rare)	Surgical resection	Radiation therapy	none	Fractionated Stereotactic Radiotherapy for invasive tumors	
Pituitary Carcinomas	Surgical resection	Radiation and Chemotherapy	Somatostatin analogues for GH and ACTH producing carcinomas	Dopamine agonists for PRL producing carcinomas	

Table 1 (Above): *Pituitary Tumour Subtypes and Treatment Option Overview.*

structures (e.g. optic chiasm or pituitary gland), normalisation of hormonal secretion (e.g. normalisation of hypersecretion or improvement in hypofunction) and improvement of progressive neurological deficits. Interventions may include surgery, medical therapy, radiation therapy, or a combination of these modalities. The treatment of choice must be individualised and is dictated by the type of tumour, the nature of the excessive hormonal expression, and whether or not the tumour extends into the brain or other critical structures around the pituitary.

The transsphenoidal microsurgical approach to a pituitary lesion is the most widely employed surgical approach to pituitary lesions and represents a major development in the safe surgical treatment of both hormonally active and non-functioning tumours. Rapid deterioration of vision is an immediate indication for surgery to relieve pressure produced by an expanding tumour mass, except in the case of macroprolactinomas (where intensive observation with a patient on dopaminergic agonists may be an acceptable alternative). Progressive deterioration of visual fields is often the primary neurological criterion on which surgical management decisions are based. Conventional radiation therapy is an effective adjunct to the treatment of pituitary tumours, and rarely used as a first-line therapy. The advantages of radiation therapy are that it is non-invasive and suitable for high-risk surgical patients. The clinical and biochemical response, however, is slow and may require from 2 years to 10 years for complete and sustained remission. In addition, radiation therapy carries a substantial risk of hypopituitarism (approximately 30% at 10 years), (Sheehan, Starke, Mathieu, Young, Sneed, Chiang, Lee, Kano, Park & Niranjan, 2013). Stereotactic radiosurgery (SRS) may be a treatment option for patients with recurrent or residual adenomas.

In acromegalic patients, impaired glucose tolerance, hypertension, and hyperlipidemia should be vigorously treated concurrently with definitive therapy. A multidisciplinary clinical approach may be required for the treatment of arthritis, carpal tunnel syndrome, obstructive sleep apnoea and prog-

nathism. Mortality is related primarily to cardiovascular and respiratory diseases.

Given the insidious and often non-specific symptoms with pituitary adenomas, there is a significant delay between symptom onset and definitive therapy. In some instances, the early clinical manifestations may even lead to erroneous diagnoses for patients with non-functional pituitary adenomas. In some cases, patients are only diagnosed once the tumour has enlarged to the point of causing pituitary dysfunction and/or altered visual fields and decreased visual acuity (Ebersold, Quast, Laws, Scheithauer & Randall, 1986; Berkmann, Schlaffer, Nimsky, Fahlbusch & Buchfelder, 2014). Making an appropriate diagnosis in a timely fashion and directing the patient towards an experienced team specialised in pituitary pathologies is essential for the patient's well-being. The multidisciplinary concept is important in the pre-operative, operative, in-patient and long-term follow-up care of patients with a pituitary lesions and offers the best chances of favourable outcome. We review the key elements that assure the success of a multidisciplinary team and present how this approach has been implemented in a centre dedicated to the management of pituitary lesions for optimal outcomes (McLaughlin, Laws, Oyesiku, Katznelson & Kelly, 2012).

Teamwork for Better Patient Outcome

In our current medical system, which encourages specialisation in specific fields of interest such as skull base endoscopic surgery, it is realistically impossible for one single physician to provide holistic care. The complex needs of patients, families, communities and populations are not usually amenable to the actions of single care providers in isolation from colleagues of other disciplines. Teamwork is recommended in order to pool skills, experience and knowledge to ultimately yield the best overall outcome for patients (Fagin 1992). In multidisciplinary teams, members coordinate their efforts to fulfil goals set forth by the team (Hamric, Hanson, Tracy & O'Grady, 2013). This type of teamwork assures greater flexibility and interchangeability between members. Multidisciplinary also serves to achieve greater resource efficiency by reducing duplication in a patient's care, by sealing potential gaps in care management and by decreasing the risk of errors with the use of protocols accepted by members of the team.

Implementation of a Multidisciplinary Approach

Multiple groups around the world have concentrated their efforts on the care of patients with pituitary pathologies. We present an overview of how members of a multidisciplinary team specifically designed for pituitary pathologies interact at various aspects of the patient's overall care (Figure 1).

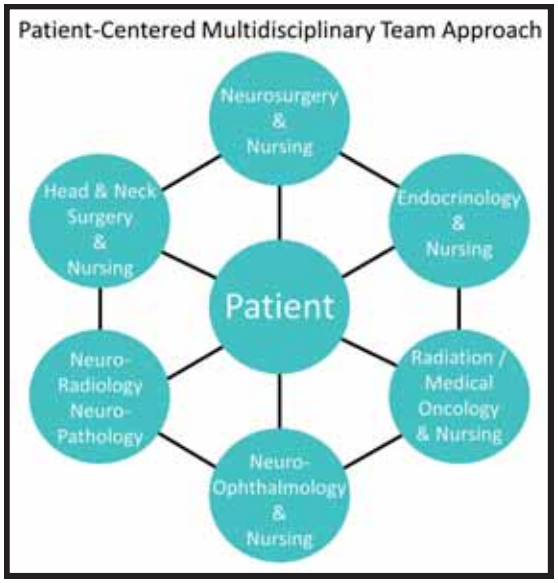

Figure 1 (Above): *Diagram demonstrating the patient-centric model of the multidisciplinary approach to the pituitary patient.*

Pre-Operative Care

The primary care physician is a central player in the pre-operative care of most patients. Primary care physicians coordinate the initial investigation, including endocrine work-up, ophthalmological assessment, neurological evaluation and radiological investigation. Referring physicians, including primary care physicians, endocrinologist, neuro-ophthalmologist, and neurosurgeons, should seek to refer their patients to a team specialised in pituitary lesions, capable of tailoring the surgical procedure and adjuvant therapy to each patient's specific situation.

The initial conversation with the team's nurse practitioner provides an opportunity for the patient to voice questions and concerns to which the practitioner can address. The nurse practitioner explains the consultation process to the patient and ensures that pertinent data such as pituitary hormonal blood evaluations, neuro-imaging and visual fields if indicated are available at the time of consultation.

During this initial consultation, a detailed clinical history and physical examination are performed. Images and hormonal test results are reviewed with the patient and their family, and the likely diagnosis is presented. In many instances, the diagnosis is clear-cut. However, in certain cases, the diagnosis may be uncertain due to ambiguous imaging or inconclusive hormonal test results. Thus, some patients may require additional evaluation before a recommendation regarding the optimal treatment can be made. Once this key data is available, definitive treatment options are discussed in detail including indications and alternatives to endonasal surgery, medical treatment options and the possible need for radiosurgery or radiotherapy. The need for hormonal replacement therapy is also discussed. Providing this data helps the patient process the information and understand the following steps. For those who ultimately require surgery, meeting the surgical team pre-operatively allows patients to direct specific questions to each team member. Once the surgical team has discussed the treatment management options, the nurse practitioner can go over key questions regarding the post-operative period from the patient's stay in recovery room to the first weeks after surgery to give the patient appropriate expectations. They will also help coordinate the pre-operative medical evaluation, including cardiac or pulmonary clearance if required as well as consultations with other medical specialists and complementary imaging.

In the 48 hours preceding surgery, the pre-operative work-up should be verified by the entire team and the patient is contacted if any further verification is required. As the patients are usually not admitted to the hospital the night before surgery, communication with the nurses in the pre-operative unit is essential to verify that the chart is complete and that all inquiries have been addressed. This is essential to prevent any delays on the morning of surgery.

In research institutions, contributing the tumour specimen to a tissue and/or blood bank should be offered on a voluntary basis to each patient prior to surgery. This is introduced by the surgical team and the consent may be obtained either by the research nurse, the investigator or the nurse practitioner.

Intra-Operative Care

Peri-operatively, the anaesthetist is an integral member of the care team. For some pituitary tumour patients, such as those with acromegaly or Cushing's disease, securing the airway may be a challenge and may require special intubation techniques. The pre-operative discussion with anaesthetist should include specific concerns, including blood pressure management and intra-operative medications. In particular, the necessity or contraindication for peri-operative steroids should be discussed. The operation is performed by a dedicated team, combining skull base neurosurgeons and head and neck surgeons, both versatile in endonasal approaches. Combining expertise on a regular basis optimises the surgical team's success in comparison with casual interaction. Intra-operative pathological assessment often confirms the presumed pre-operative diagnosis. Detailed analysis of the histological characteristics and molecular signature are important for the adjuvant treatments recommended after surgery.

Post-Operative Care

Following the endonasal transsphenoidal resection of pituitary tumour, close observation and monitoring in a skilled nursing unit is required for the initial 24 hours. Intensive care units are reserved for the unstable or high acuity patient (e.g. requiring vasopressor or insulin drips). The surgical team must inform the intensivist about the patient's clinical history, pre-operative neurological status, hormone deficiencies, intervention performed, occurrence of any intra-operative complication and total blood loss. In cases of pre-operative hypopituitarism, functional pituitary tumours or surgical procedures that might have altered the pituitary gland or pituitary stalk, an endocrinologist should manage the patient's hormone balance.

Standing orders and critical pathways are vital tools for nurses in anticipating complications and therefore improving patient outcomes. Serial neurological examinations and prompt reporting of any changes are critical in identifying neurological complications. Once identified, the treating physician must be advised. Complications such as diabetes insipidus and cerebrospinal rhinorrhoea (CSF leak) associated with endonasal surgery may result in prolonged hospitalisation and worsened functional outcome (Eisenberg & Redick, 1998). A dedicated, multidisciplinary clinical practice with large annual volume of

transsphenoidal surgery is important for safe, successful outcomes in patients with pituitary tumours (Shahlaie, McLaughlin, Kassam & Kelly, 2010). In conjunction with the surgical team, the hospital case manager initiates discharge planning as soon as the patient arrives to the ward, allowing for a thorough review of the patient's condition facilitating the discharge home or to other facilities when necessary.

The Patient's Support System

The patient's family is an important element in the pre-operative care period. Most patients have a family member that stays at bedside throughout their hospitalisation. It is crucial that they understand what is to be expected in the post-operative period. They should be informed on signs and symptoms to observe. The family members also play a key role in the patient's rehabilitation as they can stimulate progressive oral intake and mobilisation, when indicated. Early ambulation prevents the complications seen with immobility, such as atelectasis, pneumonia, deep vein thrombosis and pulmonary embolus (Prather, Forsyth, Russell & Wagner, 2003). Hence, family cooperation should be recognised and encouraged.

Discharge from the hospital is organised when the entire team believes the patient is stable. For typical patients undergoing endoscopic endonasal resection of a pituitary adenoma or Rathke's Cleft Cyst, this occurs on the second post-operative day. For patients with more complex operations, such as extended skull base approaches for craniopharyngiomas, chordomas or meningiomas, length of stay can range from three to seven days. The patient's family or immediate caregiver should always be involved in this process since they will be looking after the patient at home. Post-operative instructions specific to endonasal surgery are given to the patient prior to discharge and include recommendations for activities of daily living, medications to take and/or avoid, allowed physical activity, and appointments after hospital discharge. These discharge instructions also mention signs and symptoms that would be more worrisome and that should trigger a call to the treating team. The patients are also told that if they have permanent pituitary insufficiency (hypopitutiarism) and require long term steroids (prednisone or hydrocortisone) and/or DDAVP, they should carry a medic alert card in their wallet and wear a medic alert bracelet. This will alert medical personnel to the need for additional hormone administration in an emergency situation. A serum sodium level is evaluated on the 4th or 5th day after surgery. Delayed hyponatraemia, attributed to the syndrome of inappropriate secretion of antidiuretic hormone (SIADH), typically occurs in a delayed fashion following transsphenoidal resection of pituitary lesions. In a series of 99 consecutive patients who underwent transsphenoidal surgery for pituitary adenomas, nine patients developed delayed hyponatraemia, seven of whom were symptomatic. Of these seven patients, four had been discharged from the hospital and required readmission on postoperative Day 7 to 9. In the nine patients who developed hyponatraemia, on the average sodium levels began to fall on Day 4 and reached a nadir on Day 7 (Kelly, Laws & Fossett, 1995). Education at discharge about common symptoms of SIADH, such as nausea, confusion, fluid retention, and lethargy, is important for early recognition and prompt treatment. When left untreated, severe delayed hyponatraemia can result in coma or death.

Post-Operative and Long-term Follow-Up Care

Patients are typically seen by the surgical team 7-10 days after the surgery. After endonasal endoscopic surgery, the head and neck surgeon will perform outpatient sinonasal endoscopy and debridement at least 2-3 times over multiple months. The definitive pathology results are discussed with the patient usually at the first postoperative visit in the clinic. The possible needs for adjuvant treatments such as medical therapies for patients with acromegaly or radiosurgery for residual invasive adenomas are also discussed with the patient. In many patients, these decisions may need to be delayed for several months or years with frequent hormonal evaluation and pituitary imaging. The nurse practitioner is key in coordinating post-operative care and possible adjuvant therapy by the endocrinologist, medical oncologist and radiation oncologist. It is important that the treatment plan be communicated to the patient's primary physician to keep all caregivers informed. Patients should be referred back to their endocrinologist four to six weeks after surgery to assess the status of their pituitary function and determine if any hormonal replacement is needed or should be adjusted. Patients with macroadenomas undergo a follow-up pituitary MRI at three months after surgery. Patients with functional adenomas obtain an initial post-operative baseline MRI, but are subsequently monitored biochemically, based on their endocrinopathy. Patients with non-functional

inactive pituitary adenomas are followed with serial imaging, with progressively longer intervals between exams, with stable disease. Faithful adherence to a schedule of follow-up pituitary imaging allows for early detection of tumour recurrence and timely treatment, including either repeat surgery with or without radiation therapy and chemotherapy. Nurses who care for patients during the follow-up phase of pituitary management face the special challenge of ensuring that these individuals, who may no longer be symptomatic, return for evaluation at regular intervals. The nurse practitioner must emphasise the importance of maintaining follow-up appointments with all team members namely the endocrinologist, neuro-ophtalmologist, surgical team, radio-oncologist and medical oncologist.

Educational Opportunities

Education opportunities focusing on the care of patients with pituitary lesions is an ongoing experience. Ongoing lectures and review of journal articles continue to help nurses develop their knowledge and improve practice. A Neuroscience Nursing Symposium has been developed in our Center to keep nurses updated on state of the art treatments for pituitary pathologies and on future trends. Strategies that may further improve patient outcomes include establishing guidelines for pituitary tumour centres of excellence and more focused residency and fellowship training in endonasal endoscopic transsphenoidal surgery.

The impact of the internet on patient education and support is very vital. We correspond regularly with patients who research online for information and guidance. These patients are referred to online forums and patient associations that offer the possibility to discuss with other patients with similar pathologies. We offer a community outreach program where different specialties collaborate to educate the general population regarding pituitary tumours. Our Center offers a patient focused pituitary symposium including neurosurgeons, head and neck surgeons, endocrinologist, radiation oncologist, patient advocates, nurse practitioners and research nurses. As patients become increasingly involved in researching diagnoses and medical treatment options online, we must be able to provide the most up-to-date and comprehensive information via the internet. Our practice website is updated regularly to have the current information and publications for patient's references.

Case Study

A 40 year old man presented with a 7 year history of fatigue and low energy with a 20 year history of low testosterone treated with testosterone supplements. For over a year, the patient has noticed decreased libido, anxiety as well as worsening vision, predominantly in the right eye. His pre-operative total testosterone was 180 ng/dl (normal >250 ng/dl) with LH at 2.2m/iu/ml (low normal); prolactin was mildly elevated at 29.7ng/ml; IGF-1 was 230 ng/ml (age appropriate normal); thyroxin was 6.0 ng/ml and TSH was 1.5ng/ml (both normal); ACTH was 25 pg/ml and cortisol was 12 ug/dl (both normal). A radiographic image of the brain and pituitary demonstrated large pituitary macroadenoma with degenerative changes and subacute haemorrhage and severe chiasmal compression (figure 2).

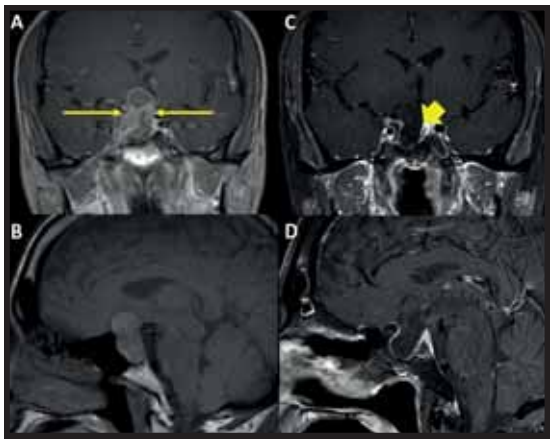

Figure 2 (Above): *Pre-operative (A&B) and post-operative (C&D) MRI images of the case study patient. Note the large macroadenoma with evidence of hemorrhage (arrow) and gross-total resection of this tumor. Note the normal, decompressed and preserved pituitary gland now visible in the post-operative images (arrowheads).*

On neurological examination visual acuity was diminished on the right (20/50) and normal on the left (20/20). There was mild bitemporal hemianopsia on confrontational examination, worse in the right eye. He was otherwise neurologically intact. He underwent endonasal endoscopic removal of an endocrine inactive macroadenoma and sellar reinforcement with an abdominal fat graft. The post-operative MRI showed gross total resection of the pituitary adenoma. His immediate post-operative prolactin level was 19.9ng/ml; cortisol 5.6ng/ml. His visual fields deficits resolved and visual acuity improved to 20/25 OD and 20/20 OS. Pathological evaluation confirmed pituitary adenoma, ACTH staining; no features of atypia or malignancy and Ki-67 is

<1% (pathological grading marker for neuroendocrine tumours). The patient was able to be discharged on the second post-operative day without complications. We saw him on follow-up 4 months after surgery and he has had an improvement in his vision. His visual acuity revealed 20/25 OD and 20/20 OS. His pituitary hormonal function was normal. It was recommended that he have a repeat hormonal function test within 2 months and follow-up visit with his endocrinologist. He was to have a follow-up appointment and repeat MRI in one year.

This case illustrates the importance of a multidisciplinary approach with members experienced in pituitary pathologies. The patient was seen by a medical physician, then referred to an endocrinologist, an ophthalmologist and neurosurgeon. The unfortunate situation in this case is that the diagnosis of pituitary tumour could have been investigated early on if an early MRI was performed. The patient had a pituitary apoplectic event due to the enlarged tumour.

Conclusion

Multidisciplinary team work is essential to optimally manage patients with pituitary adenomas and related lesions, resulting in improved quality of care and patient outcomes. As illustrated, throughout the process of pre-operative, peri-operative and post-operative care, numerous specialists and team members must be carefully integrated in this process. At pituitary centres of excellence, practitioners should demonstrate that endonasal surgery patients can be cared for safely, effectively and efficiently through multidisciplinary treatment paradigm. In order to administer excellence in nursing care, key contribution of the neuroscience nurses include maintaining a holistic view of the patient, maintaining the patient and family central to care and decision making, advocating for the patient and family interests, and educating the patient and family. The foundation for implementation of these and other aspects of care is critical thinking and highly developed clinical reasoning skills. These skills are necessary for both independent decisions by the nurse practitioner and participation in multidisciplinary settings.

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