The Turkish Journal of Pediatrics 1998; 40: 393-397

PLAQUE RADIOTHERAPY IN THE MANAGEMENT OF RETINOBLASTOMA*

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SUMMARY: Kıratlı H, Bilgiç S, Atahan İL. (Departments of Ophthalmology and Radiation Oncology, Hacettepe University Faculty of Medicine, Ankara, Turkey). Plaque radiotherapy in the management of retinoblastoma. Turk J Pediatr 1998; 40: 393-397.

Retinoblastoma is the most common intraocular malignant tumor in childhood and is radiosensitive. We treated five patients with solitary intraocular retinoblastoma using iodine-125 plaque radiotherapy as a primary procedure. Tumor basal diameters ranged from six to 16 mm and thickness ranged from three to 11 mm. The radiation dose delivered to tumor apex ranged from 3500 to 5000 centigrays. All tumors regressed considerably within a follow-up ranging between seven to 12 months. There was no tumor recurrence or any complications related to plaque brachytherapy within this early period. We concluded that plaque radiotherapy is an effective method in local tumor control and allows eye preservation in patients with retinoblastoma. *Key words: retinoblastoma, brachytherapy, iodine-125.*

Retinoblastoma is the most common intraocular malignant tumor in childhood[1]. Current treatment options of retinoblastoma include external beam radiotherapy[2], enucleation[1], laser photocoagulation[3], cryotherapy[4] and plaque radiotherapy[5]. More recently, a combination of chemotherapy, cryotherapy and laser therapy has been introduced into clinical practice to avoid external beam radiotherapy[6]. Some important clinical variables that determine the specific treatment are patient age; unilateral versus bilateral disease; hereditary versus non-hereditary disease; size, number and location of the tumors; and potential for useful vision.

There is a growing emphasis on organ preservation in selecting appropriate treatment for patients with retinoblastoma, and episcleral plaque brachytherapy (EPB) is a serious consideration in an effort to salvage the eye. In this study, we evaluated our short-term experience in the management of retinoblastoma using iodine-125 radioactive plaque brachytherapy.

Material and Methods

Patients treated with solitary plaque radiotherapy for intraocular retinoblastoma at the Ocular Oncology Unit, Hacettepe University Hospital, were selected for this study. Patients were initially examined under general anesthesia and the

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tumor size (base and thickness) was estimated by indirect ophthalmoscopy and ultrasonography (A-and B-mode). Iodine-125 radioisotope was used exclusively because of its ease in individualizing plaque designs and radiation safety. All calculatilons were made on USC 1.50 radioactive plaque software. The plaque was surgically applied to the sclera over the tumor base and was removed after the calculated radiation dose was delivered usually after three to five days. All surgical procedures were carried out with the patient under general anesthesia.

The age of the patient at the time of treatment, the eye involved, the location of the tumor (inferior, superior, medial and lateral fundus), the thickness of the tumor in milimeters measured by B-mode ultrasonogram (Fig. 1), and the radiation dose at the apex of the tumor in centigray (cGy) were tabulated. The outcome of the treatment, in terms of tumor status and follow-up period, was recorded. The tumor was considered regressed if it was smaller than at the time of plaque placement. Data on the fellow eye and systemic metastases were also reviewed.

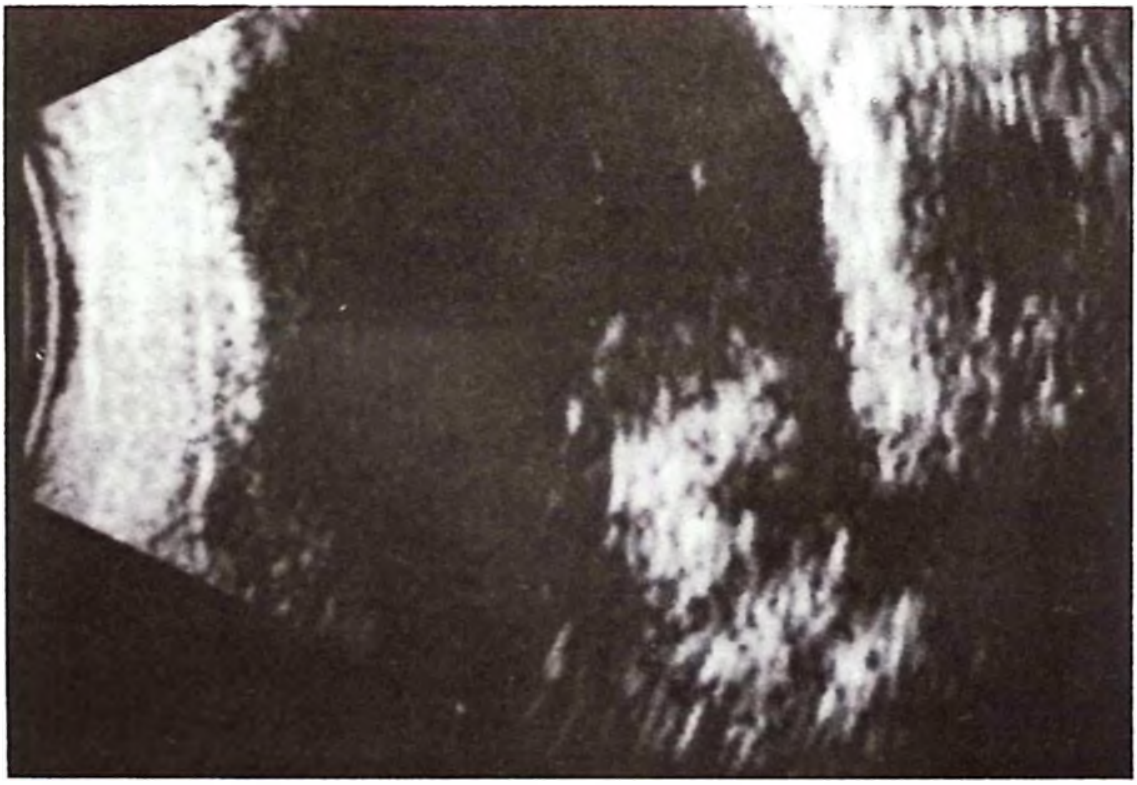

Fig. 1: Preoperative B scan ultrasonogram of the right eye of patient 4, showing the centrally calcified tumor with a thickness of 7.5 mm.

Results

Between January 1996 and January 1997, EPB was used in five patients (5 eyes) with retinoblastoma as the initial primary treatment. Table I summarizes the data on these five patients. All eyes that received EPB initially had solitary tumors

with maximum basal diameters ranging from six to 16 mm. All the tumors were at least five mm away from the fovea and/or optic disc and there were no vitreous seedings. The radiation dose at the tumor apex ranged from 3500 to 5000 cGy and at the tumor base from 12000 to 33000 cGy. Custom-made round plaques with 10 to 18 mm diameters were employed.

Table I: Data on Patients Treated with Episcleral Plaque Brachytherapy

Patient	Age (years)	Tumor Quadrant	Max. Basal Diameter (mm)	Thickness (mm)	Apical Dose (cGy)	Outcome	Follow-up (Months)	Fellow Eye
1	2	lateral	16	11	5000	regressed	7	normal
2	1	superior	6	3	3500	regressed	9	enucleated
3	2.5	inferior	8	4.5	4000	regressed	11	enucleated
4	1	inferior	9	7.5	5000	regressed	12	EBR
5	2	nasal	11	6	4500	regressed	11	enucleated

Max: maximum, cGy: centigray, EBR: external beam radiotherapy.

Patient follow-up ranged from seven to 12 months. The tumor regressed dramatically in all eyes within the first three to four weeks following EPB (Fig. 2). During the follow-up period there was no recurrence in the irradiated tumors. However, in three patients, new tumor foci were discovered in other quadrants and were immediately treated by cryotherapy. To date, there have been no acute or short-term complications related to EPB. Metastatic work-up was negative in all cases.

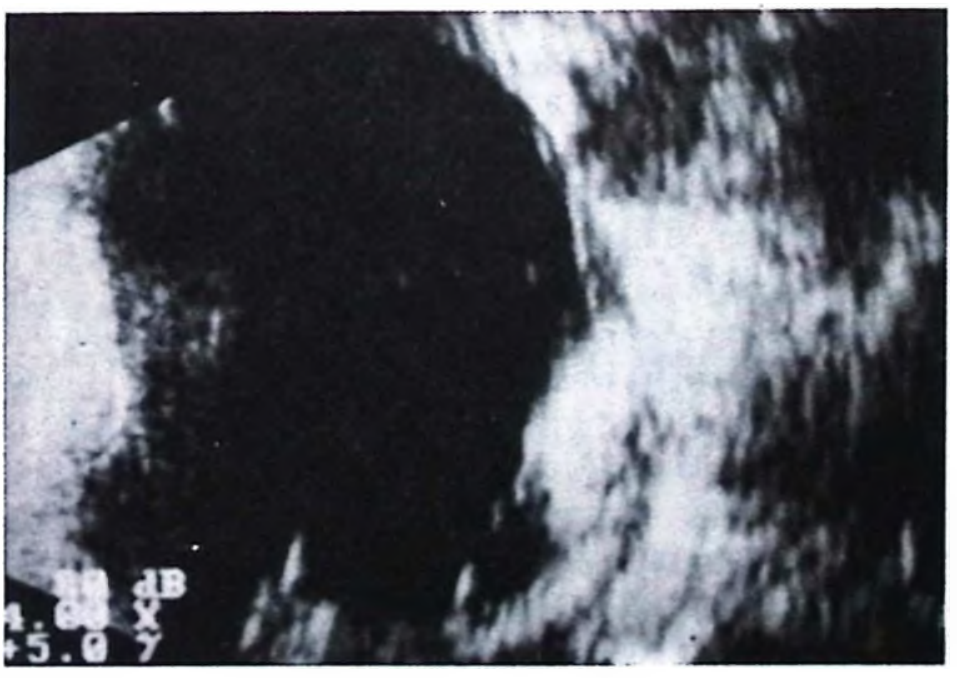

Fig. 2: 7 months after the radioactive plaque treatment, B scan ultrasonogram demonstrates that the tumor has shrunken to 2.5 mm in thickness with almost total calcification.

The fellow eye was affected in four patients. In three instances the eye had to be enucleated; one eye was managed by external beam radiotherapy. None of the four patients with bilateral disease had a family history of retinoblastoma.

Discussion

Despite the fact that enucleation is still an apropriate method for many cases with advanced or unilateral retinoblastoma, there is a definite trend toward more conservative treatments[7,8]. It has been observed that whether the patient was treated conservatively or enucleated, there was a five percent chance of metastatic disease developing; conservative modalities did not adversely affect the prognosis.[8]

Foster Moore[9] is cited as the first to succeed in destroying intraocular retinoblastoma and conserving the eye by inserting radon seeds within the tumor, in 1929. Encouraged by early results, several ocular oncology groups started to employ different radioisotopes in EPB. Recently, iodine-125 (emits gamma radiation with 27-35 keV energy) has become the choice of most centers by virtue of its appropriate tissue penetration, easy shielding and facilitation of individualized palque designs[10].

Relative indications for EPB in retinoblastoma include tumors with a basal diameter less than 15 mm and thickness less than nine mm[5,11]. Juxtapapillary and foveal tumors can also be treated using EPB[12]. In a study of 103 patients treated with plaque radiotherapy, the tumor was controlled by a single applicatilon of EPB in 87 percent of cases, whereas in 13 percent of eyes subsequent treatment was necessary[5,11]. Tumor recurrence was seen at a mean interval of five months after plaque radiotherapy[11]. We did not encounter recurrence in the irradiated tumors in our patients. EPB can also be used successfully in patients with residual or recurrent tumors after failure of one or more treatment modalities. In an analysis of 91 such patients in whom enucleation was considered to be the only remaining option, tumor regression was achieved in 89 percent of eyes with use of EPB[13].

Under proper indications, it is clear that plaque radiotherapy has the advantages of preserving the eye and of serving as an alternative to enucleation. Compared to external beam radiotherapy, which has an established role in the treatment of retinoblastoma, EPB offers the advantages of a focused radiation dose and decreased consequent side effects[10]. These complications include dry eyes, cataract, retinopathy, optic neuropathy and poor orbital bone development[10,14]. A more serious long-term risk associated with external beam radiotherapy is the development of secondary malignancies within the radiation field[15]. It has been reported that children with bilateral retinoblastoma treated with external beam radiation have a 35 percent cumulative risk of a second malignancy in the irradiated area, whereas this risk is six percent in similar patients treated with other methods[15].

The shortcomings of this descriptive case series are the small number of patients, the relatively short follow-up period and the lack of comparable information on the results of alternative therapies. Thus, one cannot weigh the relative effectiveness and benefits of plaque radiotherapy over other methods with our results. Still, our data lends strong evidence to the current belief that episcleral plaque brachytherapy as a primary treatment is very effective in the management of selected retinoblastomas, with a high rate of tumor control thus contributing to organ preservation.

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