The Value of MR Dacrocystography in Patients with Epiphora

Hawraa A. Abdul Shakoor*, Salam M. Joori**

ABSTRACT:

BACKGROUND:

Obstruction or stenosis of the lacrimal ducts, which leads to inadequate drainage of tears, may cause intermittent or constant tearing, which is termed "epiphora, radiological evaluation to the lacrimal gland are divided into anatomical (conventional dacrocystigraphy, CT dacrocystography and MR dacrocystograhy), and functional evaluation (staining test, scintigraphy and dynamic MR dacrocystography).

AIM OF STUDY:

To study the value of MRI dacrocystography in patients with clinically diagnosed epiphora.

METHODS:

A total of 36 patients who had presented to the Ophthalmology Clinic from 1st of April 2019 to 1st of October 2019 who were suspected to have obstruction of lacrimal drainage system, were evaluated with MR-DCG after instillation of 0.5% sterile water into the conjunctiva. The examination was performed at MRI department in the X-ray institute in the Medical City, then ophthalmological examination (punctum lavage test) was performed bilaterally for all enrolled patients.

RESULTS:

Obstruction of lacrimal drainage system was successfully detected in a total of 41 eyes of 36 patients undergoing examination with MR-DCG. The MR-DCG findings of 72 nasolacrimal systems were compared with the ophthalmologic professional diagnosis findings in all patients the sensitivity of MR-DCG was 90.6% for identification of nasolacrimal system obstruction when compared with the ophthalmological professional examination findings, and MR-DCG was found to detect obstruction with high accuracy and provide further information about the level of obstruction and if the obstruction in partial or complete.

CONCLUSION:

MR-DCG has a high success rate in detection of lacrimal drainage system obstructions and the level and cause of the obstruction, this method avoids both cannulation and ionizing radiation, so could be repeated if necessary, non-time consuming and avoids the side effect of contrast.

KEYWORDS: MRI dacrocystography, epiphora, obstruction, MR-DCG, Iraq.

INTRODUCTION:

Anatomy of lacrimal system

Each lacrimal drainage system is formed by lower and upper lacrimal canaliculi, common canaliculus, lacrimal sac, and nasolacrimal duct.

Epiphora

Obstruction or stenosis of the lacrimal ducts, which leads to inadequate drainage of tears, may cause intermittent or constant tearing, which is termed "epiphora."

Lacrimal pathways radiological evaluation

1. Dacryocystography (DCG)
2. Computed tomographic (CT)
3. Dacryoscintigraphy (DSG)
4. MR dacrocystography.

*Oncology Teaching Hospital Medical City Baghdad.
**Ray Institute Baghdad.

PATIENTS AND METHODS:

2.1. Study design, setting and data collection time

This was a cross sectional study that conducted in Ophthalmology Outpatient Clinic at Ibn Al-Haitham Teaching Hospital and in the MRI department in X-ray Institute at Medical City during a period of six months from 1st of April to 1st of October 2019.

2.2. Study patients and sample size

The study included 36 patients age ranging from (5-72 years), 22 females and 14 males suffering from epiphora and suspected to have obstruction of lacrimal drainage system, were referred from ophthalmologist. Patient then were evaluated with MR-DCG, after that they undergo ophthalmological examination by punctum lavage and provisional diagnosis was given.

2.3. Procedure

MR-DCG is a high resolution MRI (submillimetric) with Siemens Avanto machine, using head coil by obtaining a 3D - ultra long T2 (TR 5000, TE 106), slice thickness (3 mm), FOV (200 mm), resolution (256) sequences on the coronal plane and adding T1- weighted (TR 532, TE 8.7) and T2 (TR 2500, TE 70) weighted sequences at the transverse plane, following conjunctival sterile eye drop instillation.

We used 5-8 drops for each eye, started five minutes before the examination, and repeated each minute, at sitting position, the last drop where instilled on table at sleeping position and we asked the patient to blink eyes to facilitate filling of lacrimal canals.

2.4. Follow up

The obstruction levels in the nasolacrimal system were evaluated in the three levels based on the MR-DCG criteria recommended by Hoffman et al [19]. Obstructions at the common canaliculi and lacrimal sac union (At the level of the Rosenmuller valve) were numbered as level 1, obstructions at the lacrimal sac neck (at the level of the Krause valve) were numbered as level 2, and obstructions at the nasal cavity opening (at the level of the Hasner valve) were numbered as level 3.

The sensitivity of MR-DCG in detection of nasolacrimal stenosis was evaluated as compared with ophthalmologist examination .

The nasolacrimal system in which sterile fluid was observed in normal calibration and in which the fluid flow from the meatus nasi inferior to the nasal cavity was observed, was considered patent .

Complete obstruction was reported when there is no passage of fluid below the level of stenosis with partial obstruction was reported when there is apparent area of stenosis, but still there is passage of soma fluid distal to that point.

2.6. Statistical analysis

The data analyzed using Statistical Package for Social Sciences (SPSS) version 25. The data presented as mean, standard deviation and ranges. Categorical data presented by frequencies and percentages. Cohen's Kappa Coefficient (k) measured inter-rater agreement for qualitative (categorical) items. A level of P – value less than 0.05 was considered significant.

RESULTS

The total number of study patients was 36 and the total number of examined eyes were 72 eyes. All of the patients were suffering from epiphora, six of them presented with bilateral symptoms.

3.1. Age and gender

The distribution of study patients by age and gender is shown in figures (3.1 and 3.2). Study patients' age was ranging from 5 – 72 years with a mean of 36.7 years and a standard deviation (SD) of ± 11.4 years. The highest proportion of study patients was aged between 20 – 39 years (50%).

Regarding gender, proportion of females was higher than males (61.1% versus 38.9%) with a male to female ratio of 1:1.57.

3.2. MR-DCG finding

Lacrimal drainage system obstruction

The distribution of examined eyes by lacrimal drainage system obstruction. We noticed the 56.9% of examined eyes were diagnosed with lacrimal drainage system obstruction.

Level and degree of lacrimal drainage system obstruction

The level and degree of lacrimal drainage system obstruction are shown in table (3.2). The most common level of obstruction was level 2 (65.9%) , level 1 (19.5%) and level 3 (14.6%).

Causes of lacrimal drainage system obstruction

The causes of lacrimal drainage system obstruction. We noticed that the most of causes of lacrimal drainage system obstruction was unidentified.

Incidental pituitary macroadenoma was found in one patient, that patient was found to have bilateral dilatation of the nasolacrimal ducts without obstruction (So his epiphora could be due to over production of tears).

MR-DCG and Ophthalmological findings in diagnosing lacrimal drainage system obstruction

MR-DCG and ophthalmological findings in diagnosing lacrimal drainage system obstruction. By MR-DCG, the findings showed one side obstruction in 58.3% of study patients compared to 75% by ophthalmological findings.

Bilateral obstruction was detected in 27.8% by MR-DCG and in 16.7% by ophthalmological examination.

Normal lacrimal drainage system was seen in 13.9% by MR-DCG and in 8.3% by ophthalmological examination. In comparison in diagnosing lacrimal drainage system obstruction between MR-DCG finding and ophthalmological findings. By MR-DCG, obstruction was diagnosed in 41 eyes; 32 of them were confirmed by ophthalmological examination.

CONCLUSION:

There was a moderate agreement between diagnosing lacrimal drainage system obstruction

by MR-DCG and ophthalmological examination, and this agreement was statistically significant (kappa= 0.52, P=0.001).

DISCUSSION:

Punctum lavage can diagnose obstruction lacrimal drainage system, and anticipate the location of the obstruction preoperatively in patients with nasolacrimal duct obstruction, and therefore, can provide useful information for the subsequent endoscopy-guided surgical procedures. However, before performing dacryoendoscopy, it would be more helpful if the positional diagnosis of nasolacrimal duct obstruction can be made by noninvasive imaging methods. Several studies have reported that MR dacryocystography provided detailed information about the nasolacrimal system without risks associated with cannulation, and could be a useful method for depicting nasolacrimal duct obstruction. However, there has been no report directly comparing the diagnostic performance in nasolacrimal duct obstruction between MR dacryocystography and ophthalmological punctum lavage examination. In this study, MR dacryocystography can correctly depict the stenosis/obstruction in nasolacrimal system in 42 (57 %) of 72 eyes who were examined, obstruction was confirmed in 32 of them with punctum lavage examination.

Obstruction of lacrimal drainage system was detected was detected on the right in 13 patients, on the left in 14 patients, bilateral in 7 patients. Suggesting that epiphora might be due to systemic disease, or there are other factors that lead to cause bilateral epiphora in the same patient.

Obstruction of lacrimal drainage system was detected on the same side on MR-DCG in 8 of patients in whom obstruction findings were observed in the right nasolacrimal ducts by the ophthalmologist, and in 11 of patients in whom obstruction findings were observed in the left nasolacrimal canal. Bilateral obstruction was observed on the MR-DCG of three patients in whom obstruction was observed on the right by the ophthalmologist and MR-DCG of three patients in whom obstruction findings were observed on the left. Bilateral obstruction was found on the MR-DCG three patients whom bilateral obstruction findings were observed by the ophthalmologist.

Obstruction was found at one side by MR-DCG only while the ophthalmological diagnosis was bilateral obstruction in 2 patients, MR-DCG finding was bilateral obstruction while ophthalmological diagnosis was one eye obstruction only in five patients.

The MR-DCG found the result normal in one patient whom the diagnosis is bilateral obstruction, and the MR-DCG finding was normal while the ophthalmological diagnosis is obstruction in one eye in three patients.

Multiple causes of lacrimal system obstruction were found. mucocele was observed as the cause of obstruction in the lacrimal canal in 1 (0.13%) patients. Inflammatory changes and wall thickening are found in 3(0.41%) patients, filling defects were found inside the ducts in 5 (0.69%) patients and found to be the cause of obstruction, Furthermore, mucosal thickening in ethmoidal cells or maxillary sinuses, and sinusitis changes characterized with fluid intensities were seen in the vast majority of the patients. These results suggest than MR DCG can add information about the lacrimal ducts walls and boundaries and when comparing this to punctum lavage, which only give information about the lacrimal duct lumen.

Incidental pituitary macro adenoma was found in one patient, that patient was found to have bilateral dilatation of the nasolacrimal ducts without obstruction (so his epiphora could be due to over production of tears).MR dacryocystography has some advantages over digital dacryocystography and CT dacryocystography. Dacryocystography uses no ionizing radiation that focuses on the lenses of the eyes, and requires no local anesthesia, no cannulation of the punctum, and no injection of viscous contrast media, and has no risk of iatrogenic trauma on the punctum. In this study, MR dacryocystography was performed by using the topical administration of normal saline drops into the conjunctival sacs although some previous studies have performed MR dacryocystography with the use of diluted gadolinium contrast medium, which is an off-label use for MR dacryocystography. We preferred saline solution because, as compared to gadolinium contrast medium, the saline solution has a lower viscosity, and therefore, causes less irritation in the mucosal structures. Different from gadolinium contrast medium, the saline solution has no risk of allergy. In this study, the topical administration of normal saline drops did not cause any local or systemic side effects and the patients did not report any discomfort. Additionally,

topical administration of normal saline drops may allow a more physiologic examination,

compared with the use of diluted gadolinium contrast medium with relatively high viscosity. Regarding image quality, one study has compared topical applications of saline solution and gadolinium solution, and reported that the images obtained after the application of the gadolinium solution had artifacts caused by the susceptibility effect, compared with those obtained after the application of the saline solution. Furthermore, MR dacryocystography has some advantages over punctum lavage examination. At first, the examination time in MR dacryocystography is shorter than that of punctum lavage. Second, because MR dacryocystography requires no local anesthesia and no cannulation, the patient discomfort is extremely low. Finally, punctum lavage needs experienced ophthalmologist and specific endoscopic device. Accordingly, for the positional diagnosis of nasolacrimal duct obstruction, MR dacryocystography may be replaced for punctum lavage.

CONCLUSION:

1. MR-DCG performed after sterile instillation onto the conjunctiva is a highly sensitive and well tolerated, non-time consuming method in the assessment of lacrimal system patency.
2. The most important advantages of MR-DCG are high resolution power, no requirement for cannulation, and absence of ionizing radiation, and no need for contrast use.
3. MR-DCG and the added T1 and T2 sequences to evaluate soft tissues may be used as the standard orbital imaging protocol in cases in which lacrimal drainage system obstruction or soft tissue pathologies in the nasolacrimal canal and the surrounding tissues are considered based on clinical and examination findings.

REFERENCES:

1. Lacrimal drainage obstruction in gastric cancer patients receiving S-1 chemotherapy - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Anatomic-sites-of-obstruction-of-the-lacrimal-drainage-apparatus-After-tears-were_fig2_224966541 [accessed 18 May, 2020]
2. Mandeville JT, Woog JJ. Obstruction of the lacrimal drainage system. Curr Opin Ophthalmol 2002; 13:303–0
3. Myron Yanoff MD, Joseph W. Sassani MD MHA, ocular pathologies (seventh edition) , science direct 2015 : 147-197.
4. Dei Cas RE. Evaluation of tearing in children. In: Katowitz JA editor. Pediatric oculoplastic surgery. Springer Verlag; 2002;301–56.
5. Moeller TB, Reif E. Atlas of Radiographic Anatomy. Thieme; Stuttgart: 2000. pp. 2–39.
6. Garrity J. Dacryostenosis disorders-MSD manual professional edition last modified May 2019
7. Song HY, Jin YH, Kim JH, Suh SW, Yoon HK, Kang SG, et al. Nonsurgical placement of a nasolacrimal polyurethane stent: long-term effectiveness. Radiology. 1996 Sep;200(3):759-63.
8. Schatz CS. Dacryocystography. In: Bergeron Rt2-Osborn AG, Som PM, editors. Head and neck imaging. 1st ed. St. Louis, MO: CV Mosby, 1984 669-680)
9. Ewing AE. Roentgen ray demonstration of the lacrimal abscess cavity. Am J Ophthalmol 1909; 26:1-4.
10. Song HY, Ahn HS, Park CK, Kwon SH, Kim CS, et al. Complete obstruction of the nasolacrimal system. Part I. Treatment with balloon dilation. Radiology. 1993 Feb;186:367-71.
11. Sasaki T, Nagata Y, Sugiyama K. Nasolacrimal duct obstruction classified by dacryoendoscopy and treated with inferior meatal dacryorhinotomy. Part I: Positional diagnosis of primary nasolacrimal duct obstruction with dacryoendoscope. Am J Ophthalmol 2005; 140:1065-69.
12. Ilgit ET, Yüksel D, Unal M, Akpek S, Isik S, Hasanreisoglu B. Transluminal balloon dilatation of the lacrimal drainage system for the treatment of epiphora. AJR. American journal of roentgenology. 1995;165:1517-24.
13. Linberg JV, Moore CA. Symptoms of canalicular obstruction. Ophthalmology 1988;95: 1077–1079.
14. Clark R. Aparato lacrimal. In: González CF, Becker MH, Flanagan JC, editors. Diagnostico por la imagen en oftalmología. Barcelona: Ediciones Doyma, 1988;77–87.
15. Tucker SM, Linberg JV, Nguyen LL, Viti AJ,Tucker WJ. Measurement of the resistance to fluid flow within the lacrimal outflow system. Ophthalmology 1995;102:
16. Weber AL, Rodriguez-DeVelasquez A, Lucarelli MJ, Cheng HM. Normal anatomy and lesions of the lacrimal sac and duct: evaluated by dacryocystography, computed tomography, and MR imaging. Neuroimaging Clin N Am 1996; 6:199-217.

17. Higashi H, Tamada T, Mizukawa K, Ito K. MR dacryocystography: comparison with dacryoendoscopy in positional diagnosis of nasolacrimal duct obstruction. Radiol Med.2016;121: 580-7.
18. Eldesoky S, Farouk H, Moustafa AN, El-noueam K, Elsabaa A. The role of multi-detector CT dacryocystography in the assessment of naso-lacrimal duct obstruction. The Egyptian Journal of Radiology and Nuclear Medicine. 43: 397-405. 10.1016/j.ejrnm.2012.03.006 - ScienceDirect
19. "Clinical Guidelines for Lacrimal Scintigraphy" (PDF). BNMS. April 2013. Retrieved 23 May 2017.
20. Sagili, Suresh; Selva, Dinesh; Malhotra, Raman (10 April 2012). "Lacrimal Scintigraphy: "Interpretation More Art than Science"". Orbit. 31: 77–85.
21. Caldemeyer KS, Stockberger SM Jr, Broderick LS. Topical contrast-enhanced CT and MR dacryocystography: imaging the lacrimal drainage apparatus of healthy volunteers. AJR Am J Roentgenol 1998;171: 1501-04.
22. Cubuk R, Tasali N, Aydin S, Saydam B, Sengor T. Dynamic MR dacryocystography in patients with epiphora. Eur J Radiol 2010; 73: 230-233.
23. Ramey NA, Hoang JK, Richard MJ. Multidetector CT of nasolacrimal canal morphology: normal variation by age, gender, and race. Ophthal Plast Reconstr Surg. 2013;29:475–80.
24. Amin M, Moseley IF, Rose GE. The value of intubation dacryocystography after dacryocystorhinostomy. Br J Radiol 2000; 73:604–607.
25. Watkins LM, Janfaza P, Rubin PAD. The evolution of endonasal dacryocystorhinostomy. Surv Ophthalmol 2003; 48:73–84.
26. shen GL, Ng JD, Ma XP. Etiology, diagnosis, management and outcomes of epiphora referrals to an oculoplastic practice. (2016) International journal of ophthalmology. 9: 1751-55. doi:10.18240/ijo.2016.12.08 – Pubmed
27. Manfre L, de Maria M, Todaro E, Mangiameli A, Ponte F, Lagalla R. MR dacryocystography: comparison with dacryocystography and CT dacryocystography. AJNR Am J Neuroradiol 2000; 21: 1145-50.
28. Takehara Y, Isoda H, Kurihashi K, Isogai S, Kodaira N, Masunaga H et al, Nozaki A, Sakahara H. Dynamic MR dacryocystography: a new method for evaluating nasolacrimal duct obstructions. AJR Am J Roentgenol 2000; 175: 469-473.
29. Hoffmann KT, Hosten N, Anders N, Stroszczynski C, Liebig T, Hartmann C, et al High-resolution conjunctival contrast-enhanced MRI dacryocystography. Neuroradiology. 1999;41:208-13.
30. Kim N, Park C, Park DJ, Kim HH, Kim S, Kim YJ et al. Lacrimal drainage obstruction in gastric cancer patients receiving S-1 chemotherapy. Ann Oncol. 2012;23:2065-71.