RESEARCH

MR sialography of iatrogenic sialoceles: comparison with conventional sialography

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Objective: The objective of this study was to compare the conventional sialography with MR sialography in a series of patients with iatrogenic sialocysts (sialocyst).

Methods: 50 salivary glands in 39 patients with suspected inflammatory disease of the salivary gland underwent conventional sialography and MR sialography. Out of these 39 patients, 6 patients (age range: 16–35 years; 4 males and 2 females; mean age: 23.8 years) had sialoceles and formed our study group. MR sialography findings were compared with conventional sialography findings regarding demonstration of ductal anatomy, the cyst and its communication with the ductal system.

Results: MR sialography demonstrated the site of communication of the sialocyst with the ductal system in all six patients. MR provided additional information over conventional sialography in five cases. In four cases, the ductal system proximal to the cyst was not opacified on digital sialography but was well visualized in all cases by MR sialography. Constructive interference in steady-state (CISS) sequence demonstrated the intraglandular ducts and communication of cysts with ducts better than half-fourier acquisition single-shot turbo-spin echo (HASTE) images.

Conclusion: Our preliminary results suggest that MR sialography is a robust, non-invasive method for demonstrating the ductal system up to second-order branches, the site of ductal injury and the focal cystic lesion. MR provided at least the same information as conventional sialography in the evaluation of site of communication but provided additional information about the sialocyst and upstream ductal system in five cases. Being a non-invasive modality, we recommend MR sialography as the investigation of choice in the evaluation of an iatrogenic sialocyst.

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Introduction

Sialocele arises from extravasation of saliva into glandular and periglandular tissues secondary to disruption of the parotid duct/parenchyma. Sialocele may be a complication of a penetrating salivary gland injury or surgery.^{1,2} An iatrogenic cyst usually results after sialodochotomy for the removal of calculi or incision and the drainage of parotid abscess.^{2,3} Sialocele formation after rhytidectomy,⁴ mandibular osteotomy,⁵

zygomatic fracture⁶ and temporomandibular joint surgery⁷ has also been reported.

Diagnosis of a sialocele is usually made on the basis of the history and clinical evaluation.⁵ Imaging is required to confirm the diagnosis, evaluate the extent of the cyst and plan management. The site of parenchymal/ductal injury can also be demonstrated in a few cases. Numerous imaging modalities, such as sialography,^{3,8} ultrasound, CT^{3,9} and MRI¹⁰ have been described, but none of these consistently depicts the entire disease process.

In this context, MR sialography has been validated as an efficient technique to evaluate the ductal system of the salivary glands, especially for calculus disease

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and stricture.^{11–16} MR sialography is a non-invasive modality in the evaluation of cystic lesions of the salivary gland, but its contribution in the evaluation of sialocyst is not known. Only two reports (four cases) demonstrating the sialocyst on MR sialography have been published in literature.^{17,18}

Therefore, we undertook this study to determine the potential contribution of MR sialography in the evaluation of an iatrogenic sialocyst. The objective of this study was to compare the conventional sialography and MR sialography in a series of patients with sialocyst.

Material and methods

Between April 2005 and October 2008, 39 patients (50 salivary glands) with suspected inflammatory disease of the salivary gland underwent conventional sialography and MR sialography. Out of the 39 patients, 6 patients (age range: 16–35 years; 3 males and 2 females, mean age: 23.8 years) had sialoceles and formed our study group. Diagnosis of sialocyst was based on detailed history and clinical examination. Fluid aspiration of the cyst was performed in all cases. No biopsy or histological examination of the parotid gland was performed. The study was approved by the ethics committee and informed consent was obtained from all patients. All patients underwent MR sialography and digital sialography. MR sialography was performed before digital sialography within an interval of 5 days.

MRI was performed on a 1.5T scanner (Siemens Avanto, Erlangen, Germany) using both head and neck coils. Positioning was done without head fixation pads to avoid parotid compression. Prior to MRI, the patients were given lemon juice to stimulate salivation. On the basis of anatomic findings on a sagittal localizer, axial fast spin-echo T_1 weighted and axial fat-suppressed fast spin-echo T_2 weighted images were obtained in all patients. For MR sialography, three-dimensional (3D) constructive interference in steady state (CISS) and half-fourier acquisition single-shot turbo-spin echo (HASTE) sequences were performed. 3D CISS sequence (field of view (FOV) 180×180 mm, slice thickness 0.7 mm, time of repetition/time of echo (TR/TE) 11.46/5.73 s, matrix 192×256 , 80° flip angle, 0.7×0.7 mm in-plane resolution, scan time 6 min 56 s) was acquired in axial plane. The 3D CISS data were reformatted with a 3D multiplanar reconstruction (MPR) technique to generate axial images and oblique sagittal images parallel to the parotid duct. HASTE sequence (FOV 160×160 mm, slice thickness 30 mm, TR/TE 2800/460 s, Time of Inversion (TI) 280 s, matrix 256×256 , 180° flip angle, single slice, scan time 0.03 s) was obtained in sagittal oblique direction parallel to the parotid duct. Contrast was not administered. All patients underwent conventional sialography under digital fluoroscopic monitoring on Siemens Axiom Iconos R200 (Digital Spot Imaging 1000 MA, Erlangen,

Germany) radiographic system. 2 ml–4 ml of non-ionic contrast (iohexol containing 300 mg iodine per ml) was injected under fluoroscopic guidance until optimal visualization of intra and extraglandular ducts were achieved. As soon as pain occurred, the injection was stopped immediately.

Both conventional subtraction and MR sialograms were interpreted by experienced radiologists (AS for conventional sialography, RS for MR sialography) without having knowledge of the results of the other examination at the time of image interpretation. Clinical information was available during the interpretation of MR and conventional sialogram. The source images, together with maximum intensity projection (MIP) and MPR, were analysed.

The radiologists evaluated the size, signal intensity of the gland and focal intraparotid/extraparotid focal cystic lesion. On the MR sialography sequences, status of the main and intraglandular ducts and communication of the cyst and ductal system was evaluated. The ductal system and communication between the cyst and ducts were studied on conventional sialography. The radiologists assessed the adequacy of visualization of the duct proximal to the cyst using the following scale: 0 = not adequately visualized; 1 = adequately visualized. Additional information provided by MR sialography over conventional sialography was also evaluated.

Results

Six patients (four men and two women) were diagnosed as having an iatrogenic sialocyst (Table 1). The causes of the sialocyst were sialodochotomy for calculus at punctum ($n = 2$) and incision and drainage of parotid abscess ($n = 4$). Mean duration of symptoms was 6.6 months (range 3–12 months). All six patients had undergone aspiration of the sialocyst, which revealed an elevated amylase level.

Conventional sialography and MR sialography findings are summarized in Table 2. MRI examinations were well tolerated by all six patients. On MR sialography images, saliva manifested very high signal intensity, whereas the normal salivary gland had low signal intensity. Therefore, the intraglandular salivary ductal system was depicted as having hyperintense ramifications on the axial and sagittal oblique reconstruction images. The main duct and intraglandular branches up to second order branching were well depicted in all patients on MR sialography, whereas conventional sialography allowed visualization up to fourth order branching in two patients. In four cases, the ductal system proximal to the cyst was not opacified on conventional sialography (score 0) but was well visualized in all cases by MR sialography (score 1). MR sialography demonstrated the site of communication of the sialocyst with the ductal system in all six patients. MRI provided additional information over

Table 1 The clinical profile, aetiology and duration of symptoms of iatrogenic sialocyst ($n = 6$)

Case no.	Age/sex	Side of involvement	Aetiology	Duration of symptoms (in months)
1	16/M	LT	Incision & drainage of parotid abscess (I & D)	6
2	29/M	RT	Sialodochotomy (calculus at punctum)	4
3	18/M	RT	Sialodochotomy (calculus at punctum)	8
4	21/F	LT	I & D	12
5	35/F	RT	I & D	3
6	32/M	LT	I & D	5

LT, left; RT, right

conventional sialography in five cases. CISS sequence demonstrated the intraglandular ducts and communication of cysts with ducts better than HASTE images. However, the main duct was demonstrated by both HASTE and sagittal-obliquely reconstructed CISS images.

In four patients, the cyst was extraparenchymal in communicating with the main duct. Sialocyst was intraparotid in two cases, communicating with the main duct and second-order intraglandular branches in one case each. Communication of the cyst with the ductal system was demonstrated in all six cases by both conventional and MR sialography. However, because of its cross-sectional ability, MR sialography was better than conventional sialography regarding the site of

communication in all six cases. MR sialography demonstrated the exact location, size of the sialocyst and its relationship with the surrounding structures in all six cases. In one case, MRI demonstrated the external salivary fistula which was not demonstrated on conventional sialography.

Axial T_2 weighted and CISS sequences demonstrated the exact location (intra/extraparenchymal, superficial/deep lobe) of the cyst and its relation to muscles and vessels. This information is important from a management point of view and is not provided by conventional sialography. In all our cases, occurrence of pain was the end point of the contrast injection. The average amount of contrast injected in our study was 3.6 ml (2 ml–6.2 ml).

Table 2 Conventional sialography and MR sialography findings of all six cases

Case no.	Conventional sialography	MR sialography	Additional information provided by MR sialography	Duct visualization proximal to the cystic lesion	
				Conventional sialography	MRI
1	Abrupt termination of intraglandular duct with small cavity communicating with intraglandular branches (Figure 1)	Cystic lesion involving superficial lobe of parotid gland communicating with second order intraglandular branches	Size and relationship of the cystic lesion with surrounding structures	1	1
2	Contrast-filled cavity communicating with distal third of main duct. Intraglandular branches are pruned suggestive of chronic sialadenitis (Figure 2)	Focal fusiform dilatation of the mid third of main duct overlying masseter muscle Parotid sialadenitis present	NIL	1	1
3	Contrast-filled cavity communicating with distal third of main duct. Intraglandular branches not opacified	Oval lobulated cystic lesion overlying masseter muscle communicating with dilated main duct	Visualization and status of the intraglandular branches	0	1
4	Abrupt termination of main parotid duct near hilum of the parotid gland	Cystic lesion anterior to superficial lobe of parotid communicating with intraglandular branches, external salivary fistula present. Left mandibular osteomyelitis present	Visualization of the cystic lesion Presence of external salivary fistula and intraglandular branches	0	1
5	Contrast-filled cavity communicating with main duct. Distal intraglandular branches not visualized	Cystic lesion in right parotid gland communicating with main duct	Visualization and status of the intraglandular branches	0	1
6	Contrast-filled cavity communicating with main duct. Distal intraglandular branches not visualized	Cyst overlying the masseter and communicating with main duct	Visualization and status of the intraglandular branches	0	1

Duct proximal to the cyst using the following scale: 0 = not adequately visualized; 1 = adequately visualized. NIL, none

Case illustration: Case one

A 16-year-old male presented with progressively increasing swelling in the left parotid region following incision and drainage of a parotid abscess 6 months previously. The patient noted swelling in the left preauricular region on post-operative day 15. Pressure dressing and repeated aspirations were done at an outside institution without much relief. He then presented to our institution. On examination there was a 3 × 4 cm diffuse fluctuant non-tender swelling in the left preauricular region. Intraoral examination revealed a normal Stensen duct orifice with saliva coming out of the punctum. MRI and MR sialography were done and revealed a focal cystic lesion with areas of haemorrhage in the left parotid gland (Figure 1). Axial 3D-CISS MIP images demonstrated communication of the second-order ductal branches with focal intraparotid lesion. Subsequently, conventional sialography revealed abrupt cut-off of the intraglandular duct, which was suggestive of post-operative change and extravasation of contrast into a cavity. A diagnosis of parotid sialocoele was confirmed by aspiration of the cyst. The patient opted for surgical treatment and a total parotidectomy was performed.

A second case is illustrated in Figure 2.

Discussion

Stensen's duct injury is classified according to the anatomic site. Type A injuries are posterior to the masseter; type B injuries are over the muscle; and type C injuries are anterior to the masseter muscle. Type B and C injuries are more likely to develop during complications.

Differential diagnosis of sialocoele includes a retention cyst, sialodochitis, a branchial cleft cyst and a lymphoepithelial cyst. However, given a history of facial trauma or surgery, the diagnosis of a sialocoele can be made easily. In equivocal cases, an elevated amylase level in aspirate or imaging (sialography) can establish diagnosis. Imaging can confirm diagnosis in equivocal cases and can determine the site of ductal injury, size and location of the cyst. Cross-sectional imaging also determines the location and relationship of the lesion with respect to the facial nerve in cases of intraparotid sialocyst. Associated complications such as infection and haemorrhage in cysts can also be demonstrated.

Conventional sialography has been considered as the mainstay for diagnosis and evaluation of the sialocyst.^{3,8} Disadvantages of digital sialography include radiation exposure and pain during retrograde injection of contrast material. Failure to cannulate the ductal orifice may occur in the presence of scarring at the ductal orifice, with related oedema of the surrounding buccal mucosa. In cases of severe stenosis and transection of the duct, the upstream ductal system cannot be

evaluated. In addition, some authors have claimed that contrast injection during sialography may increase the pressure and subsequent rupture of the sialocyst.⁵

Ultrasonography, CT and MRI demonstrate the cystic nature of the lesion and status of the parotid parenchyma.^{3,8-10} However, these cannot be used to evaluate the ductal system of the salivary glands. Therefore, it appears desirable to use a less invasive yet reliable diagnostic modality for the diagnosis and evaluation of the sialocyst. MR sialography is a promising non-invasive tool for investigating the ductal system of major salivary glands.¹¹⁻¹⁶ We sought to evaluate the role of MR sialography by comparing this technique with the standard procedure of conventional sialography in patients with iatrogenic parotid sialocoele.

Lomas *et al*¹¹ described MR sialography using the single-shot rapid acquisition with relaxation enhancement (RARE) sequence. Since then MR sialography has been performed by various investigators using different sequences, such as modified RARE,¹¹ fast spin-echo,¹²⁻¹⁴ CISS¹⁵ and HASTE¹⁶ pulse sequences. In our study, the MR protocol included T_1 and T_2 weighted sequences, as well as HASTE and 3D CISS sequences. Axial T_1 and T_2 weighted sequences delineated the size and signal intensity of glandular parenchyma. Presence of focal intra/extraparenchymal cystic lesion, its relationship with muscles, nerves and internal content (haemorrhage or debris) were well demonstrated. Heavily T_2 weighted sequences demonstrated ductal anatomy, pathology and communication of the cyst with the ductal system.

This study shows the usefulness of MRI and MR sialography in the evaluation of iatrogenic sialocoele. MRI was particularly helpful in providing anatomic localization of the focal cystic lesions. MR sialography were superior to digital sialography in all six cases and demonstrated ductal anatomy, communication with the duct and intraparotid focal lesion better. MR sialography also revealed additional information in five cases and better visualization of the upstream portion of the salivary ducts in four cases. CISS sequences demonstrated the intraglandular ducts and communication of the cyst with ducts better than HASTE images. Since thick-slab HASTE projectional images were used, demonstration of communication with the ductal system was inferior with this sequence in comparison with CISS sequences. Our impression was that the additional cross-sectional images obtained using conventional T_1 and T_2 weighted sequences provided optimal assessment. The most obvious advantage of this technique is the fact that images can be obtained without the use of ionizing radiation and contrast material. Images can be obtained with the use of standard protocols and do not require an experienced examiner. Upstream ductal systems can also be visualized in cases of complete obstruction of the ductal system. In a previous report, Capaccio *et al*¹⁷ found that MR sialography is promising new diagnostic techniques for better non-invasive management of iatrogenic sialocysts.

Figure 1 (Case 1) A 16-year-old male presented with a progressively increasing swelling in the left parotid region following incision and drainage of a parotid abscess 6 months previously. Clinical photograph (a) shows a left preauricular swelling (arrow). Post-operative retroauricular scar is evident (arrowhead). Axial T_1 weighted image (b) shows a focal lesion seen involving the left parotid gland with areas of haemorrhage (black arrow). Axial three-dimensional constructive interference in steady state maximum intensity projection (3D-CISS MIP) images (c,d) demonstrate mild dilatation of the left parotid duct. Note the communication of the second-order branches with focal intraparotid lesion (arrowhead). Sagittal-oblique half-fourier acquisition single-shot turbo-spin echo (HASTE) image (e) shows areas of high signal intensity in the left parotid gland and a normal main duct. Communication of the intra-parotid focal lesion with ductal system is better demonstrated with CISS sequence. Lateral-oblique digital sialogram (f) shows abrupt cut-off of the intraglandular duct (arrow), suggestive of post-operative change and extravasation of contrast into a cavity (arrowhead). These findings are suggestive of a sialocyst

Figure 2 (Case 2) Axial T_2 weighted (a) images show focal fusiform dilatation of the distal third of the right main parotid duct (arrow). Right parotid gland is hypointense on T_1 weighted and hyperintense on T_2 weighted images. Sagittal-oblique three-dimensional constructive interference in steady state maximum intensity projection (3D-CISS MIP) (b) images clearly demonstrate the focal fusiform dilatation of the main parotid duct. Sagittal-oblique half-fourier acquisition single-shot turbo-spin echo (HASTE) image (c) shows cystic lesion in relation with main parotid duct. Lateral-oblique (d) digital sialogram show the cystic dilatation of the main duct (arrowhead) communicating with the remaining parotid duct system (arrow). These findings are suggestive of sialocyst

Visualization of third- and fourth-order branches were obtained only with conventional sialography because of its higher spatial resolution. However, all clinically relevant information was provided with MR sialography. Because we used saliva as a contrast material, intraductal filling of the ductal system was increased by stimulating salivation with lemon juice. MR sialography may, therefore, be limited in patients receiving botulinum toxin because sufficient saliva is necessary in the ductal system for their adequate delineation.

This study has several technical limitations. The main limitation was that the sialoendoscopy of the patients was not performed and thus there was no gold standard for confirmation of the findings. Capaccio *et al*¹⁸ evaluated three patients using MR sialography and sialoendoscopy. They concluded that MR sialography may be considered as a non-invasive method for the evaluation of the salivary duct disorders. Secondly, this was a study involving a relatively small number of cases

with iatrogenic sialocyst. Such small numbers presumably reflect the rarity of iatrogenic sialocyst. Although a statistical comparison of the difference in the sensitivity of HASTE and CISS sequence was not done, the opinion of the radiologist showed CISS sequence to be better than HASTE in the demonstration of intraglandular branches and communication with the ductal system.

Many sialocysts are transient and resolve spontaneously. Management options in persistent cases include aspiration with pressure dressings, total parotidectomy, low-dose radiation, anticholinergic drugs and subcutaneous botulinum toxin injection.^{2,19}

In conclusion, iatrogenic sialocyst is a rare indication for MR sialography; our preliminary results suggest that MR sialography demonstrates the ductal system up to second-order branches, site of ductal injury and focal cystic lesion. MRI provides the same or more information as conventional sialography in evaluation

of site of communication, but provides additional information about the upstream ductal system and the location of sialocyst and its relationship with

surrounding structures. Being a non-invasive modality, we recommend MR sialography as the investigation of choice in the evaluation of iatrogenic sialocyst.

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