

Role of Cyber knife Radiosurgery in pituitary mass and improvement in growth hormone levels

Abstract

Objective: Role of Cyberknife surgery in pituitary mass and improvement in Growth hormone levels.

Study design: A prospective study.

Place and duration of study: This study was conducted in the Department of Radiology JPMC Karachi from Jan 2013 to Aug 2015.

Methodology: A prospective study was conducted during the year of Jan 2013 to Aug 2015 in the department of Cyberknife Radiology, JPMC, Karachi in patients with pituitary adenoma diagnosed through MRI having clinical symptoms of amenorrhea, visual disturbances and headaches. Tumor size and Growth hormone levels were assessed before going through surgery and after Cyberknife treatment, reduction in tumor. A total of 50 patients with pituitary adenoma underwent Cyberknife gamma radiation procedure. The patient group comprised of 50 diagnosed cases of pituitary adenoma of men(56%) and women(44%). All patients were treated for recurrent or residual disease after surgery or radiotherapy, with 83% presenting with extensive tumor involvement. The median tumor volume was cm³ and median radiation dose was 15 GY defined to the 50% isodose line. The mean and median follow-up periods were 3 months and 6 months respectively.

Results: Before and after treatment of mean GH value is 2.26+3.64 and 1.49+2.75 respectively. 2(4%) patients showed stable size radiologically with reduced hormone level but 2(4%) patients showed mildly increased size initially then reduced size on followup. Out of 46(92%) patient's clinically successful outcome and radiological improvement in 40(86.95%) patients were size reduced after 5 sessions, 5(10.86%) patients received 3 sessions and one patient received only one session.

Conclusion: Cyberknife is a cutting edge technology in modern world of Radiology. After the resection of tumor through cyberknife surgery, the normal functioning of pituitary gland is less affected.

Keywords: Cyberknife surgery, pituitary adenoma, growth hormone

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Introduction

Pituitary adenoma is one of the most common benign tumors of central nervous system,^{1,2} accounting 10% of intracranial tumors.^{3,4} An estimated prevalence of asymptomatic small pituitary tumor is 16.7% (14.4% in autopsy and 22.5% in radiologic studies).^{3,4} Pituitary adenoma prevalence is based on recent cross-sectional study is estimated to be 80-90 per 100,000. 30% of pituitary tumors are non-secretory and 70% secrete greater amount of pituitary hormones. In secretory adenomas 60% prolactinomas, 20% growth hormone secreting tumors and with decreasing frequency is adrenocorticotrophic hormone (ACTH) secreting tumors and thyroid stimulating hormone (TSH) secreting tumors (10). Pituitary adenoma can be micro or macroadenoma by cutoff size of 10mm. Tumors exceeding 30-40mm are giant adenoma. Most tumors are benign, but 20-55% shows invasion.^{5,6}

Clinical symptoms produced by secreting tumors are varied. A tumor which is located near optic apparatus may be diagnosed as visual field loss as a patient first symptom. Some tumors which are large enough may cause hypopituitarism by compressing the secretion from the normal gland.⁷ Before going to surgery, all patients of pituitary adenoma, a complete review of neurological findings, pituitary endocrine status, ophthalmological examination

with radiological evaluation is necessary. Surgery is the mainstay of treatment for tumors other than prolactinomas.⁷

Compared with surgical therapy, stereotactic radiosurgery (SRS) is a new modality in the treatment of pituitary adenoma. The Cyberknife radiosurgery has been used for years in the treatment of non-secreting or secreting pituitary adenoma either primary non-surgical or alternative post-surgical treatment.⁸ It is a mechanical radiosurgery system for the treatment of many modalities including pituitary adenoma.⁹ The chief essentials of cyberknife are radiations from linear particle accelerator and a mechanical arm which allows energy to be heading at any part of body from either direction.¹⁰ It allows extremely precise dose distribution and is a favourable second line option when surgery itself is not recommended or has failed.¹¹

The procedure is unique in the way that no opening of skull is required and there is very minor damage to the surrounding brain. Although it cannot rapidly repair neurological symptoms or decrease hormone secretions,^{3,4} but after SRS, tumor control rate is estimated to be 83.3% and 100%.^{12,13} Previous studies showed the result that hormone level recovery rate after SRS is 28.2% and 35.5% and average recovery time is 362±24 months.^{14,15} Nonsecretory pituitary adenoma exhibit a better response and long term progress than secretory adenoma with external beam radiation therapy.¹⁶ Higher SRS

doses are required for secreting tumors than non-secreting tumors.¹⁷ Long term followup with a larger group of patients is required to fully evaluate the safety and effectiveness of this treatment modality.

Material and methods

This study was conducted in the department of Cyber knifeRadiology, JPMC, Karachi from Jan 2013 till August 2015, after the approval of ethical board committee of BMSI, JPMC, Karachi. All the diagnosed cases of pituitary adenoma with MRI findings along with hormonal assays and clinical symptoms of visual disturbances, amenorrhea or headache between ages 20 years to 80 years of both the gender were included in the study. The tumor mass and growth hormone level before and after cyber knifeprocedure were assessed, reduction in size of tumor and growth hormone levels were assessedafter 5 sessions.

Results

A total of 50 patients, mean ages was 43.40 ± 12.86 years (20-75 years) (Chart No.1) associated with pituitary adenoma underwent Cyberknife gamma radiation procedure. 50 diagnosed cases of pituitary adenoma of men 28(56%) cases and women 22(44%) cases. All patients were treated for recurrent or residual disease after surgery or radiotherapy, with 83% presenting with extensive tumor involvement. The median tumor volume was 3.8 ± 2.1 cm and median radiation dose was 15 GY defined to the 50% isodose line. The mean follow-up period was 3 months. 46(92%) patients with pituitary adenoma showed marked decrease in growth hormone levels and size of tumorafter Cyberknife robotic radiosurgery. Before and after treatment of mean GH value is 2.26 ± 3.64 and 1.49 ± 2.75 respectively (Chart No.2). 2(4%) patients showed stable size radiologically with reduced hormone level but 2(4%) patients showed mildly increased size initially then reduced size on followup (Chart No.3). Out of 46(92%) patient with clinically successful outcome and radiological improvement, in 40(86.95%) patients size reduced after 5 sessions, 5(10.86%) patients received 3 sessions and one patient received only one session.

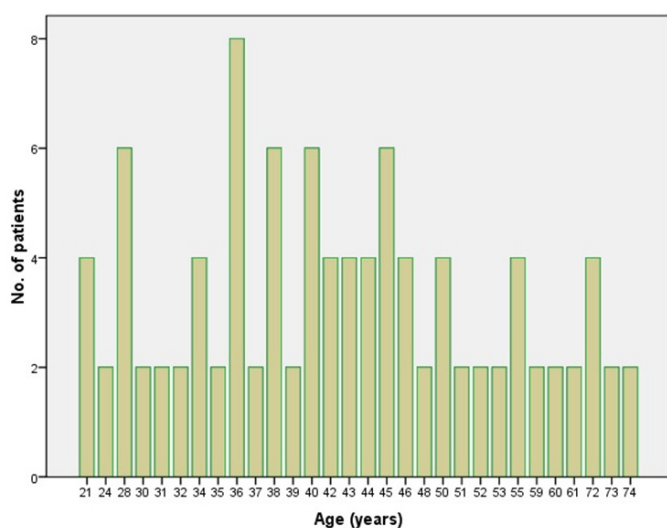


Chart no.1 Age distribution.

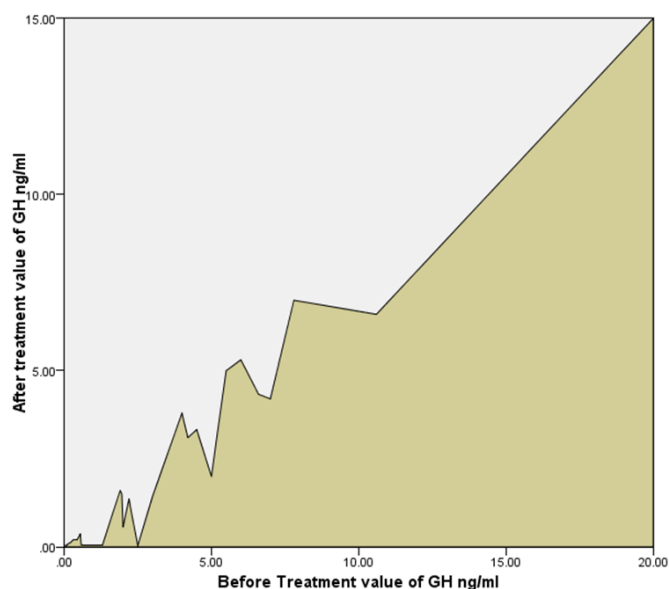
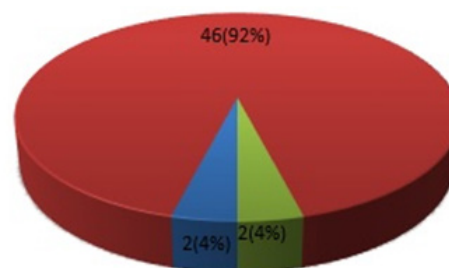


Chart no.2 Before and after treatment of value of gh ng/ml.



- Stable tumor size radiologically with reduced hormone level
- Marked decrease tumor size and growth hormone levels
- Initially mildly increased tumor size then reduced size on followup

Chart no.3 After cyberknife robotic radiosurgery.

Discussion

Adenomas pituitary are the most common lesion, which are between 10 and 20% of all primary brain tumors. Epidemiological studies have shown that approximately 20% of the general population suffering from a pituitary adenoma.¹³ Therefore, surgery is the “gold standard” in the treatment of these lesions.¹⁸ However, mostly patients are not fully resectable because it is close to the critical neurovascular structures, the size of the side of the pituitary fossa, or the invasion of Dura. In such cases, repeat after removal subtotal is only about.¹⁸ CyberKnife (Accuray, Sunnyvale, CA) is a relatively new technological device which combines a mobile linear accelerator mounted on a robotic arm with an image-guided robotics system. The system allows for frameless SRS achieving the same level of targeting precision as frame-based SRS. Patients are fixed in a thermoplastic mask, and the treatment can be delivered in form of hypofractionated regimen in patients with tumors involving the optic apparatus and who are not suitable for SRS.^{19,20}

In our study patients mean age was 43.40±12.86 years (20-75 years). Pituitary adenoma more occur in men 28(56%) cases then women 22(44%) cases. However in the study of Chul Bum Cho¹⁸ reported patient age ranged from 31 to 69 years (mean±SD: 48.5±10.0 years). Fourteen patients (53%) were male, and 12(47%) were female. In fractionated radiation, the tumor control rate ranges from 76% to 97%.^{21,22} Therefore, CyberKnife CKRS compares favorably with fractionated radiotherapy. According to the literature, the tumor control rate for the pituitary adenomas following Gamma knife radiosurgery (GKRS) ranges from 93.3% to 94%.²³ The results reported here improvement assessment by radiological in 21(42%) patients with pituitary adenoma showed reduction in size of tumor. The improvement rate of endocrinopathies after Gamma knife radiosurgery (GKRS) has been reported to be 77.7% to 93%, and the normalization rate has ranged between 21% and 52.4%.²⁴ In fractionated radiation, endocrinological improvement ranges from 38% to 70%.²⁵ Thus, the current results of CKRS (endocrinological improvement: 100%, endocrinological normalization: 44%) are similar to that of GKRS and a little superior to that of fractionated radiation. While in our study observed clinically successful outcome and radiological improvement in 46(92%) patients were markedly reduced level of hormones (Before and after treatment of Mean GH value is 2.26±3.64 and 1.49±2.75 respectively) and size of tumor.²⁶

Conclusion

Radiosurgery is an efficient treatment modality for the patients of pituitary adenoma with negligible peril. Cyberknife surgery provides control of tumor growth in majority of cases and normalization of hormone levels in various secretory tumors. So it has a levelheaded anti-secretary and a high anti-tumoral efficacy making it important treatment plan. Even though the possibility for hormone normalization in secretory tumor is less than 50%, both SRS and surgery in these patients may eliminate or reduce the requirement for expensive anti-secretary drugs and their side-effects. Cyberknife surgery is indicated post-operatively as an alternative therapy if residual secretory or non-secretary tumors persist, at the time of tumor growth or when biochemical markers establish recurrence. Due to its mechanism of action being based on precise single high dose fraction, SRS should be reserved to small lesions, precise on imaging techniques. A regular follow-up is obligatory after the procedure and should take into account the risk of late reappearance.

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None

Conflict of interest

Authors declare there is no conflict of interest.

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