A COMPARATIVE STUDY OF CONTRAST DACRYOCYSTOGRAM AND NUCLEAR DACRYOCYSTOGRAM

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A comparative study was run between conventional radiographic contrast dacryocystogram and radioisotope scan of the lacrimal drainage apparatus (henceforth called "nuclear dacryocystogram"). A total of 20 contrast dacryocystograms (DCG), 22 irrigations, and 42 nuclear dacryocystograms (DCG) were performed in 21 patients having symptoms of obstruction in the lacrimal drainage system. The study revealed that there was a good correlation between these two diagnostic techniques and nuclear DCG was, perhaps, superior to contrast DCG.

The conventional radiographic procedure called dacryocystography (*1*) is at present the technique of choice for evaluating obstruction in the lacrimal drainage apparatus. The purpose of this paper is to present a comparative study of contrast dacryocystogram (DCG) and a recently introduced radioisotope or nuclear dacryocystogram (DCG) in order to assess the diagnostic accuracy of the latter procedure.

MATERIALS AND METHODS

A total of 21 patients having symptoms of blockage in the lacrimal drainage apparatus were studied using both contrast and nuclear DCGs. All patients had nuclear studies bilaterally, a majority of them had had unilateral contrast studies with a few having bilateral contrast studies, and a small group had no contrast studies but had irrigation tests instead. Thus, a total of 20 contrast DCGs and 42 nuclear DCGs were performed in this group of patients.

About 200 μCi of ^{99m}Tc-pertechnetate in 0.01–0.05 ml sterile normal saline vehicle was used as an eye drop for each eye and the patient was immediately positioned upright in front of a scintillation camera face (Fig. 1). Care was taken not to spill technetium outside the eye because of resulting artifacts in the scintiscan. The collimator used in this study was a 0.04-in. diam pinhole. This helps in getting higher magnification and resolution of the different parts of the lacrimal drainage system such as the canaliculi, the sac, and the nasolacrimal duct. Patients were properly positioned so that their eyes were at the level of the pinhole. The distance between the pinhole and the patient's eye varied between 0.5 to 3 in. depending on whether or not one or both eyes were scanned. Following instillation of the radioisotope in the conjunctival sac, the patients' eyes were scanned sequentially at 0, 5, 10, and 15 min after instillation. Both Polaroid and conventional x-ray films were exposed. At the end of the study, both contrast and nuclear studies were read independently by different physicians unbiased by the other study.

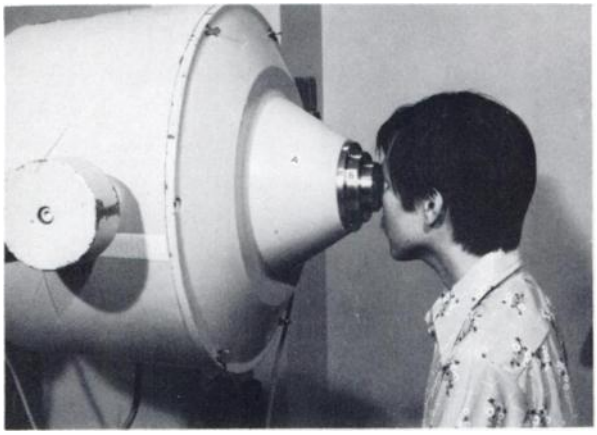

FIG. 1. Position of patient for nuclear dacrycystography. (A) Collimator base; (B) pinhole insert.

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FIG. 2. Anterior nuclear DCG on left eye showing normal flow. Note visualization of sac in immediate scan and duct in subsequent scans.

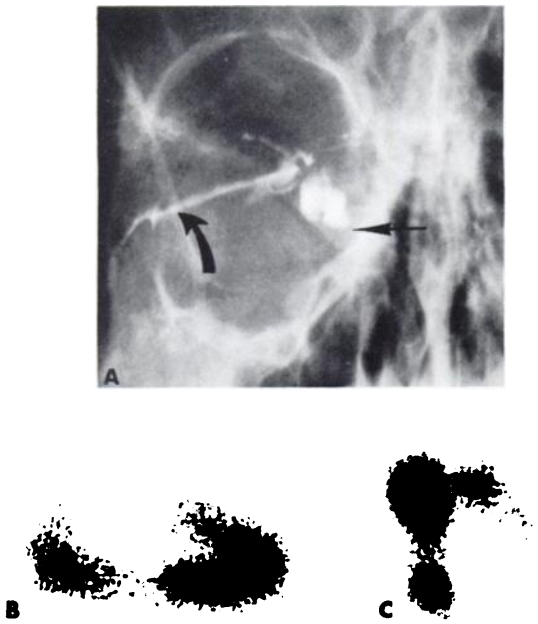

FIG. 3. (A) Contrast DCG showing obstruction (horizontal arrow) on right eye distal to dilated sac. (Curved arrow points to contrast dye along lid margin.) (B) Nuclear DCG reveals no flow on right eye distal to sac up to 15 min. Note normal drainage on left eye (C) at same time.

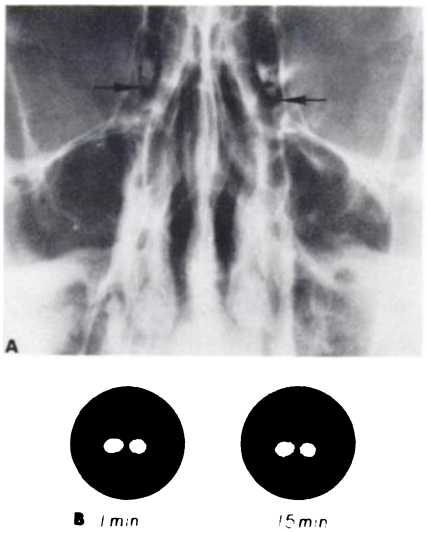

FIG. 4. (A) Contrast DCG discloses no flow of dye distal (arrows) to sac bilaterally. (B) Anterior nuclear DCG also demonstrates no activity distal to sacs bilaterally.

RESULTS

Twelve studies demonstrated obstruction in the lacrimal drainage system in both contrast DCG and nuclear DCG. Seven had unilateral obstruction; five had bilateral obstruction. Five patients underwent dacryocystorhinostomy (DCR) and a postoperative scan was also obtained in this group of patients. Studies on three of them demonstrated patency of dacryocystorhinostomy while in two other patients, postoperative DCG still revealed "no flow" indicating an unsuccessful operation which fitted well with the results of the fluorescein dye test. Two studies were normal in contrast DCG and irrigation but abnormal in nuclear DCG (functional block). Two studies demonstrated anatomic discontinuity of canaliculus.

We will illustrate studies of one patient from each group. Figure 2 represents a case with normal nuclear DCG on left eye. Figure 3A, B, and C shows obstruction on the right eye demonstrated in both studies. Figure 4A and B depicts bilateral obstruction demonstrated in both contrast and isotope studies. Figure 5 is the study of a patient with functional block, i.e., normal contrast DCG but abnormal nuclear DCG on the left eye. Figure 6A represents the preoperative contrast study showing obstruction on the right eye distal to the sac. Figure 6B depicts the nuclear studies demonstrating "no flow" preoperatively and return of flow postoperatively indicating successful surgery. Figure 7 represents the postoperative scan of a patient who had DCR on the right eye. The scan demonstrates "no flow" on the right eye indicating unsuccessful surgery. This patient continued to have epiphora postoperatively and a fluorescein dye test also disclosed failure of surgery indicating good correlation with the isotope study. Figure 8 represents the scan of a patient who had complete transection of the right lower canaliculus due to laceration resulting from a dog bite. Note the ragged distribution of activity along the right lower canaliculus while the right upper canaliculus and the left upper and lower canaliculi have a smooth outline of activity.

DISCUSSION

The procedure commonly employed at present to diagnose blockage in the lacrimal drainage apparatus is radiographic contrast dacryocystography (DCG) (*1*). The major disadvantage of this technique, however, is that the study requires catheterization of the canaliculi thus traumatizing the patient.

More recently a radioisotopic method has been introduced (*2*). To date, however, there is no detail report in the literature of a comparative study between these two techniques to determine how they compare in diagnostic accuracy. We have made a

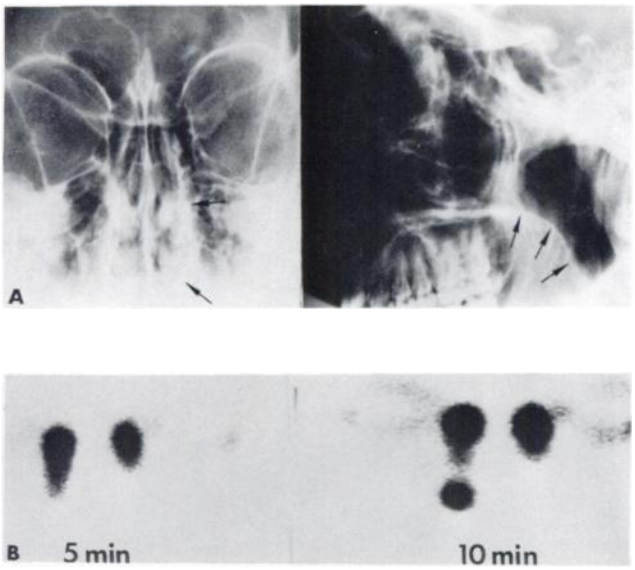

FIG. 5. (A) Contrast DCG (anteroposterior and lateral views) reveals normal flow of dye (arrows) on left eye. (B) Nuclear DCG shows block on left eye distal to sac. (Note, however, normal drainage on right eye.)

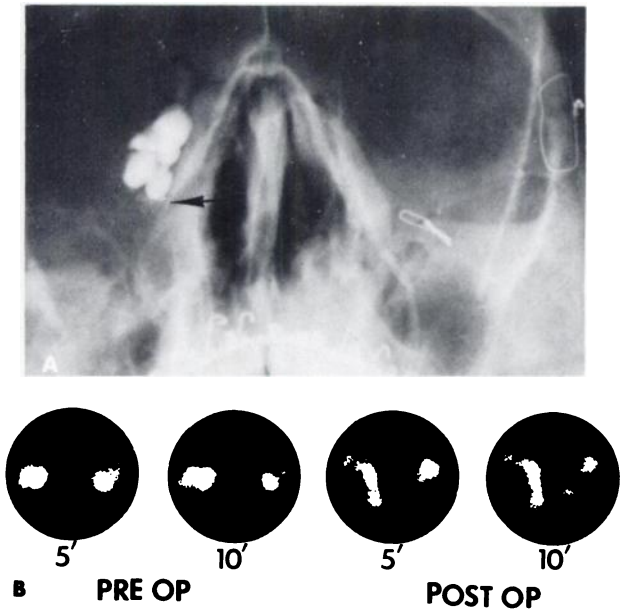

FIG. 6. (A) Preoperative contrast DCG showing obstruction distal (arrow) to dilated sac on right eye. Left eye also had symptoms of obstruction and positive irrigation test. (B) Nuclear DCG. Preoperative scans show bilateral obstruction distal to sac. Postoperative scans demonstrate successful operation.

comparative study of these two diagnostic tests and concluded that the isotope technique is superior to x-ray DCG.

We would like to propose a nomenclature for the radioisotope procedure—"nuclear dacryocystography" to conform with the style of naming other nuclear medicine procedures such as nuclear angiocardiography, nuclear venography, nuclear angiography, etc.

We used a conventional Searle Radiographics pinhole collimator with our specially designed and assembled (*3*) insert having an aperture diameter of 0.04 in. This way, one gets higher magnification and resolution of different parts of the lacrimal drainage system, namely the canaliculi, sac, and the nasolacrimal ducts.

It is difficult to determine the $T_{1/2}$ of tear drainage because it varies so much from one patient to another because of emotional factors, irritation to the eye, and the pre-existing conjuctivitis, etc. However, whatever the variables are, one should visualize activity in the nose within 8–10 min. More than 10 min indicates delayed drainage or blockage. We concluded this from our experience with 21 patients.

We observed a good correlation between these two techniques in all studies. In none of these cases did we observe abnormal contrast DCG but normal nuclear DCG. In two studies there was a discrepancy, namely, normal contrast DCG but abnormal nuclear DCG. The reason for this discrepancy is that the contrast DCG is performed under manual injection pressure while nuclear DCG is a physiologic study mimicking the normal state of tear drainage. With contrast DCG, normal and extreme pathologic obstruction can be demonstrated. In functional block, however, such as in abnormal "lacrimal pump" or partial stenosis of the nasolacrimal duct where the system irrigates freely but does not permit free passage of tears under normal circumstances, the nuclear DCG would be abnormal whereas the contrast DCG would be normal since the latter is performed with catheterization and under manual injection pressure. Thus, contrast DCG which employs direct catheterization of the canaliculi and injection under pressure could create a false passage or open up physiologic or anatomic blocks, thus erroneously implying nor-

FIG. 7. Post-DCR anterior scan of patient taken at 15 min shows unsuccessful operation on right. Patient still had symptom postoperatively. (Left eye demonstrates normal flow.)

FIG. 8. Anterior nuclear DCG at 5 min of patient who had complete transection of right lower canaliculus resulting from dog bite.

mality. Nuclear DCG should obviate both these problems.

The absorbed radiation dose to the lens in nuclear DCG would range from 4–6 mrads compared with 200–300 mrads delivered from an anteroposterior skull x-ray.

Nuclear DCG would also help the ophthalmologist decide whether or not dacryocystorhinostomy (DCR) should be performed in a patient with a suspected lacrimal block. Thus, DCR is indicated if nuclear DCG shows evidence of obstruction, if the system does not irrigate, and if the patient remains symptomatic.

A temporary block of the system by mucus plug, concretion, or other debris or a block due to anomalous valve of Krause or valve of Taillefer in the nasolacrimal duct would go undetected by either irrigation or contrast DCG. These types of anatomic block, however, can often be detected by nuclear DCG.

We, therefore, think nuclear DCG is superior to contrast DCG because (A) it is an atraumatic procedure since no catheterization of the duct is executed, (B) it provides better diagnosis of functional and anatomic block, and (C) it delivers smaller radiation dose to the lens and anterior chamber.

In conclusion, nuclear DCG should be a routine screening procedure to evaluate suspected lacrimal block preoperatively. A postoperative nuclear DCG would also be a valuable tool in assessing the success of DCR.

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