

Glaucoma due to Hypermature Cataract: The Use of Urea in Diagnosis

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A PATIENT seen for the first time with glaucoma due to hypermature cataract (phacolytic glaucoma) frequently poses a difficult problem in diagnosis because this disorder often presents simply as a "blind painful eye". Even when the patient is made more comfortable with analgesics, the eye may remain so congested and the cornea so cloudy that adequate investigation cannot be carried out. Miotics and even acetazoleamide may fail to reduce the intraocular pressure to a level at which important investigations such as gonioscopy and slit-lamp examination can be of value, and the ophthalmologist finds himself without sufficient information to determine the best form of therapy.

Phacolytic glaucoma, first described by Gifford,¹ frequently presents a characteristic clinical picture.^{2, 3} The patient is generally elderly and his memory is poor. The history may reveal simply that the eye in question has been "blind" (because of a mature cataract, of which the patient may not have been aware) for many years but that it has become very painful recently, and this pain has caused him to seek help. The opposite eye often has good vision with normal intraocular pressure. This may be all the information available. Close relatives may only acknowledge that the patient has had no vision in the painful eye for some time. With this scanty information and with conditions which prevent adequate ophthalmic examination, enucleation may be decided upon to relieve the pain, as was reported by Flocks, Littwin and Zimmerman³ in a series of 138 eyes with phacolytic glaucoma from the Armed Forces Institute of Pathology. It was determined that lens extraction alone might well have resulted in useful vision,^{4, 5} since examination of the retina and optic nerve in these cases revealed little or no evidence of damage.

It is the purpose of this report to present a classification of this condition, and to discuss in some detail the problem in diagnosis and therapy, illustrated by a case report of a patient who was found to be resistant to conventional therapy. The problem to date, in some cases, centred around the difficulty in reducing the intraocular pressure with local miotic drops and parenteral acetazoleamide. However, this has been solved^{6, 15} for the most part with the introduction of intravenous urea into clinical ophthalmology.⁶⁻¹⁴ The mechanism by which urea is thought to function will be outlined.¹⁵⁻¹⁷

This report is in keeping with an earlier one by Crews and Davidson,⁶ who used urea in the treat-

ment of five cases of phacolytic glaucoma. All of these cases responded dramatically "within half an hour of the end of the infusion". The historical aspects leading to the use of urea in ophthalmology will not be discussed here, as they have been adequately covered in other reports.⁶⁻¹⁰

Classification of Lens-Induced or Phacogenic Glaucoma

1. Phacos (the lens itself).—(a) Phacolytic glaucoma^{1-5, 18, 24} (Glaucoma due to lens cortex): characterized by liquefaction of lens cortex in a hypermature lens; open iridocorneal angles; presence of large histiocytes containing engulfed liquefied lens material which obstructs the trabecular apparatus. (b) Glaucoma capsulare^{19, 20} (Glaucoma due to pathology in lens capsule): pseudo-exfoliation of the lens capsule occurs with obstruction of the intertrabecular spaces by desquamated particulate matter (hyaline flakes). (c) Phaco-anaphylactic endophthalmitis (Glaucoma due to secondary granulomatous inflammatory products from involved lens substance): anterior and/or posterior synechiae are present, with obstruction of the chamber angle by inflammatory exudate.

2. Phacomorphic glaucoma (Glaucoma associated with shape of lens).—(a) Intumescent cataract; may be senile or traumatic cataract: Swelling of the lens may force closure of the filtration angle or may interrupt aqueous circulation by blockage of the pupillary aperture (pupillary block). (b) Microphakia (spherophakia):²⁴ A small lens may obstruct pupillary aperture (pupillary block). (c) Anterior lenticonus:²⁴ Anterior aspect of lens is congenitally mis-shapen and may "plug" the pupillary aperture (pupillary block).

3. Phacotopic glaucoma (Glaucoma associated with location of lens): for example, ectopia lentis (dislocated lens).—Mechanism by which glaucoma occurs here is still not fully understood.

The foregoing classification provides a basis for a differential diagnosis of phacolytic glaucoma. It can be seen that glaucoma can be caused in a variety of ways depending on the particular abnormality of the lens.

CASE REPORT

A 68-year-old Negro was struck in the left eye in 1952. Following this, there was gradual deterioration in the vision of this eye until it became completely blind. Ten days prior to admission he began suffering severe pain in the left eye. He was seen by his family physician and given medication. This gave only partial relief and he came to the eye clinic for further treatment, at which time he was admitted to hospital. On examination the patient was found to be in acute distress. Visual acuity was 20/30 in the right eye and there was no light perception in the left. The intraocular pressure was 19/10 in the right eye and 70/10

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mm. Hg in the left (70 mm. Hg with 10 g. weight-Schiötz). The left eye was congested and the cornea was edematous. However, an exceptionally deep anterior chamber was noted on slit-lamp examination, which also revealed cells and a flare. The pupil was in mid-dilation and fixed, and a leukocoria (white pupil) was present. The right eye was essentially negative on examination. The patient was given miotics and acetazoleamide. This produced a fall in pressure to 19/10 and 58/10 mm. Hg in the right and left eyes respectively, giving the patient some relief; however, the glaucomatous eye was still severely congested. Intravenous urea was then given and the pressure fell to 18 mm. Hg in both eyes in one-half hour. The cornea cleared, permitting further investigation.

The anterior chamber now revealed a one-plus flare and cells. On gonioscopic examination an open angle was noted with an anterior chamber that was deeper than that of the normal right eye. A hypermature cataract was seen and a diagnosis of phacolytic glaucoma was made. Within the next six hours the patient was taken to surgery and a lens extraction was performed. Refraction six months later showed a visual acuity of 20/70-1. Fundus examination revealed glaucomatous optic atrophy.

DISCUSSION

It is apparent that the difficulty in therapy in cases of phacolytic glaucoma centres around the difficulty in treating the elevated pressure. As long as the intraocular pressure is elevated the diagnosis remains in doubt. It therefore becomes vital to control the glaucoma so that the anterior segment and lens can be properly examined. When this is done, phacolytic glaucoma may be differentiated from the other causes of secondary glaucoma and appropriate therapy may then be carried out.

Miotics (except when a pupillary block is suspected) and acetazoleamide are often extremely helpful in lowering the ocular tension. However, as in the case described in this report, they may not produce the desired effect. If such is the case, urea must be used, since it causes hypotony by an entirely different mechanism: The concentration of urea in the aqueous is about 18% less per unit volume than in the blood serum, measured in millimols per kilogram of water.²¹ Its concentration in the vitreous is also less. In addition, when blood is suddenly loaded with urea by intravenous injection, there is a definite barrier which does not allow urea to diffuse readily into the aqueous.²² Therefore, since there is less urea in the aqueous than in the blood, the membrane separating the two fluids cannot be inert, but must show selective permeability.²³ It was also shown by Moore, Scheie and Adler²² that even when aqueous is formed rapidly (for example, the secondary aqueous which forms when the anterior chamber is opened and the pressure outside the blood vessels has been reduced to zero), the concentration of urea in the aqueous rapidly comes to resemble that of primary aqueous. Therefore, even when aqueous is formed quickly the concentration of urea within it remains lower than that in the

blood serum. Hence a potential osmotic gradient exists and is maintained. Should intravenous urea be administered, the concentration in the blood serum would be raised still further without significant effect on the aqueous, exaggerating the difference. This should lead to a shift of intraocular fluid from the eye to the blood serum and thus to a reduction in the intraocular pressure.

MATERIAL, METHODS AND PRECAUTIONS

The urea used in this case was in the form of Ureaphil,* which is now commercially available. The preparation is made up fresh to provide a urea solution in 10% invert sugar, as originally recommended by Javid.¹² It is administered intravenously over a period of 60 to 90 minutes, in a dosage of one gram of urea per kg. body weight. The maximum dose should not exceed 1.5 g./kg. A dosage of 1.0 g./kg. was used in the case reported.

Although the use of urea is generally contraindicated when renal function is markedly impaired, elevation of the serum non-protein nitrogen level to 60 mg. % does not preclude its use. It has been used in glaucoma patients suffering from renal disease, and complications were not reported.¹⁴ Ackerman⁹ stated that "moderate elevation" of the blood urea nitrogen was not a contraindication. Particular inquiry should be made in males as to any difficulty with micturition. Tarter and Linn¹³ reported that there was such a sudden and profuse diuresis that it was necessary to insert an indwelling catheter in all patients so treated. In our experience simple proximity to lavatory facilities was sufficient. In one reported case¹⁵ of angle-closure glaucoma treated with urea no notice was taken of the condition of the bladder until the operation was well under way, when the anesthesiologist noted a sudden quickening of the pulse rate. In checking the patient a markedly distended bladder was found. After catheterization the patient's condition returned to normal and the operation was continued.

Ackerman⁹ reported one patient who developed acute pulmonary edema after the administration of urea. This was thought to be due to the capacity of urea to increase blood volume. The author cautioned against the use of urea in patients with diminished cardiac reserve. However, this same patient was given urea over a more prolonged period (75 minutes) and experienced no difficulties. Because of its rapid diuretic action, urea also lowers blood volume and thus maintains its own safety mechanism.

Friedman, Byron and Turtz,¹¹ in a series of 100 cases, reported one patient who became disoriented, agitated and incontinent of urine and feces, causing postponement of operation. It was felt that this was due to a too rapid administration of the urea. Kwitko¹⁵ described one patient with lens-

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induced glaucoma who suffered severe headache, marked sweating and nausea, after the total infusion was given in 30 minutes. Plans for operation had to be cancelled. The following day a similar infusion was given, but over a period of two-and-one-half hours. This caused the patient no discomfort, and produced the same reduction in intraocular pressure. The same author, in another paper¹⁶ reporting the use of urea in children, described a patient who became dehydrated. Intravenous therapy was required to maintain the child in proper fluid balance.

Davis, Duehr and Javid⁸ reported one case in which sloughing occurred and required skin grafting. However, even these authors observed that "with ordinary care in preparation and administration, urea is a safe drug, contraindications to use being few and complications following its use rare."

RESULTS OF THERAPY

The use of urea in a case of phacolytic glaucoma resistant to other conventional forms of therapy proved to be the essential factor for successful treatment. With the intraocular pressure restored to a normal level, the diagnosis was made and the appropriate surgical procedure was performed. Had this not been possible, a dangerous situation would have remained. Medical treatment alone would certainly have left the patient in pain and would have seriously affected the remaining vision of the eye; but to operate in the face of elevated tension would have made serious operative complications distinctly possible.

Others faced with the same situation³ had resorted to enucleation of the affected eye.

SUMMARY AND CONCLUSION

The use of intravenous urea in the treatment of phacolytic glaucoma is discussed. A theoretical basis

for its use is outlined and clinical experiences of the author and others are described. Complications were not of a degree which would cause us to avoid its use when indicated.

The best treatment for this condition is earlier cataract extraction before the lens becomes hypermature, as recommended by Gifford¹ almost two-thirds of a century ago. However, when faced with the problem of a patient with elevated intraocular pressure, which presents simply as a "blind painful eye", intravenous urea should be administered when other agents have failed. With the pressure lowered and the patient comfortable, careful examination may be made of the anterior segment, lens and filtration angle. Then with the diagnosis made, proper therapy may be carried out under favourable conditions.

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PAGES OUT OF THE PAST: FROM THE JOURNAL OF FIFTY YEARS AGO

Hospital management in years past was notoriously lax, but in recent times business methods have been introduced into many of the newer institutions. It would do all medical men good to visit up-to-date business houses and see the card index systems and the various short-cut methods employed in every day business. It would also be admirable for the trustees of the various hospitals to see to it that the same systematic and business-like methods are used in the registration of data in the hospitals with which they are connected, as they employ in their individual business. I cannot help thinking of the Episcopal clergyman in New York, who had as his board of trustees several wide-awake business men. On one occasion it took them several hours to discuss the expenditure of a few hundred dollars. Finally the clergyman in despair leaned over and whispered to one of the trustees, "How would you handle such a proposition in your business?" This trustee replied that such small matters never came to his attention. The ludicrous side of the situation suddenly dawned upon him. Here he and his brother trustees, all millionaires, were spending hours worrying over trivial matters—that would in their business offices be attended to by junior clerks. . . . The trustees of the hospital and the various members of the medical staff are in some measure in a similar position

to that board of trustees. Their time is too valuable to be continually taken up in routine, but it is their duty to see to it that competent clerks are employed to keep careful records of all patients entering the hospital or dispensary. The findings at operation must be recorded with precision and the microscopical examinations of the specimens added to the history.

This is an age of time-saving devices and all business men are keen to see what results have accrued from their endeavours. What applies to business applies equally well to the subject of cancer. What is the use of operating year after year in a routine manner, having but a hazy idea of what has finally become of the patient. At least one tactful clerk in every hospital should be assigned to the task of keeping in constant contact with those who have been operated on. In this manner one can at a glance tell how many patients have been relieved by operation. The results of one operator are compared with those of another—of course in a most friendly way, and there is no doubt that a runner can always make better progress with a pacemaker.—Thomas S. Cullen: Address in Gynecology, presented at the Annual Meeting of the C.M.A., June 1913; *Canad. Med. Ass. J.*, 3: 669, 1913.