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Original article

MR imaging following herniography in patients with unclear groin pain

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Abstract. The aims of the present study were to assess if MRI gives the same diagnostic information as herniography concerning the presence of hernias and reveals other causes of groin pain. The prospective study enrolled 20 patients referred for herniography, 6 women and 14 men, mean age 48 years. After herniography the patients underwent MRI using T1-weighted, fat-suppressed inversion recovery (STIR), and magnetic resonance cholangiopancreaticography (MRCP) pulse sequences. No contrast medium was administered at MRI. Herniography revealed 11 hernias and MRI depicted 8 of these. Magnetic resonance imaging depicted well the anatomy in the groins. In 3 patients where hernias were not revealed, MRI revealed inflammatory changes in the symphysis region as a possible cause of groin pain. The primary diagnostic tool for diagnosing hernias is herniography. If the herniogram is normal, MRI may reveal other causes of groin pain and may also better visualize related structures in the groin.

Key words: Herniography – MRI – Hernia – Groin pain

Introduction

Inguinal hernias are relatively common with an increasing incidence with age and more often affect men than women; however, in some patients the symptoms of groin pain and lump in the groin are not typical for a hernia, or the physical examination fails to reveal any pathology. In this group of patients with unclear groin pain herniography is often the primary radiologic method [1, 2]. In 2 of 3 the patients undergoing herniography a hernia cannot be revealed and there may be several other causes of groin pain, e.g. symphysitis and other conditions of musculoskeletal pathology, bursitis and ilioinguinal nerve entrapment [3, 4, 5]. Besides herniography there are studies advocating the use of ultrasound [6, 7] and ultrasound together with CT [8].

Magnetic resonance imaging (MRI) with modern systems suitable for imaging of the abdomen is becoming more widely available. Magnetic resonance imaging is generally a good method for visualization of musculoskeletal structures and may reveal the origin of the pain in the groin region [3, 5]. For inguinal hernia only studies which show clinically palpable hernias have been published thus far [9, 10]. In the present study the patients were referred for herniography because a hernia could not be revealed at clinical examination. As far as we know there is no study that has addressed this entity.

The aims of the present study were therefore to assess if MRI (a) can give the same diagnostic information as herniography concerning hernias and if MRCP pulse sequences could be used, (b) reveals causes for groin pain other than inguinal hernia, and (c) can visualize the anatomy in the groins.

Methods

Patients

Twenty patients referred for herniography, 6 women and 14 men, mean age 48 years, were enrolled in the prospective study. All patients gave their written consent. The study was approved by the Ethical Review Board at Lund University.

Herniography

The patients first underwent herniography procedure using a digital fluoroscopic system (Philips Multidiagnost 2, Eindhoven, The Netherlands). Fifty milliliters of iohexol at a concentration of 200 mg I/ml (Omni-

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Table 1. Pulse sequences used at MRI. *MRCP* magnetic resonance cholangiopancreatography; *HASTE* half-Fourier acquisition single-shot turbo spin-echo

	1	2	3	4[a]	5[a]
	T1-weighted spin echo	STIR	T1-weighted	MRCP HASTE	MRCP HASTE
TR (ms)	694	5100	178	2800	–
TE (ms)	12	30	4.1	1100	95
TI (ms)	–	150	–	–	–
Matrix	384 × 512	210 × 256	128 × 256	240 × 256	240 × 256
FOV (mm)	300	300	350	300	270
Slice thickness (mm)	5	4	6	70	4
Fat saturation	No	Yes	No	Yes	Yes
Slice direction	Axial and coronal	Axial and coronal	Axial	Coronal	Coronal
No. of slices	15	19	23	1	17
Acquisition time (min)	4.47	5.30	0.22	0.07	0.26
Breathhold	No	No	At Valsalva maneuver	Both at rest and at Valsalva maneuver	At Valsalva maneuver

[a] Pulse sequence originally intended for MRCP using half-Fourier acquisition single-shot turbo spin-echo

paque 200, Nycomed Amersham, Oslo, Norway) was injected with the patient lying in a supine position on the patient table. Herniograms were obtained while the patients were straining, in prone position and in oblique positions with the patient table raised 15° and with the patient in a standing position.

MRI

Immediately after the herniography, the patients were brought to the MRI unit and investigated with a 1.5-T system (Siemens Magnetom Vision, Siemens, Erlangen, Germany). A circularly polarized phased-array body coil was used. Magnetic resonance imaging was performed in prone position with arms raised. No contrast medium was administered. All patients received hyoscine butylbromide (Buscopan, Boehringer, Ingelheim, Germany) at a dose of 40 mg intramuscularly 5 min before the start of the examination to reduce motion artifacts from intestinal peristalsis. T1-weighted, fat-suppressed inversion recovery (STIR) pulse-sequences and pulse sequences originally intended for magnetic resonance cholangiopancreaticography (MRCP) were used (see Table 1). The total examination time for a patient was approximately 30 min including instructions and MR-system preparation.

Evaluation

Three experienced radiologists analyzed the examinations without blinding. The herniography was considered as gold standard for hernias. For other diagnoses at herniography and MRI, and for depicting the anatomy at MRI, the evaluation was obtained by consensus.

Results

Herniography depicted 11 hernias: 6 indirect (Fig. 1 a); 4 direct; and 1 femoral. Of these 11 hernias, 5 hernias in 5 patients were revealed on the contralateral side compared with the patients' symptom.

Magnetic resonance imaging depicted 8 of all 11 hernias (Figs. 1, 2; Table 2). Of the hernias not revealed at MRI, 1 patient did not manage to be positioned prone at MRI. In this patient bilateral hernias were shown at herniography, but in MRI a unilateral hernia was diagnosed. Diagnoses other than hernias revealed by herniography and MRI are listed in Table 2. Magnetic resonance imaging in 2 patients revealed inflammatory changes in the symphysis pubis (Fig. 3). In herniography in those 2 patients an irregular and sclerotic skeletal structure in connection with the symphysis was seen. In 1 patient MRI diagnosed a thickened superior ligament in the portion of the symphysis as a sign of early inflammatory changes.

For detecting hernias the MRCP pulse sequences gave images resembling the herniograms and was a compliment to the diagnosis (Fig. 1 e).

Magnetic resonance imaging depicted clearly the anatomy in the groins. In all patients the rectus abdominis musculature and femoral and inferior epigastric vessels were delineated, the inguinal ligament in 85% and in 75% the spermatic cord (in men) and the round ligament (in women), respectively (Fig. 4). In 20% of the patients the median and medial umbilical folds could be delineated. Neither the inguinal canal nor the internal or external opening of the same could be delineated.

One patient suffered from pain in conjunction with injection of the contrast medium at herniography. In this patient MRI revealed an area of high signal intensity in the left rectus muscle representing bleeding and/or local edema from contrast medium deposition intramuscularly (Fig. 5). One patient did not comply to be positioned in prone position but was examined in supine position.

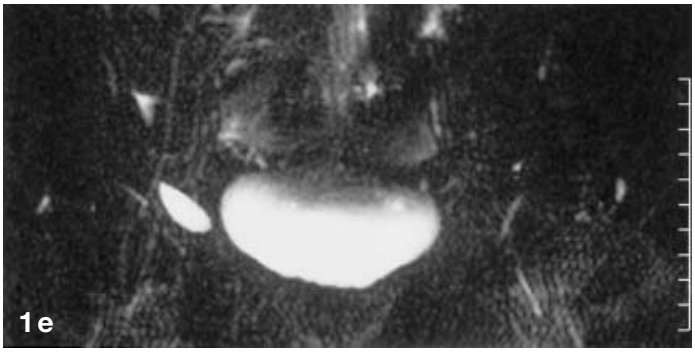

Fig. 1 a–e. Indirect right-sided hernia in a 66-year-old man. **a** Herniography; **b** T1-weighted axial MR image shows the hernia filled with fat *(arrow)*; **c** Fat-suppressed inversion recovery (STIR) image at the same level as **b** shows the hernia filled with fat *(arrow)*; **d** T1-weighted coronal MR image shows the hernia filled with fat *(arrow)*; **e** Magnetic resonance cholangiopancreaticography (MRCP) image resembles the herniography. Patient is in prone position

Fig. 2 a, b. Indirect left-sided hernia in a 56-year-old man. Lateral to the spermatic cord a small hernia filled with fat is detected. **a** T1-weighted axial MR image shows the hernia filled with fat *(arrow)*; **b** corresponding STIR image shows the hernia *(arrow)*. Patient is in prone position

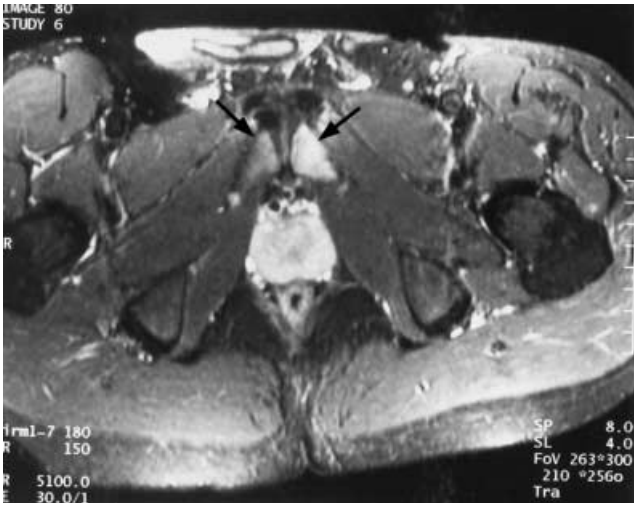

Fig. 3. Inflammatory changes in the symphysis pubis in a 34-year-old man. The STIR image shows high signal in the cancellous bone surrounding the symphysis *(arrows)*. Patient is in prone position

Table 2. Number of hernias and other pathologic findings revealed by both modalities, herniography and MRI, and with either of the two modalities

Methods	No. of hernias	Pathology other than hernia revealed
Both herniography and MRI	8	3[a]
Herniography only	3	0
MRI only	0	2[b]

[a] Two patients with symphysitis and one with osteoarthritis in the right hip

[b] One patient with contrast deposition in the rectus musculature and one with thickened superior ligament in symphysis

Discussion

The majority of patients with inguinal hernias have a typical clinical history and at physical examination the hernia can be palpated. For these patients there is normally no need for an imaging method for confirming the diagnosis, but rather the patient is scheduled for an operation, presently often performed using a laparoscopic technique. However, in the present study patients with unclear groin pain were investigated and herniography is often the primary radiologic method [1, 2]. Besides herniography, there are studies advocating the use of ultrasound [6, 7]. Ultrasound may not only show a hernia but also other causes of groin pain such as hematomas, seroma, and inflammation in muscle insertions. Ultrasound together with CT is especially useful in ventral hernias [8]. A disadvantage of ultrasound is that the method is highly operator dependent and few radiologists are familiar with ultrasound in the groin regions.

Relatively few patients were examined in the present study, but the age and gender distributions are in accordance with the group of patients with inguinal hernias. In the 3 males with no hernias but changes in the symphysis pubis the ages were lower than average, 20, 26 and 41 years, respectively. They all had high physical activity, e. g., marathon runners, and were representatives of a group of patients where other causes than inguinal hernia often are the origin of groin pain [5]. A little higher incidence of hernias were revealed (11 of 20) than normally in a group of patients with unclear groin pain (approximately 1 of 3). We have no explanation for this, but it may be an incidental finding because the patient material was small.

Magnetic resonance imaging did not perform as well as herniography in revealing hernias. One major advantage of herniography is that the patient strains in a semierect and erect position. This cannot be accomplished in a normal solenoid superconducting MR system. The best compromise was to put the patient in a prone position. Most patients find it cumbersome to be positioned a longer period in prone position and 1 patient did not comply but was examined in supine position. In this patient bilateral inguinal hernias had been revealed at herniography, but only a unilateral hernia could be diagnosed at MRI. The three hernias not diagnosed at MRI were either small (two direct hernias that were 1.5 cm in length as measured at herniography) or was an indirect hernia with a narrow neck that on MRI could not be separated from the normal signal that originated from the vein plexus surrounding the spermatic cord. To diagnose larger hernias using MRI is in accordance with other studies where larger clinically palpable hernias could be detected [9, 10].

In 5 patients the herniography revealed five hernias on the contralateral side compared with the patients' symptom. In 2 of these 5 patients there were no hernia on the ipsilateral side showing that the patients' symptoms may be diffuse and hard to localize, or that the patient is suffering from pain of other origin and has asymptomatic hernias. Asymptomatic hernias are well known from previous studies [1].

Magnetic resonance imaging depicted well the anatomy of the groin. An advantage with MRI is that the content of the hernia can be evaluated. A hernia may reveal itself as a comparatively small finding on herniography as a result of fat in the sac. These hernias may give the patient symptoms and there is a risk that they will be underdiagnosed on herniography.

In the present study MRI in 2 patients revealed inflammatory changes in the symphysis pubis as a possible cause of groin pain. These findings presented as high signal on STIR images. On herniography symphysitis were suspected from irregular skeletal borders in the symphysis pubis borders. However, on plain radiography the activity of the condition cannot be evaluated and it may well be that changes in the skeleton can be a remnant of a previous injury. In sportsmen it is well known that symphysitis and other conditions of musculoskeletal pathology, bursitis and ilioinguinal nerve entrapment may be the origin of unclear groin pain [3, 4, 5]. Therefore, in younger patients with a negative herniography it is proper to proceed with further imaging methods to reveal the diagnosis. In 1 patient the only finding of symphysitis was a thickened superior liga-

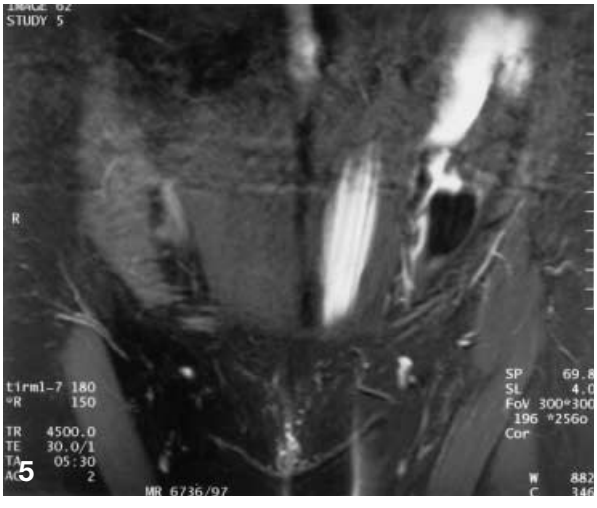

Fig. 4a–d. Anatomical structures shown at MRI. **a** T1-weighted coronal MR image shows inguinal ligaments *(arrows)*; **b** T1-weighted coronal MR image shows femoral vessels *(straight arrows)*, epigastric vessels *(arrowheads)*, and spermatic cords *(curved arrows)*; **c** The STIR image shows epigastric vessels *(arrowheads)* and spermatic cords *(curved arrows)*; **d** T1-weighted coronal MR image shows median umbilical fold *(arrow)* and medial umbilical fold *(arrowheads)*. Patient is in prone position

Fig. 5. A STIR image shows high signal in the rectus muscle after an inadvertent injection of contrast medium intramuscularly. Patient is in prone position

ment of symphysis pubis. In this patient herniography did not indicate the presence of an early symphysitis.

Magnetic resonance imaging was performed in prone position in direct conjunction with the herniography; therefore it cannot be excluded that the extra intrabdominal fluid from the radiographic contrast medium facilitated the possibilities to diagnose the hernias on MRI. Currently, we have only little experience in a few patients to diagnose a hernia on MRI without a preceding herniography as well as the performance of MRI if the patient is examined in the supine position.

A variety of pulse sequences were used in the study. The T1-weighted pulse sequence with 512 matrix gave excellent anatomical resolution in the groin region. The problems with respiratory artifacts in abdominal imaging are eliminated in the groin, especially when the patient is positioned prone. A significant characteristic of STIR images is very efficient fat suppression. In these images hernia and edema around the spermatic cord could be clearly detected. However, the anatomical resolution is not sufficient in the STIR images alone; hence, a combination with high-resolution T1-weighted images is optimal. In addition, on STIR images it is sometimes hard to separate high signal of lymph nodes from necks of hernias. The MRCP pulse sequences

gave images which resembled herniography and are attractive because the pulse sequences are fast and can therefore be acquired in both rest and at Valsalva maneuver. The T1-weighted breath-hold gradient-echo images were not found to contribute to the diagnosis in almost all cases. The reason was that the anatomical resolution was too poor.

Hyoscine butylbromide (Buscopan, Boehringer, Ingelheim, Germany) is routinely used in our department for abdominal MRI to reduce motion artifacts from the intestine. It is especially important when long pulse sequences are used as with the T1-weighted pulse sequence with 512 matrix in the present study.

One patient suffered from pain in conjunction with injection of the contrast medium at herniography. At MRI an area of high signal intensity was seen in the left rectus abdominis muscle, probably representing contrast medium deposition and/or bleeding.

Conclusion

Herniography is superior to MRI for diagnosing inguinal hernias and is the primary method for evaluation of patients with unclear groin pain. In younger patients who are physically active and where no hernia is revealed at herniography, MRI may reveal other pathologic findings including musculoskeletal abnormalities.

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