

syphilis. One case has been reported where a child had congenital syphilis and at one year of age had interstitial keratitis, then later in life acquired syphilis and had a second attack of interstitial keratitis.

OPACIFICATION OF THE CORNEA FOLLOWING CATARACT EXTRACTION.*

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The following case is the only one I have seen among 209 cataract operations, and seems worth placing on record:

History.—D. D., male, aged 81 years, retired furrier, native of England, entered the University of California Hospital Aug. 23, 1907, to be operated on for hemorrhoids. He was recovering from a carbuncle and lumbago. The medical report of his physical examination gives the heart action as being intermittent and irregular, with systolic and diastolic murmurs; the result of the blood examination was not significant. Senile breathing; lungs negative; urine gave trace of albumin; yet all his life he had been considered a very well man. The recovery from the general anesthetic and operation was prompt and uneventful.

Examination.—The patient being practically blind, I examined his eyes September 6. An interesting ocular condition was found with an uncertain history. He stated that for three months after birth his eyes did not open, also that he had a congenital cataract in the left eye. (If the former were due to ophthalmia neonatorum the latter was probably an anterior polar cataract.) The vision of the right eye was good for all purposes until he was 45 years old, when, after a fall on his head, glasses for reading became necessary. Attention was not attracted to his eyes again until 1893, when he had an attack of pain in the right eye, accompanied by failing vision. But even before this he thinks his sight was not perfect. Two years later the vision had gradually failed until reading was no longer possible. About this time a competent oculist told him that there was a chalky degeneration of the left lens which irritated the right eye somewhat and advised extraction of the lens. Vision of the left eye had never changed.

Ten years ago an ophthalmic surgeon of national reputation operated on his left eye. A preliminary iridectomy was done, later the cataract was extracted without accident. Neither pain nor inflammation attended, but there was a turning in of the lashes. No vision was given by the operation.

Inspection revealed a spastic entropion of the right lower lid which was successfully controlled by repeated applications of collodion. For some conjunctival irritation due to the entropion a boric acid wash and the occasional use of argyrol were advised. Patient's general condition steadily improved. On September 20 he was transferred to my service in the hospital, and the following notes were made:

Status Præsens.—Left eye: Cornea rather thinly but entirely opaque, with patches of greater density, while the site of the corneal section, two millimeters from the limbus, is solidly white. The opacity appears to be in the stroma, but the epithelial covering is very irregular and steamy. The key-hole pupil is faintly visible. Tension normal; vision equals movement of hand in all directions. Right eye: Cornea clear and slightly anesthetic. Lens appears a dark amber color. The ophthalmoscope shows red reflex around the periphery of cataract when pupil is dilated. Tension normal. Vision equals perception of light; projection good.

Treatment.—I advised extraction of the cataract and performed the preliminary iridectomy on this date. Atropin instilled, bandage applied, rest in bed. No reaction whatever followed the operation, blood remaining in the anterior chamber after the cut of the iris promptly disappeared. Healing was normal and rapid. Pupil widely dilated; cornea perfectly clear; patient discharged.

October 17 he re-entered the hospital and was given the usual preparation. General condition and spirits decidedly improved. The right eye differed apparently in no wise from a normal cataractous one after an iridectomy, but owing to the history of the fellow eye unusual precautions were taken. October 18 operation was done with the patient in bed. A 4 per cent. solution of cocain was instilled three times, at intervals of five minutes. Section of two-fifths of limbus, raising small conjunctival flap above, from which was slight hemorrhage. Peripheric capsulotomy done with sharp cystotome; when the capsule was opened a small amount of clear fluid escaped. Speculum removed and the cataract, about two-thirds the size of an average lens, was expressed easily with the fingers. As a few flakes of soft lens matter remained in the pupil, the anterior chamber was gently irrigated with a special glass nozzle pipette, using a small quantity of a warm sterile physiologic salt solution. No further manipulation was required; there was no loss of vitreous or other mishap and even less than the usual traumatism. The patient behaved well and experienced no sensation during the operation. Atropin was instilled and a gauze bandage lightly applied over both eyes. Before closing the eye operated on, attention was called to the fact that the lips of the entire corneal wound were whitish.

After the lapse of twenty-four hours the eye was inspected though the patient had no discomfort. The wound was closed: anterior chamber fully restored; thickened capsule in pupil which was widely dilated; edges of coloboma free, but the entire upper half of the cornea was affected by the appearance of a well-marked typical "striped keratitis;" otherwise no evidences of reaction. At the end of the second day the striated appearance had extended the full width vertically across the cornea. Anterior chamber very deep; tension, —1. There were no subjective symptoms; no ciliary and but slight conjunctival injection; the wound was firmly closed. The bandage was left off and a light dressing was held in place by strips of silk plaster.

October 21, in addition to the striated opacities, the cornea was thinly and diffusely opaque, apparently due to changes deep in the substantia propria or endothelium. Pupil not distinctly seen, but was widely and evenly dilated.

October 27, the eye had remained entirely free from inflammatory reaction and the patient complained only of his lumbago. The general diffuse opacity had gradually increased, but was conspicuous only by focal illumination. The striated opacities seemed less marked and were broken so that a dark branching line about one millimeter wide appeared in the shape of a "Y," with the arms above extending to the extremities of the site of the corneal section and the thinner body reaching below within three millimeters of the limbus. Close inspection with oblique illumination revealed that the dark line did not mean entire transparency. The epithelium was undisturbed; the corneal surface was smooth and glistening. Tension normal; no subjective symptoms. Dionin and hot fomentations were commenced. General condition satisfactory.

November 2, as the eye seemed entirely well but for the corneal opacity, the patient was allowed to leave the hospital, with instructions to continue the dionin and hot applications, and to use atropin to keep the pupil dilated. He has been seen at intervals since, and at the last visit, March 8, the eye remained much the same. The striated opacities were still distinct and crossed irregularly by fine opaque lines, the "Y" appearance being but faintly defined. The deeper and diffuse opacification was less dense to the temporal side. The cornea was very slightly steamy. Vision 2/200. No change in tension, and had it not been for the corneal opacities the healing process could have been recorded as uneventful. Patient's health continued fair, appetite and nutrition good, but stayed in bed a great deal because of "misery in his back."

It is generally known that the use of a solution of bichlorid of mercury for irrigating the anterior chamber, as well as various accidents and complications, may be followed by corneal changes, nor would opacification be unexpected in a patient whose general condition and nutrition were undoubtedly bad. But in my case none of these elements entered into the causation, so far as

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can be determined. As it was impossible to obtain details from the first operator, I had thought it not unlikely that the opacification had been due to bichlorid, as that antiseptic was being used extensively about this period. Also there might have been some connection between the presence of the opacification and the section having been made far into the corneal tissue. And at this time, ten years before my operation, the patient's health was most excellent.

Had the cornea shown the slightest haziness following the preliminary iridectomy I should not have proceeded to extraction.

In the literature at my command only one or two text-books of ophthalmology mention general opacification following uncomplicated cataract extraction, and attribute it to the use of corrosive sublimate solution. So it seemed worth while to call attention to the subject. Hoping to make my paper of some value, the following questions were addressed to every member of the Section on Ophthalmology of the American Medical Association:

1. Have you had cases of general opacification of the cornea following cataract extraction; if so, how many (or if none) in what number of cataract operations?
2. To what cause or causes do you attribute its occurrence?
3. What appearance or forms did the opacity assume?
4. What part of the cornea seemed to be the seat of the lesion, and what the pathologic change?
5. To what extent did the opacity disappear, and how long before corneal changes ceased?
6. Kindly give separately the ultimate corrected vision in each case.
7. What preventive measures and curative treatment have you found of value?
8. What percentage of your cataract' extractions has been followed by "striped keratitis"?
9. Have you ever seen striped keratitis fail to clear up so that the ultimate vision was affected by it; if so, what percentage did not clear completely?
10. Does your experience touch on any notable point outside your answers to the above questions?

To search case records for absolutely accurate replies was a task too laborious to be expected from any one, but I had hoped for a large number of approximate estimates of cataract extractions. This, with the data on corneal opacifications, should throw some light on an apparently obscure subject. However, I can not sufficiently express my appreciation for the generous and courteous responses made and regret that the limited space prevents my using more extensively the very valuable material gathered.

Out of the 227 heard from at this writing, 87 gave either the precise or estimated number of extractions, amounting to 19,821. From the figures given a conservative estimate of extractions by my correspondents would not be less than 50,000, and among these are only 39 cases of general opacification.

Concerning striated keratitis, there were great variations in statements. Sixteen correspondents reporting the exact number of cataract operations (the largest 397) aggregating 1,248 cases, had never seen this condition, while others gave large estimates, ranging from 50 to 100 per cent., depending, one says, on how closely we observe the condition of the cornea. The average of all answers is about 11 per cent. In my limited experience it has been about 3 per cent. and has always disappeared. Eleven reported cases of striped keratitis that affected the ultimate vision. One colleague wrote, "Ribbed keratitis (Elschnig) or zonular keratitis (Salz-

mann) always heralds general bulbar degenerations," but I had reference to that well-known clinical appearance, commonly noted in case-histories in a routine way by "striped keratitis present."

About 45 cases were reported as general opacification, but closer review determined that the process did not involve the entire area of the cornea. Distinct causes enumerated in all of these histories were identical with many of the known causes for the cases of complete opacifications. The pathologic conditions were probably similar, differing only in degree. One operator leaves the bandage on his myopic subjects twice the usual time. Another had frequently seen striped keratitis until he adopted the "open method" of treatment, but none since. Another of large experience states that since he had abandoned attempts at artificial ripening he had not seen a case of striped keratitis. And another advised, in cases of marked arteriosclerosis, to make the section in the limbus with a large conjunctival flap. Two interesting cases of partial opacification have been reported by Dr. Harold Bruns and one by Dr. H. Gedde.¹

Following is a synopsis of the 39 cases reported of general (complete) opacification of the cornea.

CASE 1.—Doubtful cause, syphilis. Specific treatment did no good.

CASE 2.—Operations, 75. Causes given, senility and poor nutrition, blood count low. Ultimate vision, 5/200.

CASE 3.—Operations, 150. Bichlorid getting into anterior chamber. Cleared up under atropin and alteratives. Vision, 15/50.

CASE 4.—Alcoholism and debility. Cleared up about one-half.

CASE 5.—Accidentally irrigated anterior chamber with bichlorid for saline solution. Ultimate vision, moving objects.

CASE 6.—Operations, 100. "Infection," no treatment; cleared; vision, 20/50.

CASE 7.—Cause doubtful unless incision too far in cornea. Vision, fingers 4 feet.

CASE 8.—Operations, 21. Dislocated lens; general debility. Vision, fingers 2 feet.

CASE 9.—Operations, 50. Section with poor knife. Corneal changes very similar to my case. Vision, fingers at one meter.

CASE 10.—Caused by infection more than a week after operation. Leucocytic infiltration of substantia propria. Opacities permanent.

CASE 11.—No cause. Partly cleared, dionin. Vision, 20/120 after five months.

CASE 12.—In another's practice, due to bichlorid solution.

CASE 13.—Operations, 200. Much lens matter left in anterior chamber produced irritation. Slight opacity only after three months. No treatment.

CASE 14.—Operations, 100. Traumatism and possibly syphilis. Vision P. L.

CASE 15.—Continued hemorrhage from "abnormal retinal vessel."

CASES 16 and 17.—Operations, 80 to 100. Caused by irrigation of anterior chamber (with what not stated), both cleared completely in two weeks, hot applications, atropin and dionin.

CASE 18.—Operator of large experience. Patient in good health, aged 58 years. Perfectly smooth operation, simple extraction, no rational cause discovered. Rapid opacification of entire cornea, apparently in parenchyma. Under long continued subconjunctival injections it cleared up in a measure, but no useful vision was obtained.

CASES 19, 20, 21 and 22.—Operations, 1,000. La grippe, followed on second day after operation. Very feeble patient. No cause known. Debility.

CASE 23.—Operations, 20. Senile debility, age 83 years.

CASE 24.—Operations, 400. Caused by using strong solution (4 per cent.) holocain in place of a 1 per cent. solution. Disap-

peared in four months. Used hot applications, atropin and diamin ointment, 5 to 10 per cent.

CASE 25.—Striped keratitis, involving entire cornea, that never cleared. Patient in good health, age 79 years. No cause known.

CASES 26, 27 and 28.—Operations, 200. All said to be due to "lessened nutrition of cornea;" all cleared practically, he believes, after several months.

CASES 29, 30, 31, 32, 33 and 34.—"Many hundred operations." All due, he thinks, to lack of "constitutional vigor."

CASE 35.—Operations, 50. Caused by extensive (three-fifths of circumference of cornea) section and to action of bichlorid on endothelium. Vision, 20/200.

CASE 36.—Hypermaturation cataract. Great loss of vitreous. Vision, fingers three feet.

CASE 37.—Operations, 100. Caused by accidental introduction of alcohol into anterior chamber. Vision perception of light ultimately.

CASE 38.—Operations, 100. Cause, severe iridocyclitis. Vision, perception of light. As this is the only case in which the pathology given is based on the microscopic findings, it is a great satisfaction to copy the report in full: "The whole cornea looked like ground glass. There was a deep white change with no disturbance of the superficial epithelium, not the so-called ground glass dots, but a general white opacity. Sections of the eye showed that the endothelial lining was replaced by a mass of dense new connective tissue, possibly one-third as thick as the original cornea. This new tissue, I believe, was the result of the iridocyclitis—masses of organized exudate. The proper substance of the cornea was unchanged, and the epithelium was normal. My colleagues and myself looked on this case as one of general opacification of the cornea. The whole appearance justified the expectation that the microscope would reveal interstitial changes."

CASE 39.—My own.

One operator only out of the twenty-nine reporting cases could include the history of the other eye, also operated on for cataract with useful vision obtained, but lost two years later through infection, and emphasizes the rarity of my case in which the second eye, ten years later, almost paralleled the course of its fellow through its peculiar and unexplainable history of opacification.

CONCLUSIONS.

The deductions that I would make from my study of this subject are that treatment is of but little or no avail, and that there is no indication at present known which enables us to determine beforehand when general opacification of the cornea may follow cataract extraction. But with the warning from such a result in one eye, the cause undetermined, I should favor some method other than extraction for the remaining cataract, and would suggest this as one of the very few conditions where couching may be a justifiable operation.

DISCUSSION.

DR. J. L. THOMPSON, Indianapolis: During the grip epidemic a man of 75 came to me with what looked like a favorable case for operation, and we did have one of the smoothest imaginable, but two days afterward the patient had the grip. There was no tendency to suppuration, but the cornea became entirely opaque, without any pain or anything of the kind, and the operation was a complete failure. I recall another case in a woman who suffered from stomach trouble and who had a very thin cornea. She was operated on and the case went exactly the same way. I also recall two doctors that were in the habit of drinking—taking something to keep the chills off in the morning, and then a little appetizer at noon, and in the evening a nightcap, and about sixteen during the day. One lost an eye. The other was able to write prescriptions afterward.

DR. D. W. GREENE, Dayton, Ohio: I have done over 1,000 operations on the lens in the past twenty-five years, largely

in a class of men, veterans of the Civil War, many of whom were broken in health and subject to dissipations and vices of all kinds, more than 90 per cent. being now above 60 years of age, with an average age of 67.72. The number of extractions I have made among these men is large, and I have not seen a total opacity of the cornea result. In private practice I saw one case, ten or twelve years ago. This occurred in a portly German, more than 60 years old, who led a sedentary life, being a tailor, and who was a large consumer of beer. The operation had been free from accidents, and no other complications followed. I am not sure of the strength of bichlorid used, nor whether the section was large enough, and the knife keen and sharp, nor whether much pressure was used in delivering the lens; these seem to be important factors in the evolution of striped keratitis, the type of total opacity which Dr. Hulen has brought to our attention being an exaggeration of this condition.

It seems strange at first glance that total opacity of the cornea is not a more frequent result of extraction of cataract. If striped keratitis consists essentially in wrinkling and other damage to Descemet's membrane, at right angles to the line of incision, from the strong antiseptic solutions that have been used, or from excessive pressure in delivering the lens through an insufficient corneal incision, there are sufficient exciting causes. Not all cataract cases, however, have striped keratitis, and we know that many operators still continue to use strong antiseptic solutions and that the great tendency among operators is toward making too small a corneal incision, for easy delivery of the lens. Experience has satisfied me that this has done more to keep up the number of cases than anything else, except the inordinate pressure in delivery, which is necessary because of it. There is abundant evidence that the condition is not inflammatory but rather a nutritive or circulatory change in the canals of the posterior layers of the cornea. It lasts but a few days and is not painful. These are sufficient exciting causes, in the absence of a known predisposing cause. Permit me to cite the influence which arterial diseases, with or without high blood pressure, is believed to have in the circulation and nutrition of other parts of the eye and to ask why the same conditions may not apply to the circulation and nutrition of this part of the cornea, as are believed to obtain in glaucoma and perhaps in cataract as well.

I now have a case of extraction made two weeks ago, after a preliminary iridectomy, in a woman 67 years old, with B. P. 220 mm. Hg. The other eye had been lost by glaucoma after an extraction and subsequent discission, made by a competent operator. No strong antiseptic solution was used, the section was ample, and expression of the lens was easy in my operation, yet I saw on the third day that striped keratitis was present. An ominous opacity of the cornea still persists. [Note: Since this statement was made the cornea has cleared entirely.]

DR. H. V. WÜRDEMANN, Milwaukee: In over a thousand extractions and expressions I have had total opacity of the cornea follow but once, but within the last two years I have seen eight cases of striped opacity of the cornea, all following expression of the cataract in the capsule; and I think that this is due to the mechanical pressure of the instrument used in expressing the lens. When you do this operation you are stroking the lens through the cornea for anywhere from fifteen to twenty seconds to four or five minutes before the lens comes away. The mechanical injury to the cornea produces this condition of opacity. None of these cases has lasted more than two or three weeks after the extraction and all the patients have recovered with good visual acuity. I have also believed the condition to be due heretofore to strong antiseptics and some years ago to the use of cocain.

DR. G. C. SAVAGE, Nashville: In saying that "in selected conditions couching may be justifiable," of course Dr. Hulen must have meant that if one eye has been operated on and the cornea has become opaque, then couching is justifiable for the other eye. No man can know whether opacity is going to occur or not and couching is so unscientific and so danger-

ous that we all want to avoid it when we can. For a good many years I have made but little pressure on the cornea in expressing the lens and I never did make pressure anything like from two to five minutes, I am sure. But, it occurred to me some time ago to make just enough pressure on the cornea below to make the lens present itself in the incision and then with the cystotome transfix it from behind and lift it out without making any further pressure at all. My purpose was to avoid that occasional annoying occurrence, rupture of the hyaloid membrane and escape of vitreous. If you transfix the lens in this way there is no danger of rupture of the hyaloid membrane and if there is danger of producing corneal opacity by pressure in stroking the cornea this is avoided as well. Now I have had such cases, some getting well just as rapidly as Dr. Würdemann has suggested. I believe that in dionin we have a solvent for lymph. I have seen it disappear rapidly under the effect of dionin when it had failed to disappear before dionin was used and I believe that if we use it immediately after we see the opacity forming the plasma will not become organized and if it does not become organized then permanent opacification is impossible. If we can absorb it before it is converted into connective tissue we prevent opacity. Atropin should be instilled first and then after a proper interval, five or ten minutes, the dionin should be instilled. This can be done with the assurance that in recent cases corneal opacification will disappear under its influence.

MR. E. TREACHER COLLINS, London, Eng.: These cases of opacity of the cornea following operations on the eye, such as extraction of cataract or iridectomy for glaucoma, I have usually regarded as due to damage to the endothelium of Descemet's membrane. We know that this epithelium prevents the infiltration of aqueous humor into the stroma of the cornea and that if it is damaged this filtration occurs and produces opacification of the cornea. The cases in which I have seen most opacity follow after extraction of cataract have been, as Dr. Würdemann has mentioned, cases in which strong antiseptics have been used. In the early days of antiseptics, when I was house surgeon at Moorfield's Hospital, there was one surgeon who was so desirous of making everything antiseptic that he injected into the anterior chamber after extraction of the lens a solution of biniodid of mercury, 1 to 25,000, and in these cases there occurred marked opacity of the cornea. I urged on my senior that the opacity was due to this, but he would not have it. We decided to have a test case; he injected again and that case was the worst case of opacity I ever saw and it remained permanent. This same operator, a very skilful man, and a pioneer in antiseptic surgery, used to like to use a drop of 1 to 20 carbolic acid on his keratome when he made the incision. Some would trickle into the anterior chamber in the vicinity of the wound and in these cases I have frequently seen striped keratitis follow. One or two cases in which I have seen opacity occur have been where the keratome has been used for iridectomy in glaucoma. The operator was so anxious not to put the point into the lens that he pushed it into the back of the cornea instead and the point went through Descemet's membrane into the back of the cornea. I have had an opportunity of examining microscopically an eye in which this has occurred and have lantern slides showing the gap in Descemet's membrane.

DR. WILLIAM ZENTMAYER, Philadelphia: I have had the privilege of seeing a case of this opacification in the practice of Dr. W. F. Norris. The patient was a man of 30, on whom a combined operation had been done on one eye, followed by the cornea becoming opaque; in order to avoid this occurrence in the other eye a preliminary iridectomy was made, which was followed by the same lesion, notwithstanding that a keratome was used and the incision was made at the limbus. Thyroid extract was used without favorable result. This case was particularly interesting because the man subsequently developed phthisis. He died about three years subsequent to the loss of his sight. Whether the corneal condition was due to impaired nutrition at that time or whether he had uveitis as a result of his tuberculosis was not determined. I know

of one case of opacity following the use of Dr. White's bichlorid salve after cataract extraction. It was not permanent, but extensive and annoying for a time. It occurred in a case of ordinary senile cataract.

DR. VARD H. HULEN, San Francisco: There are certain definite causes that will produce opacification of the cornea, such, for instance, as the use of strong antiseptics, or overenthusiasm in irrigating the anterior chamber; but there are also cases, as I am satisfied from my experience and the reports I have received, that are predisposed to opacity of the cornea following a perfectly simple, correct cataract extraction. If you have that result in one eye, what are you going to do with the other eye? That is the point to which Dr. Savage referred in mentioning couching. If you have that experience in one eye, with no complication to cause it, then you should not do an extraction in the other eye. If not an extraction, what? Dionin was used early in my case, beginning with a 5 per cent. solution and gradually increasing until the powder was being used and continued a number of weeks along with hot applications. The patient's general condition improved, but the opacification was not affected at all. In regard to striped keratitis, I was struck with the reports I received as to the great variation in statements. Some members of the section who have had much experience reported that they had never seen a case of striped keratitis. That seemed most remarkable to me. Others made the statement that if one looked carefully enough he would find it in 100 per cent. of cases. There is no explanation, it seems to me, for this great variation in statements unless it is failure of careful inspection to bring the matter out.

THE SURGICAL TREATMENT OF ORBITAL COMPLICATIONS IN DISEASE OF THE NASAL ACCESSORY SINUSES.*

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The orbital complication referred to in this paper is the subperiosteal abscess. When disease of the nasal accessory sinuses extends to the orbit, the infection passes through the os planum of the ethmoid or through the floor of the frontal sinus. Two clinical pictures will be present, depending on whether the perforation occurs suddenly or gradually—acute or chronic. In the former, the local symptoms are those of an acute abscess with cullulitis. The orbital manifestations may disappear with intranasal treatment or else the pus works its way to the surface and discharges spontaneously. The acute symptoms may then abate, while the fistula either closes or remains open and a purulent sinus persists, leading into the frontal or ethmoidal cavities. In the second variety there is a greater or less defect in the orbital bony wall of the frontal and ethmoidal sinuses, and with the orbital periosteum a large abscess cavity is formed, causing marked exophthalmos which usually brings the patient to the eye clinic.

In children, the acute perforation takes place through the ethmoidal plate. A curved incision is made along the inner and upper orbital margin, the orbital periosteum and contents are retracted and the opening in the os planum can then be seen. This should be enlarged, and the adjoining cells curetted according to the amount of disease found present.

In the chronic cases with exophthalmos and in the other cases with acute perforation which do not improve on the restoration of intranasal drainage, the method of operating is as follows: It is a distinct advantage to

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