CLINICAL EVALUATION OF MICROSCINTIGRAPHY OF THE LACRIMAL DRAINAGE APPARATUS

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Lacrimal drainage was studied by sequential imaging ("microscintigraphy") of the orbit after ^{99m}Tc was placed in the eyes of 62 patients. Specific criteria of normal drainage were developed from observations in 28 individuals. Thirty-four epiphoric patients in several categories of lacrimal drainage symptomology were studied. This technique of microscintigraphy of the lacrimal apparatus was shown to be a valuable diagnostic tool.

Many methods have been used to determine the patency of the lacrimal drainage apparatus in man, notably the fluorescein dye test by Jones (*1*), dacryocystography described by Campbell (*2*), Milder and Demorest (*3,4*), and Francois and Neetens (*5*), and the pressure transducer described by Callahan, Forbath, and Besser (*6*). Recently, Rossomondo, et al (*7*), have proposed a procedure called "microscintigraphy" in which a small drop of radioactive tracer is followed through the lacrimal drainage system with a gamma camera. This test involves no discomfort to the patient. Since the canaliculi are not instrumented and the radioactive material is suspended in a sterile, buffered, normal saline solution, the natural physiologic dynamics of the drainage system are maintained. The radiation dose to the lens of the eye is about 2% of that received in an anterioposterior radiograph. The purpose of this paper is to report on microscintigraphy as a clinical diagnostic tool in the study of the lacrimal drainage system.

MATERIALS AND METHODS

Approximately 100 μCi of ^{99m}Tc was placed in the eye in the form of a 15-μl drop. The patient was positioned in front of the gamma camera and recording was begun approximately 3 sec after the administration of the drop. Two-second exposure frames were recorded with a 35-mm camera for the first 20 sec and 40-sec exposure frames were recorded thereafter. After the first 5-min the patient was allowed to rest and was repositioned for each additional frame. The field of view of each scintiphoto was approximately from the middle of the cornea to the nasal midline.

NORMAL STUDIES

Normal subjects were asymptomatic volunteers with no history of lacrimal drainage problems. A total of 28 individuals, including 12 males and 16 females with ages ranging from 21 to 37, were studied.

Results of a typical normal study can be seen in Fig. 1. Selected frames from the dynamic 35-mm

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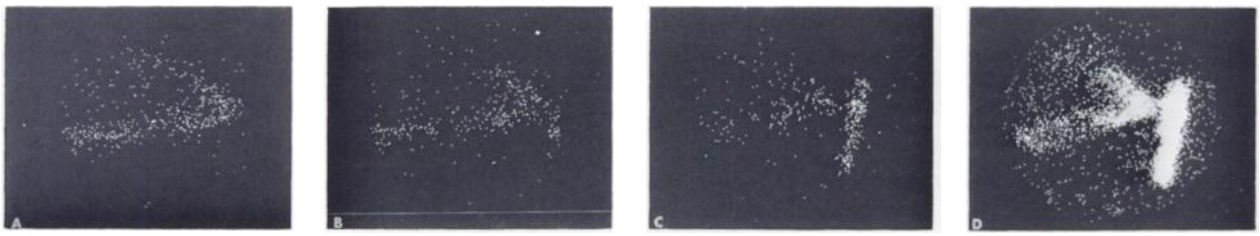

FIG. 1. Normal study of right eye. A shows radioactive material distributed over eye primarily in palpebral fissure 4 sec after administration of drop. B shows radioactivity first seen entering sac at 10 sec. C shows radioactivity first seen at bottom of nasolacrimal duct at 16 sec. D shows complete lacrimal drainage system outlined at 43 sec.

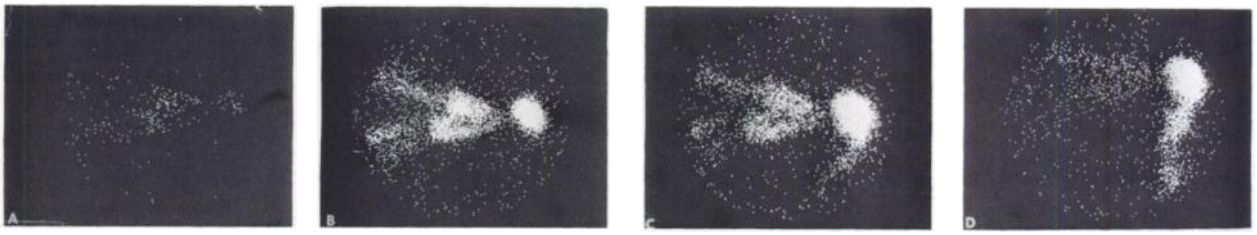

FIG. 2. Apparent obstruction of right eye. In A radioactivity is first seen entering sac at 12 sec. B shows sac filled out at 43 sec. At 3.5 min (C) duct begins filling. D shows radioactivity first seen at bottom of duct at approximaely 10 min.

FIG. 3. Apparent obstruction of the left eye in 60-year-old woman with left eye pain and intermittent epiphora. In A radioactive material is first seen in sac at 14 sec. After 2 min (B), radioactive material is first seen at bottom of duct and first suggestion of filling defect in duct appears. C shows filling defect in midportion of nasolacrimal duct clearly seen at 4 min.

recording system are presented. After administration the radioactive material is seen to spread rapidly over the eye, collecting in the palpebral fissure (Fig. 1A). The next frame depicts the radioactive material first entering the lacrimal sac. The time of entry into the sac is one parameter which has been chosen in an attempt to quantify lacrimal drainage dynamics. The next frame shows radioactive material reaching the bottom of the nasolacrimal duct and serves as the second point of reference for measuring transit time. The last frame verifies anatomic definition and clearly illustrates the longer inferior and shorter superior canaliculi. The physiologic clear space previously reported by Rossomondo, et al (7) is clearly seen between the vertex of the canaliculi and the lacrimal sac. The straight nasolacrimal duct is also seen in detail. The increased density of the last frame results from a data collection time of 40 sec rather than the 2-sec exposure times used in the first three frames.

From these initial studies of normal subjects the median transit time from administration of the radioactive material until the material reached the lacrimal sac was determined to be 6 sec with a range from 4 to 43 sec. With the present technique it was not possible to measure a time of less than 4 sec. The median transit time to the bottom of the nasolacrimal duct was 43 sec with a range of 4 to 323 sec. In a future publication more extensive data using computer-assisted imaging and digital analysis will be presented.

ABNORMAL STUDIES

The abnormal patients studied were individuals with a history of clinically significant epiphora. This group of 34 people presented with a history of lacrimal drainage apparatus symptomatology and were arbitrarily divided into three categories: apparent obstruction, injury, and functioning and nonfunctioning post-dacryocystorhinostomies.

Apparent obstructions. Figure 2 shows a study of a 29-year-old white female with a several week history of intermittent epiphora associated with tenderness and swelling in the area of the right lacrimal fossa. This series of scintiphotos demonstrates an apparent obstruction in the area of the valve of Krause. The transit time to the sac is 12 sec. The nasolacrimal duct transit time is approximately 10 min which is considerably longer than the normal median.

Figure 3 shows a study of a 60-year-old black female with a 3-month history of vague left eye pain and intermittent epiphora. A filling defect in the midportion of the nasolacrimal duct is obvious. The sac transit time is 14 sec and the duct transit time is 2 min.

FIG. 4. Injury to medial portion of left lower lid. Radioactivity is first noted in sac after 43 sec (A). At 3 min superior canaliculus is outlined (B). Collection of radioactive material is seen in inferior lacrimal lake. C shows nasolacrimal duct is outlined after 1 hr. Radioactive material has been removed from lacrimal lake with absorbent paper.

Injury. Figure 4 is a study of a 26-year-old black male involved in an industrial accident resulting in the laceration of his left inferior canaliculus. The diagnosis was made by a slit lamp examination. Microscintigraphy done 2 hr post-trauma showed a sac transit time of 43 sec and a duct transit time of approximately 1 hr. The 3-min frame demonstrates a pooling of the radioactive material in the inferior lacrimal lake. The superior canaliculus is clearly outlined but the inferior cannot be visualized.

Post dacryocystorhinostomies. Figure 5 is a study of a 27-year-old white female with a history of chronic dacryocystitis necessitating a left dacryocystorhinostomy for epiphora 3 years before the present study. The patient has not had difficulty with epiphora since the operation. The 6-min frame demonstrates the nasolacrimal duct filled to two thirds of its length. At approximately the midpoint of the duct the radioactive material egresses into the nasal cavity through the surgical ostium and is dissipated on the mucosal lining of the nasopharynx.

FIG. 5. Post-dacryocystorhinostomy of left eye. Patency of surgical ostium is demonstrated with dissipation of radioactive material onto mucosal lining of nasopharynx. Radioactive material egresses from medial aspect of midpoint of duct.

Figure 6 shows a study of a 29-year-old black male who had a dacryocystorhinostomy for epiphora 12 years before the present study. Epiphora had persisted during the interval and presently is a major complaint. Figure 6A shows that the radioactive material has collected in the sac but has not progressed down the nasolacrimal duct nor through the surgical ostium. Figure 6B shows no additional progression of the radioactive material after 1½ hr, thus substantiating the clinical impression of a nonfunctioning dacryocystorhinostomy.

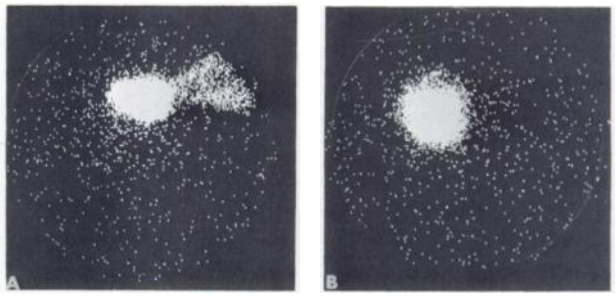

FIG. 6. Post-dacryocystorhinostomy of left eye. Radioactive material enters sac through well outlined canaliculi at 1 min (A). B shows that sac remains filled with no evidence of progression through surgical ostium or down nasolacrimal duct at 90 min.

ASYMPTOMATIC VARIANT

Figure 7 shows a study of an asymptomatic, 22-year-old white female with an entirely negative ophthamologic history and physical examination. The radioactive material rapidly entered the sac in 4 sec and progressed in a counter-clockwise direction forming an unusual C-configuration. Figure 7D shows the sac and canaliculi to be clearly outlined. Figure 7E shows the nasolacrimal apparatus completely outlined. This interesting configuration is thought to represent a congenital variant.

COMMENTS

The gamma camera is a widely used diagnostic tool found in more than 1,000 hospitals in the

FIG. 7. Asymptomatic varient left eye. In A, B, and C radioactive material is seen rapidly entering sac and progressing in counterclockwise direction at 4, 6, and 8 sec. In D canaliculi and sac are well outlined at 43 sec. At 2.5 min (E) nasolacrimal apparatus is completely outlined. Interesting configuration is thought to represent congenital variant.

United States. Technetium-99m is a relatively low-dose radioisotope and is extensively used. The development of the micropinhole collimator extends these tools for the use of the ophthalmologist. Microscintigraphy of the lacrimal drainage system is inexpensive, safe, and easy for a nuclear medicine department to perform without patient discomfort. Knowledge of the type of obstruction and location will help in the selection of the best mode of medical or surgical therapy. Microscintigraphy is valuable in assessing the results.

Microscintigraphy is the technique of choice to evaluate the dynamics of normal lacrimal drainage. With this technique there is no sampling from the cul de sac and no instrumentation of the patient's canaliculi, thus essentially preserving the normal physiological state.

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