Neurochirurgie xxx (2014) xxx–xxx

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Report 2013: Tumors of the pineal region

Role of radiosurgery in the management of pineal region tumours: indications, method, outcome

Place de la radiochirurgie dans la prise en charge des tumeurs de la région pinéale : indications, technique, pronostic

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ARTICLE INFO

Article history:
Received 21 March 2013
Received in revised form 8 September 2013
Accepted 23 November 2013
Available online xxx

Keywords:
Germ cell tumour
Pineal tumour
Pineoblastoma
Pineocytoma
Radiosurgery

ABSTRACT

Numerous tumour types can occur in the pineal region. Because these tumours are uncommon and heterogeneous, it is often difficult to establish optimal treatment strategies based on comparative clinical trials. To date, the role of radiosurgery for the treatment of pineal region tumours remains controversial. This report of a 10-year single-department experience and review of the literature focuses on the spectrum of pathologic features found in these pineal parenchymal tumours and on the interest of radiosurgery in their management. Considering pineocytomas, although these tumours have been considered to be radioresistant to fractionated radiotherapy, our results are in agreement with similar results reported in the literature in suggesting that radiosurgery may be an alternative to surgical resection or an adjuvant therapy when the resection is not optimal. When dissemination occurs after radiosurgery, however, craniospinal radiation and chemotherapy are necessary. Radiosurgery has also proven its interest in the treatment of germinomas as an alternative to encephalic radiotherapy with limited long-term damage. Regarding the other pathologies, radiosurgery can be considered as part of a multimodal treatment including surgery, chemo-radiotherapy and its role still has to be clearly defined.

Mots clés :
Tumeur germinale
Tumeur de la région pinéale
Pinéaloblastome
Pinéalocytome
Radiochirurgie

RÉSUMÉ

De nombreux types de tumeurs peuvent être observés dans la région pinéale. Du fait de leur caractère rare et hétérogène, il est souvent difficile d'établir des stratégies thérapeutiques optimales basées sur des études cliniques. À ce jour, la place de la radiochirurgie dans le traitement des tumeurs de la région pinéale demeure controversée. Nous rapportons une expérience monocentrique de 10 ans ainsi qu'une revue de la littérature exhaustive sur l'intérêt de la radiochirurgie dans ces lésions. Concernant les pinéalocytomes, bien que ces tumeurs aient été considérées comme radiorésistantes à la radiothérapie fractionnée, nos résultats confirment ceux de la littérature en suggérant que la radiochirurgie pourrait constituer une alternative à la chirurgie ou un traitement adjuvant lorsque la résection n'est pas optimale. En présence d'une dissémination cérébrospinale, une irradiation crâniospinale associée à une chimiothérapie s'avère en revanche nécessaire. La radiochirurgie a également prouvé son intérêt dans le traitement des germinomes comme alternative à l'irradiation encéphalique avec une toxicité à long terme réduite. Concernant les autres pathologies, la radiochirurgie pourrait s'inclure dans une prise en charge multimodale associant chirurgie, chimio-radiothérapie, mais sa place précise reste à définir.

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http://dx.doi.org/10.1016/j.neuchi.2013.11.007
0028-3770/

1. Introduction

Neoplasms of the pineal region are a rare entity accounting for less than 5% of all intracranial tumours. Numerous tumour types can occur in the pineal region, including pineal parenchymal tumours, germ cell tumours, papillary pineal tumours, gliomas and mixed tumours. Because these tumours are uncommon and heterogeneous, it is often difficult to establish optimal treatment strategies based on comparative clinical trials. Most data available in the literature come from small clinical series or case reports with no control group, achieving very low level of evidence to build new protocols.

Factors that are currently known to influence the outcome of pineal tumours include surgical resectability, radiosensitivity, chemosensitivity, and a tendency to disseminate. These factors are defined by the histological characteristics of the tumour. Then, both histological samples and cerebrospinal fluid (CSF) or blood specific markers are decisive in the management of these tumours and no curative treatment should be initiated without these elements.

To date, the role of radiosurgery for the treatment of pineal region tumours has remained controversial. Although there have been advances in microsurgical approaches which have significantly reduced the morbidity of open surgical procedures, resection of pineal region tumours still remains challenging, carrying potential adverse effects, and is sometimes worthless [1]. As a consequence, radiosurgery, alone or in combination with open microsurgery and/or chemotherapy, has been advocated as an alternative to microsurgical complete removal of pineal tumours. This report of a 10-year single-department experience and review of the literature focuses on the spectrum of pathologic features found in these pineal parenchymal tumours and on the interest of radiosurgery in their management. Meningiomas, metastases, gliomas and vascular malformations were excluded from this study.

2. Report of a 10-year single-department experience

In the last ten years (January 2004–February 2013), 4772 Gamma-knife radiosurgical procedures were performed in the university hospital of Lille. During this period, 12 patients with pineal region tumours benefited from this technique, representing 0.25% of the patients treated. There were 8 males and 4 females (sex-ratio M/F: 2). Mean age at the time of radiosurgery was 49 years old (range from 7 to 73 years). Clinical symptoms were almost exclusively represented by intracranial hypertension symptoms (Table 1). In 1 patient the pineal tumour was fortuitously discovered during a magnetic resonance imaging (MRI) for asthenia. Obstructive hydrocephalus was observed in 11/12 cases and was managed in emergency by ventriculocisternostomy. Levels of alpha-fetoprotein (αFP), beta-human chorionic gonadotropin (βhCG) and carcinoembryonic antigen in the serum or CSF were measured in all cases prior to stereotactic biopsies or open surgery, and were negative in all cases. Diagnosis was achieved based on stereotactic biopsies in 8 cases and open microsurgery in 4 cases. All the patients who were treated by radiosurgery had defined histological diagnosis. No patients had evidence of dissemination before radiosurgery.

Gamma-knife radiosurgery (GKRS) was the sole treatment in 8 cases of pineocytomas (Fig. 1) but followed partial microsurgical resection in 1 case of a mixed tumour, 1 teratoma with germinoma component, 1 papillary tumour (Fig. 2) and 1 pineocytoma. It was followed by chemotherapy for the treatment of the mixed tumour. The radiosurgical goal was local tumour control in all patients. The Leksell stereotactic frame type G (Elekta Instrument AB) was used in all cases. The images for dose planning were obtained with a 1.5-T MRI. Millimetric volumetric images in transverse and frontal orthogonal planes after gadolinium enhancement were used. Computerised tomography (CT) millimetric axial images were obtained. The slice interval was 1 mm. Dose planning was performed with the Gamma Plan software (Elekta Instrument AB) in all cases. The radiosurgical treatments were performed using the Leksell Gamma-Knife model C (Elekta Instrument AB).

The marginal dose was chosen mainly depending on the histological type and the tumour volume, taking into account the radiation tolerance of surrounding structures, mainly thalami and tectal plate. The average dose distributed to the lesion was 15.7 Gy (range 12–18 Gy) prescribed at the 50% isodose. The mean follow-up was 26 months (from 5 to 76 months). Two patients were lost to follow-up. Concerning tumour size control, 1 patient had a complete regression of tumour size, 1 patient had more than 50% decrease in tumour size, 7 patients had a stable lesion, and 1 patient had a local recurrence. No adverse event occurred during the procedures or during the follow-up. All patients were alive at the end of the follow-up period.

3. Role of radiosurgery in the management of pineal tumours

3.1. Primitive parenchymal pineal tumours

The latest World Health Organization (WHO) classification, released in 2007, categorized pineal parenchymal tumours into 3 subtypes with up to 4 different grade categories: WHO Grade I pineocytomas, WHO Grade II or III pineal parenchymal tumours of intermediate differentiation, and WHO Grade IV pineoblastomas [2].

Table 1
Description of the population treated by Gamma-knife from 2004 to 2013 for pineal tumours in Lille.
Description de la population traitée par Gamma-knife de 2004 à 2013 pour des tumeurs de la région pinéale à Lille.

Sex	Age (year)	Symptoms	Diagnosis	Average tumour volume (cm^3)	Average dose range (Gy)	Isodose (%)	Morbidity	Follow-up (months)	MRI volume
F	64	ICH	Pineocytoma	1.8	16	50	None	39	PR
M	45	ICH	Pineocytoma grade II	3.4	14	50	None	76	Stable
M	57	ICH	Pineocytoma	8.7	12	50	None	72	Stable
M	7	ICH	Mixed germ cell tumour	1.9	18	50	None	10	Progression
M	62	ICH	Pineocytoma	2.5	17	50	None	15	CR
M	63	ICH	Pineocytoma grade II	2.5	15	50	None	12	Stable
M	64	ICH	Pineocytoma grade II	5.2	14	50	None	NS	NS
M	18	ICH	Mature teratoma	1.3	17	50	None	NS	NS
F	27	ICH	Papillary tumour grade II	1.1	15	50	None	6	Stable
M	65	ICH	Pineocytoma grade II	3.7	17	50	None	14	Stable
F	73	ICH	Pineocytoma grade II	1.16	15	50	None	14	Stable
F	46	None	Pineocytoma grade II	2.41	18	50	None	5	Stable
Mean	49	–	–	3.0	15.7	50	None	26.3	–

ICH: intracranial hypertension; PR: partial response; CR: complete response; NS: not specified.

Please cite this article in press as: Balossier A, et al. Role of radiosurgery in the management of pineal region tumours: indications, method, outcome. Neurochirurgie (2014), http://dx.doi.org/10.1016/j.neuchi.2013.11.007