

the eyeball, decided that the patient could resume his full duties. He told him so, saying that there was no sign of any trouble, and that he could see well. My patient replied, at the very first there was no injection or any sign of disturbance of the eye itself, tho the suffering was at times severe. The vision, he also told him, had remained unaffected thruout.

The agent reported to me, and so did my patient. I at once answered the agent, that my patient would remain under partial disability as I did not agree with the opinion of the oculist. Thus you see, the oculist felt that he saw no reason, even after a careful examination why he should not give the eyes full work, as the eye seemed normal in every way. But, so it was at the first, and the only local signs of the blow, were the darkened and swollen lids.

This is a very interesting case, and my patient's position puts him above any suspicion.

About this time—that is three years ago—I had two other similar cases, in which the symptoms and appearances were exactly the same. In these also several months had to elapse before even ordinary use of the eyes could be born.

To the oculist who first sees the case the course that it follows is recognized

and understood. However, the mistake made by the oculist who saw it two months later, was to the first oculist very natural—if the second were guided by appearances only. This error of his, resulting from being guided by appearances solely, can be avoided by a careful examination of the history of the accident and the knowledge how these cases act, derived from practical experience.

In patients who have an object in remaining idle, the time for resumption of full duty can be deduced from the condition present at the time the injury was received, and from decisions derived from the experience of others.

Therefore the opinion of an oculist consulted for the first time, at the end of—say two months—as to whether the eyes can be freely used is of little or no value, if the decision be based only upon the condition noticed by the second oculist, as previously mentioned.

Here lies the medico-legal point, which should be fully realized. The second oculist should not only say what he sees on examination, i. e. that the eye is apparently normal: but also in order to diagnose correctly, should always have full knowledge of the history and of the peculiarities attendant upon these cases. Moreover, if these latter be omitted, then the opinion regarding the fitness of the eye to be used freely, is rendered almost valueless.

REPORT OF CASE OF RETINAL GLIOMA TREATED WITH RADIUM

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This paper reviews the unfavorable prognosis for bilateral glioma as set forth in the literature, and the earlier accounts of the use of radium for it. It emphasizes the importance of reporting every case so treated with the dosage as determined by the amount, time, and screening of the radium used. It then reports a case showing the dosage used and the reaction observed, the progress of the case being thus far favorable. Read before the Sioux Valley Eye and Ear Academy, July 14, 1920.

The purpose of reporting this case to this meeting is not to bring before it any remarkable result, but rather because I have been deeply interested in the subject and because I am very desirous of learning the experience of men older in ophthalmology than myself, and on my return, of giving the

patient, who is still under treatment, the result of such knowledge.

When the patient, whose case history I will read later, was brought into my office, I was confronted with this problem. A bright, apparently perfectly normal, male child of one year with good central vision, right, no

signs of trouble left, with the exception of the yellowish pupillary reflex. The mother had noted since three months of age a peculiar light pupil in the left eye, but the patient had been otherwise an apparently normal child until about four weeks from the time when the case was first seen by myself, when the yellowish reflex became rapidly much more noticeable. The balance of the physical signs, etc., I will enumerate later, but a diagnosis of bilateral retinal glioma was speedily reached. According to the men of most experience, then, the child's best chance for life was immediate enucleation of both eyes, altho he had good vision right, and exenteration of the orbit if the pathologic report showed extension beyond the bulb; altho the tumors were still in the first stage, i. e. apparently confined within the eye ball and causing no appreciable signs of irritation or increased tension.

On looking up the literature on the subject I was struck by the scarcity of reported cases treated by other than surgical means and of the few cases that I found that had been treated by the X-ray and radium. In the report of cases that I found treated by radium alone, while the dosage as to milligrams and filters was given, the time was not stated. Also in these cases both eyes had been enucleated and the orbit simply treated for recurrences, and I did not know what effect the radium rays would have on the retina itself. In another series the X-ray and radium were used jointly, and it was difficult to tell which was effective and which harmful. With the above problem in mind, the condition was explained as well as possible to the parents. The left eye, which was already practically blind, was at once enucleated, sent to the pathologist, who reported retinal glioma with involvement of the nerve and paraneural sheath. We then had a case with extension already beyond the bulb and either a complete exenteration of the posterior part of the orbit, left, and enucleation of the other eye, or some other form of treatment was indicated.

It might be well at this time to

briefly review the literature of glioma retinae before taking up the case history and treatment of the case in question.

Glioma of the retina, according to Fuchs is the only primary retinal tumor and is essentially malignant. It is a comparatively rare ophthalmologic condition, as Berrisford¹ in a statistical report of 41 cases during the last 42 years at the Royal London Ophthalmic Hospital gives an incidence of 0.01%. As to sex, there is probably a slight predominance in the male, in Berrisford's series, there being 22 cases in males to 17 in females, with six cases in which the sex was not reported. It is unusual to find the condition hereditary but A. Hill Griffith² reports a family with six children in which the mother and three children had gliomas of the retina, and notes eight other examples in the literature besides his own. He states that in hereditary cases there seems to be an abnormal tendency to affect several members of the family and to affect both eyes. No note has been made to my knowledge with regard to any race predilection to the disease. As to age, it is without question one of early life. Curt Adam³ reports 47 cases with 94% under four years of age. Berrisford reports a majority in his series under five years of age. The condition is usually unilateral, Duncan⁴ giving bilateral cases as 15-20%, Owen⁵ less than 25% bilateral in a series from the literature of 552 cases. Berrisford¹ gives the proportion of unilateral to bilateral as 7 to 1.

With regard to the pathology, only cases that are confirmed microscopically are considered. Duncan in a series of cases from the literature, reports 20% of eyes enucleated under a clinical diagnosis of glioma were pseudogliomas. According to Ries,⁶ the glioma develops from embryonic cells and is potentially present at an early stage in the development of the eye. As stated before, the growth has its origin in the retinal tissue and microscopically "is a soft vascular tumor made up of small round, deeply staining cells, many of them containing long protoplasmic processes; they form thick mantels of cells around the thick-

ened blood vessels, the cells between the mantles staining poorly and showing calcareous degeneration. In many of these neoplasms peculiar rosettes have been described by Flexner, Wintersteiner and others, which are composed of elements resembling the rod and cone visual cells and for these growths the term *neuroepithelioma* has been suggested."

A very full description of the minute and gross pathology is given by de Schweinitz⁷ from whom the above is quoted. "The tumor macroscopically is usually of a light gray color and is subject to various degenerative changes—fatty, cheesy and calcareous, and tends on one hand to invade the orbit, involve the optic nerve, and travel by way of its sheath to the brain, and on the other to pass thru the sclerotic and cornea and spread forward." Recurrences are very common after extirpation and usually occur within a short time. According to Berrisford¹ a case which has continued three years without recurrence may be considered cured. The tumor may invade any of the tissues of the eye, it may extend back along the nerve involving the brain or meninges, it may involve the cranial and facial bones or adjacent lymph glands, the before mentioned being the most common sites of extension. It may also involve the parotid, spinal cord, skeletal bones, liver, ovaries, kidneys, lungs and spleen. According to the direction in which the growth takes place it may be divided into glioma endophytum, where the vitreous is occupied by the growth, and glioma exophytum, where it lies between the retina and choroid.

Clinically, the tumor is classified into four conditions:

1. A blind eye with a yellowish pupillary reflex. "The Amaurotic Cat's Eye."

2. The glaucomatous stage with irritation and increased tension, altho the eye may temporarily shrink, producing phthisis bulbi.

3. Growth of the tumor out of the orbit or along optic nerve to the brain.

4. Metastasis and death from exhaustion or involvement of vital structures.

The diagnosis is made clinically, by the history of gradual loss of vision in a child, usually at an early age, by the peculiar yellow reflex of the pupil, often noticed by the parents. There is often a slight or marked increase in tension, especially in the second or irritative stage; and this should be looked for in differentiating from pseudoglioma, where the tension may be subnormal. With the ophthalmoscope depending upon the size of the tumor, a yellowish grey mass is seen apparently coming from the retina, wholly or in part filling the vitreous chamber. It must be differentiated from persistence of the posterior part of the fetal fibro-fascular sheath, masses of tubercle in the choroid, inflammatory or purulent effusion into the vitreous, following retinitis or cyclitis, usually with detachment of the retina, and circinate retinitis. Sarcoma of the choroid is differentiated by the fact that it usually occurs later in life. In case of doubt, the eye should be enucleated. Glioma is never pigmented. Final diagnosis of course is with the microscope.

As to prognosis, early diagnosis is very important, followed by prompt treatment. According to Leber¹ with early enucleation, the tumor being confined within the eye ball it results in 40-50% of cures. Extension without the eye ball renders the surgical treatment practically hopeless. Thus we have a condition where, even if seen in the earliest stage, when confined within the eyeball only, with optimistic reports only 50% survive, and with present methods of treatment, if the growth has extended without the bulb practically 100% mortality. If the surgical treatment is used, especially if followed by exenteration of the orbit, at best we have an otherwise normal child, blind and disfigured for life.

With the above in view, I went thru the literature looking for some other therapeutic measure, for in this case even if I enucleated the eye with the smaller tumor, in which there was still good vision; according to the pathologist I had an extension back along the optic nerve which I could not be cer-

tain of completely removing by an extensive operation.

Axenfeld⁸ in 1915 reported a case treated by the X-ray with favorable results, but his report was not complete. Kusama⁹ reported three cases in detail in 1919, all of which, after nearly total destruction of the eye by phthisis bulbi, ended fatally. In Axenfeld's case, which was bilateral, one eye was enucleated and vision was gradually restored to the remaining eye with the tumor much reduced in size. The tumor was examined at intervals thru a dilated pupil with the patient under an anesthetic. The final result was not given but the treatment had extended over several months. Mesothorium was also used twice for from 12-15 hours, but the amount and filters were not stated. Of Kusama's cases all were bilateral. None of the eyes were enucleated, and two patients were in the second stage and one in the first stage. Both the X-ray and radium were used, the greater dependence being placed on the former. The dosage and technic were carefully given for the X-ray; and the amount and time of the radium, but without the method of filtration or technic of the latter. In all his cases there was gradual shrinking in size of the tumor, but the lashes fell out, the cornea became infiltrated and hazy, the aqueous assumed a reddish hemorrhagic appearance, the pupils and iris obscure, and tension was lowered. The lids became thickened and indurated. All of the eyes went on to phthisis bulbi, metastasis occurred either locally or at a distance and death ensued. The interval between the commencement of treatment and death was, the shortest eleven months, the longest two years.

Rex Duncan⁴ in 1918 reports three cases of retinal glioma treated with radium alone. All three cases were unilateral, in the second stage, when first seen, and all three eyes were at once enucleated. Recurrences rapidly disappeared under the use of radium, not more than three applications being given in two cases and several in the third. The amount used was rather large, the tissues being protected about the recurrences, and the technic as to

filters was given, but not the time of application. The report covered several months, during which there was no sign of recurrence, but a final report was not given.

Of the nonsurgical measures then, radium seemed the most advisable. But the only data that I had was on recurrences when radium was used alone, and I did not know what effect the element would have on the retina if used on an eye in situ. Experiments by Wiedersheim⁷ on rabbits' eyes showed no changes except a slight conjunctivitis when treated with X-ray; and in Kusama's cases it was impossible to tell whether the injurious effects were from the X-ray or radium, but he seemed to think it was from the former. Also there was the effect to be considered on the growing eye. It has been shown experimentally by Triboudeau and Belley⁹ that the X-ray will induce cataract and interfere with the growth of iris pigment in young rabbits, but not in old; and in von Hippel's experiment with X-ray on the abdomen of a pregnant rabbit which produced cataract in the young; nothing had been reported to my knowledge on the effect of radium. In this connection I think it would be well that ophthalmologists in reporting the results of the use of radium in this or any other condition should on reporting the case, if it seems that the final results are worth reporting, give the exact technic with the number of milligrams, amount and character of filter, and length of time the radium is used, for the guidance of those that may seek to profit by their experience.

With regard to the effect, manner of application, amount and time of application, if possible the treatment should be left in the hands of the radiographer; with the ophthalmologist carefully checking the case at frequent intervals thru a widely dilated pupil and, if necessary, with the patient under a general anesthetic. At best, in the hands of the most experienced, radium therapy is still in its infancy, and any data that any of us may add will help to early prove or disprove its value. The question of dosage and technic is of the greatest importance, as it is easy to

assume that too slight a dose might stimulate an otherwise fairly quiescent growth to great activity, while too large a dose might cause irreparable damage.

It might be sufficient in discussing the physical properties of radium to state that the rays emitted from radioactive bodies are very similar to those produced in an ordinary X-ray tube, there being three distinct types, i. e. the Alpha, Beta, and Gamma rays. The principal difference is accounted for by the fact that the Alpha and Beta rays are expelled at higher velocities than the canal cathode rays, and the Gamma rays are more penetrating than the X-rays. The Alpha and Beta rays are the burning rays. On account of their short range and extremely low penetrating power, the Alpha rays are of little practical value in radium therapy. The Beta rays, however, possess therapeutic value, and can be and should be used where the radium can be directly applied to the lesion. In cases where normal tissues intervene between the lesion and the surface on which the radium is applied, one must screen the radium so that the Beta rays will be absorbed to such an extent as to prevent a burn of the normal tissue.¹⁰ According to New and Benedict¹¹ quoting Horsley and Finzi, "Radium rays from which the penetrating Beta rays have been filtered off, exert no influence discoverable by present methods on nerve tissue." Allowing then for the fact that the Beta rays are the most effective in nerve tissue, and that they are very short rays, it seems that radium may still be used in the treatment of glioma, as the Beta rays do not necessarily have to be entirely filtered off, but with the exposure timed just short of a burn. The radium may be placed very close to the growth, when it is in the eye. If it is shown to be effective in the absorption of glioma, a technic might be evolved by posterior sclerotomy and radium needles to place the element in the center of the growth itself.

I wish to close by a brief report of my own case, and while I realize that too short a time has elapsed to be able to form any opinion as to the value of

the treatment, I hope to profit by the experience of others as brought out in the discussion, and to briefly give my own technic, which may or may not be of benefit to others.

CASE.

HISTORY. White, male; aged eleven months when first seen. Norwegian parents; both alive and well. No history of eye trouble in the family. One other child, female, aged two and a half. Family history negative as to eye trouble. Past medical history negative. Normal delivery. Has always been an unusually healthy child; breast fed. At about the age of three months mother noticed a peculiar appearance of left pupil, seemed lighter than the right, especially when the light shone on it a certain way. No other change and child apparently saw well. About four weeks before admission the yellowish reflex in left eye became rapidly much more apparent. No signs of discomfort at any time. No apparent change or redness in eye except for increasingly yellow pupil.

EXAMINATION. Patient first seen on April 7, 1920. White, male child, well developed and apparently in the best of health. Examination negative with the exception of the eyes.

Lids, cilia, palpebral fissure, lacrimal apparatus, conjunctiva, cornea, anterior chambers, iris apparently normal in all respects. The left pupil showed a marked yellowish reflex. Normal in size and reacted to light. The right pupil was round, equal, black and reacted to light and accommodation. Vision right apparently good for near and distance. Very small objects. Vision left apparently very poor. The pupils were dilated with homatropin and the patient given a general anesthetic. Tension right and left 40 mm. Hg. with McLean tonometer.

Examination of the left fundus showed the media clear and a small area of the retina to the temporal side of the bulb could be seen, apparently normal. Coming from the nasal side, apparently from the retina was a yellowish grey tumor, completely covering the disc and filling about two-thirds of the posterior chamber. Growth was slightly irregular, nonpigmented with retinal vessels extending over and into it.

The right fundus was negative with the exception of a growth similar in character but much smaller starting apparently from the retina. Measuring about four mm. at its greatest thickness and extending from well behind the iris to a point about 2 mm. from the macular region. A diagnosis was made clinically of bilateral retinal glioma.

On April 10, 1920, the left eye was enucleated, cutting the nerve as far back as possible. There were no macroscopic signs of extension beyond the bulb with the exception of a few apparently fibrous adhesions of the sclera to the orbital tissue in the region of the nerve to the nasal side and anterior. Specimen sent to pathologic laboratory and report returned "retinal glioma" with slight involvement of the nerve and paraneural sheath. Uneventful postoperative recovery.

On April 17, 1920, 30 mgs. of radium sulphat was applied to the right eye and left orbit. The lids being sealed with adhesive, and radium held in place with adhesive strips. Time 8 hours for each application. Radium screened with 1.4 millimeters of gold and 12 millimeters of gum rubber. No reaction reported.

On April 28, 1920, child returned, pupils dilated with $\frac{1}{2}\%$ homatropin, anesthetized and right fundus examined. No change seen. Second application of 50 mgs. radium sulphat. Time, screen and technic the same to eye and orbit. No reaction reported.

May 7, 1920, pupil dilated as before, anesthetized. Still no change seen in growth. No signs of recurrence left. Left socket well healed and apparently healthy. 75 mgs. radium sulphat ap-

plied. Time, screen and technic the same. There was a marked reaction in four days time. The outline of radium container plainly seen over both orbits; lids slightly edematous and very red. Conjunctiva red and congested. Cornea clear, slight ciliary congestion, anterior chamber and other media clear. Iris normal. Pupil widely dilated, remaining so for six days. All redness disappeared in one week and pupil became normal.

Patient reported for observation on June 7, 1920. No signs of recurrence left. Right pupil dilated with homatropin. Anesthesia. Apparently no greater in extent. Tension 40 McLean, anterior chamber normal. Peculiar silvery looking spots over center of growth. Vision before dilation apparently good. No signs of conjunctival or ciliary injection.

Last seen July 12, 1920. Vision apparently good, child a little irritable and fretful. Mother says he is cutting teeth. Gingiva red and swollen in molar region. Pupil normal; dilated with homatropin, anesthetic. Growth much flatter; same in extent. Tension 40, McLean. Media clear. No conjunctival or ciliary injection. Growth about 2 mm. thick. Large areas in center of tumor that look like silvery white exudate. No sign of recurrence left. Mother says child appears perfectly normal in every way about home.

CONCLUSIONS. 1. Probably 75 mgs. radium sulphat, screened as above, for eight hours is about the maximum dose for child of one year.

2. All other conclusions are held in abeyance until a longer time has elapsed.

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