Case Report of Advanced Juvenile Nasopharyngeal Angiofibroma with Cavernous Sinus Involvemen: Advantages of Advanced Radiotherapy Thechnique Volumetric Modulated Arc Therapy

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Abstract

Objectives: In very advance unresectable stages Juvenile nasopharyngeal angiofibroma (JNA)radiotherapy is treatment of choice. Usually JNA is in close proximity to different organ at risk, which necessitates accurate and precise radiation delivery. Series reported the application of IMRT (Intensity Modulated Radiotherapy) with good sparing of organ at risk, but the literature search found no report on VMAT (Volumetric Modulated Arc Therapy) treatment in case of JNA.

Clinical case: The present publication report for first time a patient irradiated with VMAT and IGRT (Image guided radiotherapy) for JNA. The stage of the tumor based on CT and MRI was IIIB according to Radkovsi with cavernous sinus invasion. Moderate total radiation dose 36 Gy in 1.8 Gy per fraction was delivered. No early and late toxicity was recorded. The patient is followed up every six months and persistent residual tumor on MRI was seen, but no bleeding onphysical exam. At one year follow up this is accepted as good local control.

Conclusion: VMAT and IGRT could be safely applied with reduction of the radiation dose at organ of risk. VMAT is promising in the treatment of juvenile angiofibroma with advantages over conventional radiotherapy, but as this is case report of only one patient, further experience with VMAT is needed in JNA

Key words: Advanced juvenile nasopharyngeal angiofibroma, treatment, radiotherapy, VMAT, IGRT

Introduction

Juvenile nasopharyngeal angiofibroma (JNA) is the most common benign tumor of nasopharynx. It accounts for 0.05 % of all head and neck tumors and mostly affects adolescent males [1-3]. It is a highly vascular and cellular tumor. Although benign histology JNA could be very aggressive penetrating trough bone intracranial with invasion of cavernous sinus and life threatening bleeding. Main treatment approach is surgery, usually preceded by preoperative embolization [4]. In very advance unresectable stages radiotherapy is treatment of choice [5, 6]. Usually JNA is in close proximity to different organ at risk, which necessitates accurate and precise radiation delivery. Series reported the application of IMRT (Intensity Modulated Radiotherapy) with good sparing of organ at risk, but the literature search found no report on VMAT (Volumetric Modulated Arc Therapy) treatment in case of JNA. We present the first case of implementation of advancedradiotherapy techniques VMAT and IGRT (Image Guided Radiotherapy) in advanced JNA with cavernous sinus invasion,combined with embolization treatment.

Case report

A 15 years old male patient presented with 3 years history of right sided headache, intermittent nasal

bleeding and nasal obstruction. It was suggested to be polypus of the choans and extirpation was proceeded. This has led to massive bleeding and anterior and posterior tamponade was applied. Diagnostic CT and MRI were performed and juvenile nasopharyngeal angiofibroma was suspected. Biopsy was performed and the diagnose was histological proven. Because of persistent nasal bleeding diagnostic angiography was performed showing big tumor formation of nasopharynx end nasal cavity with main blood supply by right external carotid system and specific right maxillary artery. Than embolization of the right maxillary artery was undertaken. The MRI described big tumor formation of nasopharyx with involvement of nasal cavity, sphenoidal sinus, infiltrating the clivus, right fossa pterygopalatina, masticator space with partial involvement of right sinus cavernous and to lesser extent of left sinus cavernous. The formation lies next to both internal carotid arteries with no encasement (Fig. 1). According to Radkovski staging system it was the highest stage IIIB [7]. The case was discussed among surgeons, pediatrician and radiation oncologist and considering the extensive tumor and high risk of surgical complication, decision for radiotherapy was made. Radiotherapy was given in 1.8 Gy daily fraction to 36 Gy total dose with VMAT irradiation technique, combined with IGRT-daily imaging in the treatment room with cone beam CT (Fig. 2). The mean dose to the optic nerve (R31 Gy; L 32 Gy),brainstem (27.5Gy), brain (9Gy), lenses (6.8Gy; 6.2Gy), and parotid (L14.6Gy; R 15.3Gy) were the lowest that could be achieved in case of large and invasive tumor, next to them. These mean doses became possible only with irradiation of advanced VMAT technique and could not be achieved with 3 D conformal radiotherapy.

During the radiotherapy course no bleeding was observedThan the patients was follow up every 6 months with MRI and ENT physical exam. The first MRI at six months post radiotherapy reported that there slight reduction of anterior posterior dimension ofthe nasopharyngeal and sphenoidal part of the tumorformation and no significant change of the dimensions and spread of the formation. The follow up MRI at one year did not detect any significant difference compared with the previous MRI (Fig. 3). The physical ENT exam described tumor formation of nasopharynx with no signs of bleeding, right nasal cavity -opened, left nasal cavity-obstructive with no signs of bleeding. At one year of follow upthe disease is fully controlled with no acute and late radiation toxicity. The follow up continues.

Discussion

JNA invades intracranial in 6% to 37.5% [6, 8]. The surgical excision in these cases leads to 50% recurrences and perioperative complications [4]. Advanced stages of JNA have been treated with radiotherapy for number of decades with a very good local control raging between 73% and 100% [5, 8, 9, 10]. Recent study reported a dose response for tumor control, which reached 91% when 35-36 Gy are delivered compared to 77% with 30-32Gy. So the recommended dose is 36 Gy in 1.8Gy per fraction, with every 6 months imaging follow up form minimum 5 years [11].

There are two major concerns with irradiation. One is about malignant transformation of the irradiated JNA, but in all reported cases with radiation induced tumors a very high radiation dose was delivered exceeding 60 Gy (66–90 Gy) [12, 13]. The risk nowadays is limited with the prescription of moderate doses of 36 to 40 Gy in most recent series.Second one is about growth defects in craniofacial skeleton with JNA irradiation in the maturing adolescent [1], but till now no such deleterious effect has been described in reported series [1, 6, 10]. Radiation induced panhypopituitarism led to grow retardation of patient height but after delivery of 96Gy [12].

The moderate radiation doses needed to control extensive intracranial JNA 35–46 Gy could cause significant late toxicity to the parotid gland, optic chiasm, optic nerve, pituitary gland, and eye. Conformal radiotherapy techniques led to limited dose to organ at risk and reduced complication risk [14]. The modern radiotherapy techniques like IMRT, its advanced form VMAT and IGRT improved the accuracy and precision of radiotherapy delivery to the target volumes. This contributes to better target coverage with simultaneous reduction the radiation dose at organ at risk. This is very important in cases where next to the target volume lie many organ at risk and when the patient organism is still immature. This is the case when the invasive angiofibroma located intracranial is close proximity to optic nerve and chiasm, brainstem, lenses, pituitary gland, parotid gland. One of the earliest series reporting IMRT use in JNA [15] achieved dose reduction at organ at riskwhile the local con-

trol in all patients has been maintained. During the follow-up period (6 to 40 months) progressive tumor shrinkage withcontrol of the symptoms was observed. IMRT reduced mean doses to optic nerve to 24–28 Gy (53–82% of prescribed dose) [15]. Another series reported the range of mean doses to optic nerve from 63% to 100% of the prescribed dose, which is related to larger target volume and higher incidence of proximity to optic nerve [6]. Benefit of IMRT application is eliminating geographical misses, which were the reason for treatment failure in one report [10]. With introduction of IMRT no ocular or neurologic complications, no xerostomia (secondary dental caries) have been recorded [6]. Implementing IMRTin the reported case significant reduced the toxicity compared to older radiotherapy reports, which leads to improved and sustained good quality of life, which is crucial in maturing adolescent patient with expected long term survival. VMAT is the more advance radiotherapy technique compare to IMRT-its advantages is the reduced treatment time and monitor units, so less integral dose delivered to healthy tissue. In the literature there is no report of VMAT application in JNA. IGRT help us the patient position to be reproduced every day and ensures that with the daily imaging of the tumor and the organ at risk in the treatment room we deliver the prescribed dose accurately at the target volume and do not irradiate the organ at risk with higher dose. Combining VMAT and IGRT could contribute for improvements of treatment results and reduction of toxicity.

Some of the reported series like the reported case observed asymptomatic persistent residual tumor on MRI or CT [5, 6, 10]. But this is the natural slow involution of JNA, which necessitates close follow up with physical examination and imaging.

The present publication report for first time a patient treated with VMAT and IGRT for JNA. The stage of the tumor based on CT and MRI was IIIB according to Radkovski with cavernous sinus invasion. Moderate total radiation dose 36 Gy in 1.8 Gy per fraction was delivered based on recent recommendation. No early and late toxicity was recorded. The patient is follow up every six months with imaging and physical exam and persistent residual tumor on MRI is seen, but no bleeding at physical exam. At one year follow up this is accepted as good local control.

Conclusion

Radiotherapy should be recommended as first line treatment in patients with JNA invasion of the cavernous sinuses based on CT and MRIstaging. Excellent local control was achieved withcombination of VMAT and IGRT of moderate dose of 36Gy at 1 year of follow up. No serious early toxicity was observed and longer follow up is recommended to detect any late morbidity. Themost advanced radiotherapy techniquesVMAT and IGRT could be safely applied with reduction of the radiation dose at organ of risk. VMAT is promising in the treatment of juvenile angiofibroma with advantages over conventional radiotherapy, but as this is case report of only one patient,further experience with VMAT is needed in JNA

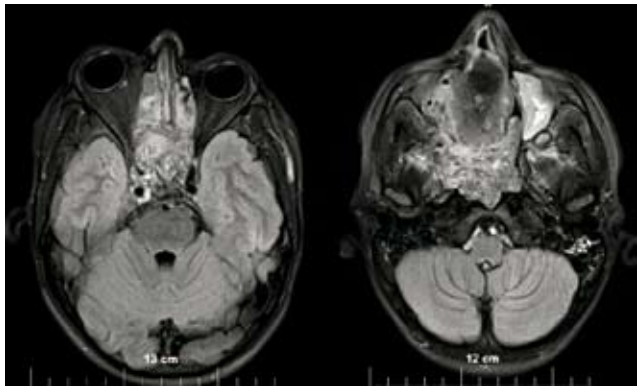

Fig. 1. Diagnostic MRI before treatment

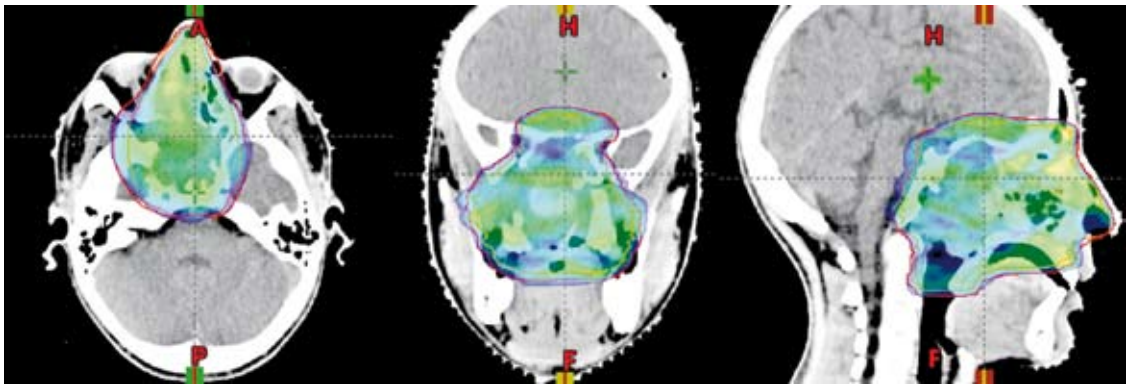

Fig 2. Treatment plan ofVMAT irradiation technique

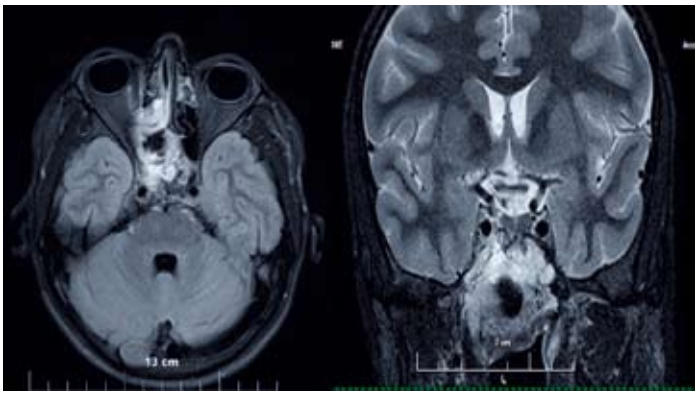

Fig. 3. Follow up MRI one year post treatment

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