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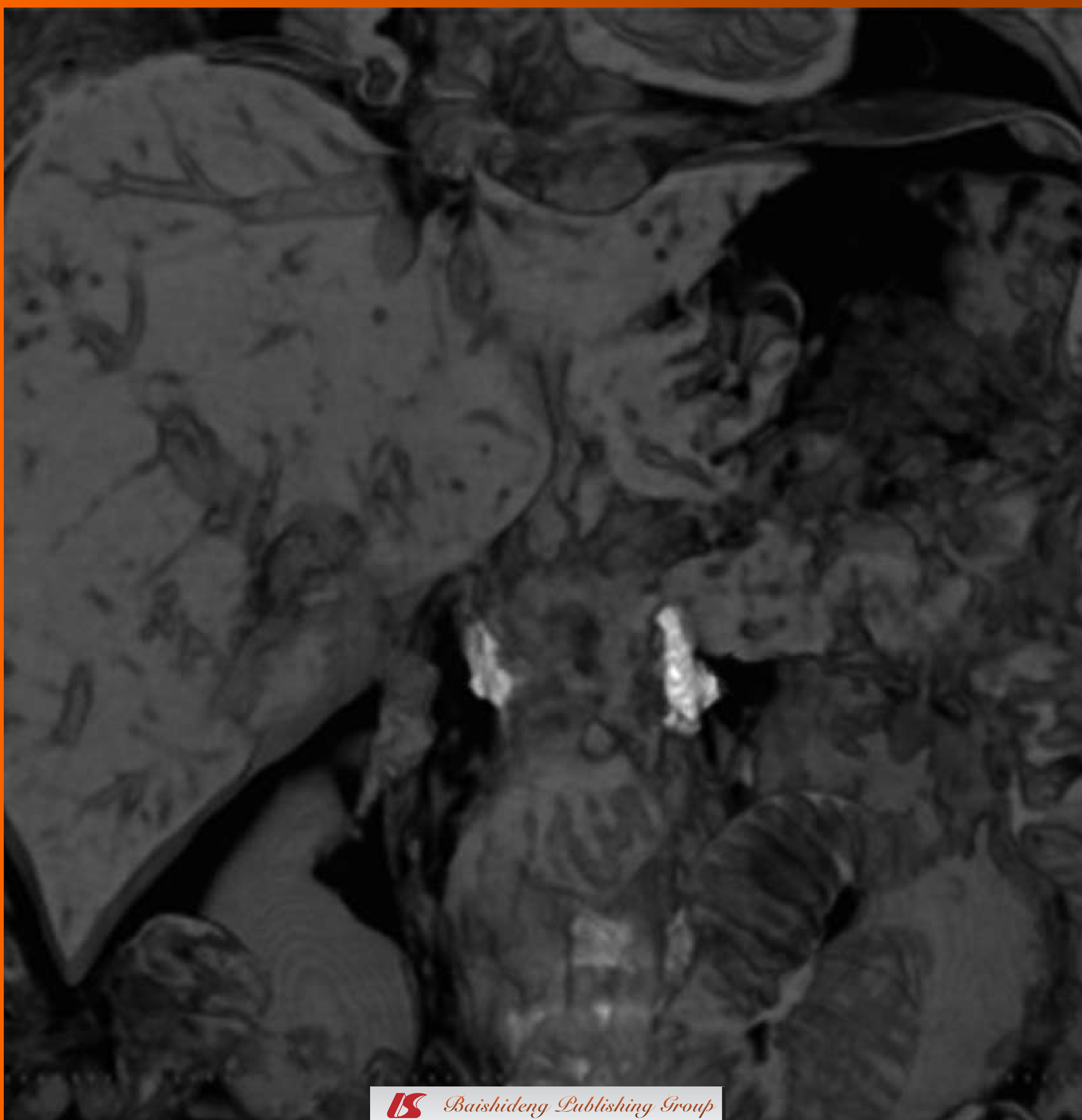

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REVIEW

Anatomy and imaging for pancreatic carcinoma invading the extrapancreatic neural plexus

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Abstract

Pancreatic carcinoma is an extremely high-grade malignant tumor with fast development and high mortality. The incidence of pancreatic carcinoma continues to increase. Peripancreatic invasion and metastasis are the main characteristics and important prognostic factors in pancreatic carcinoma, especially invasion into the nervous system; pancreatic nerve innervation includes the intrapancreatic and extrapancreatic nerves. A strong grasp of pancreatic nerve innervation may contribute to our understanding of pancreatic pain modalities and the metastatic routes for pancreatic carcinomas. Computed tomography (CT) and magnetic resonance imaging (MRI) are helpful techniques for depicting the anatomy of extrapancreatic nerve innervation. The purpose of the present work is to show and describe the anatomy of the extrapancreatic neural plexus and to elucidate its characteristics using CT and MRI, drawing on our own previous work and the research findings of others.

Key words: Computed tomography; Magnetic resonance imaging; Extrapancreatic neural plexus

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INTRODUCTION

Pancreatic carcinoma is a type of tumor associated with high mortality, and even in the early stages, peripancreatic invasion and metastasis are observed[1,2]. The pattern of cancer invasion *via* neural routes (perineural invasion) has been studied extensively, and 53% to 100% of results have reported neural invasion in pancreatic carcinoma. The perineural invasion and the degree of perineural invasion, especially of the extrapancreatic neural plexus, can provide some useful information for planning surgery, and it has also been shown to be an important prognostic factor for pancreatic carcinoma by several studies[3-16]. The innervation of the pancreas is a very important factor in the progression of disease, primarily of the biliary tract and pancreas and in surgical procedures[3,6,11,16]. It is critical for the anatomy of the extrapancreatic innervation of the pancreas to be made clear. Several studies have offered descriptions of the innervation of the pancreas[3,17,18].

The major celiac ganglia are distributed around the pancreas, and its nerve fiber branches not only mediated effective internal and external secretion in the pancreas but are also related to abdominal algesia. Neurotropic growth is one of the important biological features of pancreatic carcinoma[19,20]. Extrapancreatic neural plexus invasion was not only the prognostic indicator of pancreatic carcinoma but also related to the retroperitoneum recurrence after operation[21]. For the relief of intractable epigastric and back pain caused by advanced pancreatic carcinoma or other advanced epigastric tumors, computed tomography (CT)-guided celiac plexus block was widely launched in clinics[22-25]. Therefore, to understand the celiac ganglia that are invaded by epigastric malignancy, improving the likelihood of success for celiac plexus block, reducing complications, and correctly identifying celiac ganglia are essential.

The development of modern imaging technology has permitted imaging of the extrapancreatic neural plexus[12,26,27].

ANATOMY OF EXTRAPANCREATIC NERVE PLEXUS

Innervation of the pancreas by the sympathetic division of the autonomic nervous system occurs *via* the splanchnic nerves, and innervation by the parasympathetic division occurs *via* the vagus nerve[28]. Both types of nerves are generally accompanied by blood vessels. Both nerve divisions contribute efferent (motor) fibers to the walls of the blood vessels, the pancreatic ducts, and the pancreatic acini and visceral afferent (pain) fibers. For vagal afferent innervation, the major portion descends in the gastroduodenal branch toward the duodenum, pancreas, and pylorus[29].

The abundance of nerve fibers and their encasement of the neural plexus of pancreas, which consists of the intrapancreas nerve interlaced with the extrapancreatic, and the peripancreatic and retroperitoneal distribution of many netlike nerve fibers are the main reasons that pancreatic carcinoma easily causes nerve invasion and metastasis. The extrapancreatic neural plexus has six parts[30,31], including the following.

The neural plexus of the pancreatic head

Concerning the innervation of the pancreas, Yoshioka *et al*[32] and Yi *et al*[3] explained that the plexus pancreaticus capitalis (PLX) could be divided into two parts, PLX-Ⅰ and -Ⅱ. The main routes for both of the nerves from the celiac plexus and the ganglia to the pancreas include two parts, one being the direct route from the celiac ganglia to the posterior surface of the head of the pancreas (PLX-Ⅰ) and the other route extending from the bilateral celiac ganglion to the left margin of the uncinate process, *via* the plexus, around the superior mesenteric artery (SMA) (PLX-Ⅱ)[1] (Figures 1 and 2). Yi *et al*[3] also reported that the plexus from the celiac plexus to the pancreas head was divided into the anterior hepatic plexus and the posterior hepatic plexus; the former ran along the common hepatic artery, and the latter ran below and behind the portal venous system. The PLX-Ⅰ represents approximately 20% of the fibers derived from the posterior hepatic plexus. The PLX-Ⅱ is the portion most often invaded by pancreatic carcinoma, and it is reported to be involved in 74%-90% of cases of pancreatic head carcinoma[4,33].

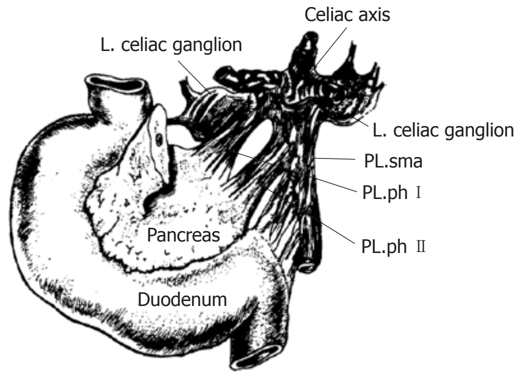

Figure 1 The anatomy of the extrapancreatic plexus. PL: Plexus; sma: Superior mesenteric artery; ph: Pancreatic head.

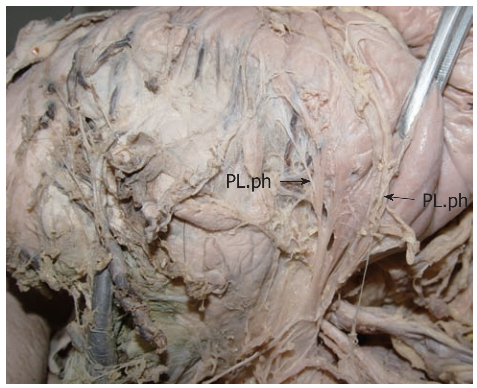

Figure 2 The anatomy of the pancreatic head plexus in a cadaver (arrows). The plexus extends from the celiac ganglia to the posterior surface of the head of the pancreas, the uncinate process. PL.ph: The plexus of the pancreatic head.

The celiac plexus

The celiac plexus is the center of the viscus and composed of celiac ganglia, several large and small nerves that terminate with the celiac ganglia, several nerve fibers that originate from the ganglia, and the abdominal branch of the posterior vagal trunk. The celiac plexus is located in front of the superior segment of the abdominal aorta, surrounding the celiac trunk and the root of the SMA[34,35] (Figure 3). At dissection, most of the celiac ganglia were between thoracic 12 and lumbar 1 (T12 and L1), and these ganglia were found in the upper part of the retroperitoneum, in front of the diaphragmatic crura, medial to the adrenal glands, and near the aorta between the origin of the celiac artery and the SMA[26] (Figures 4 and 5).

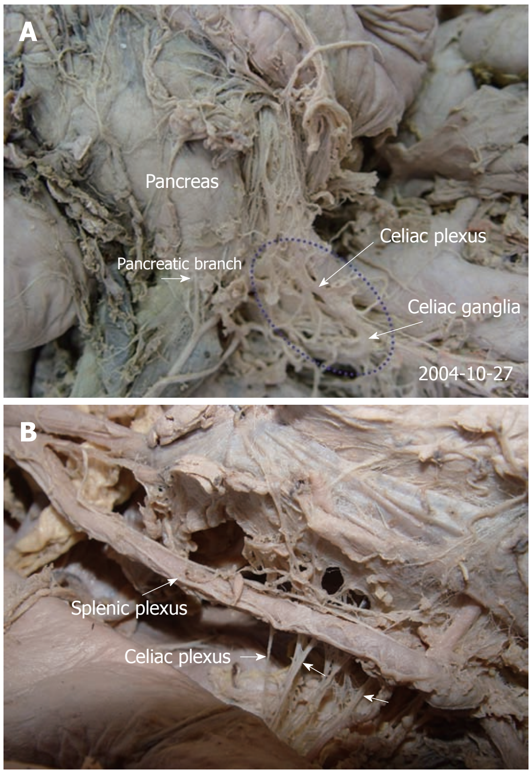

Figure 3 The anatomy of the celiac plexus in cadavers (A, B). The pancreas was moved upward. The pictures demonstrate that the celiac plexus is the center of the viscus and composed of the celiac ganglia and several large and small nerves that terminate with the celiac ganglia (arrows).

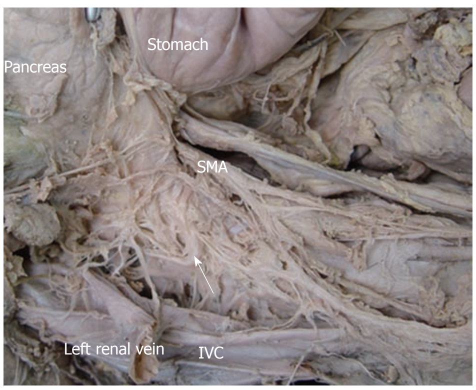

Figure 4 The anatomy of the celiac ganglia in a cadaver. The celiac ganglion (white arrows) was close to the aorta at a level intermediate to the origin of the celiac artery and superior to the mesenteric artery. It was located in the space bound by the inferior vena cava (IVC), the head of pancreas and the superior mesenteric artery (SMA). The pancreas was moved upward. The IVC was cut and moved laterally.

The plexus around the superior mesenteric artery

There are many pancreatic branches from the SMA to the right edge of incisure of the pancreas, the center and to the right of the region behind the head of pancreas, which bypass the dorsal mesentery (Figure 6).

The hepatic plexus

This route and its branches go from the liver to the back and superior borders of the pancreatic head along the common hepatic artery and proper hepatic artery (Figure 7).

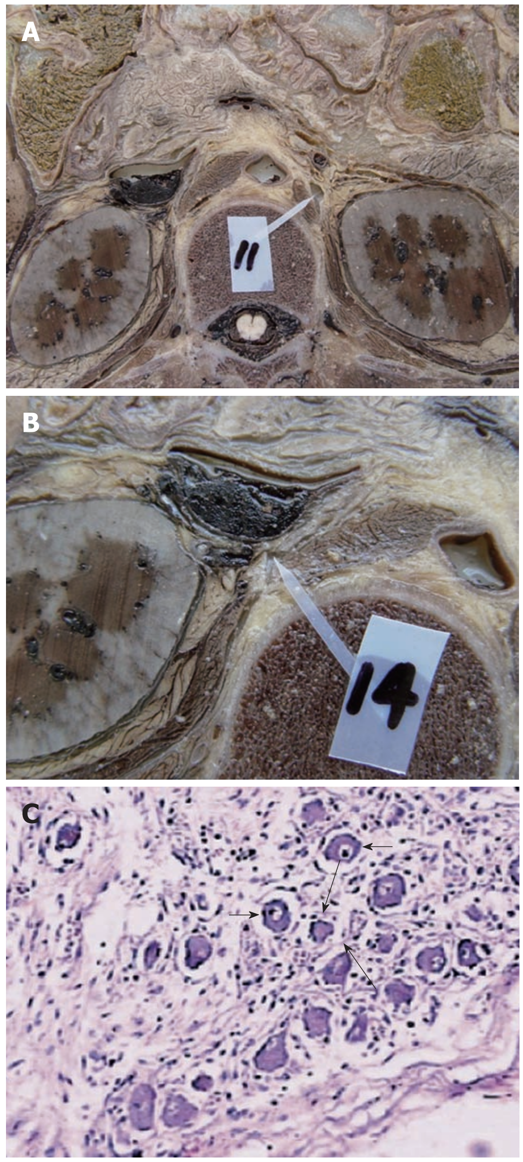

Figure 5 The dissection of the celiac ganglia in a cadaver at the L1 level. A: The left celiac ganglia; B: The right celiac ganglia; C: The histologic specimen stained with hematoxylin-eosin staining (× 100). With light microscopy, the celiac ganglion shows scattered ganglion cells (short arrows) and sparse nerve fibers (long arrows) among these ganglion cells.

The aortic plexus

This route and its branches travel around the aorta and extend to the head and uncinate process of the pancreas (Figure 8A).

The splenic plexus

This route travels along the splenic artery, and the main route and its branches reach the tail of the pancreas (Figure 8B).

CT FINDINGS OF EXTRAPANCREATIC NERVE PLEXUS

Multi-detector row CT allows thinner images (1.0 or 0.5 mm) to be reconstructed, enabling clear identification of the details of the pancreatic and peripancreatic anatomies[36].

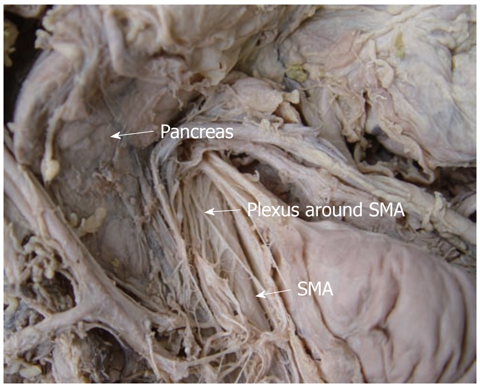

Figure 6 The anatomy of the plexus around the superior mesenteric artery in a cadaver. This route extends from the superior mesenteric artery (SMA) to the right edge of incisure of the pancreas.

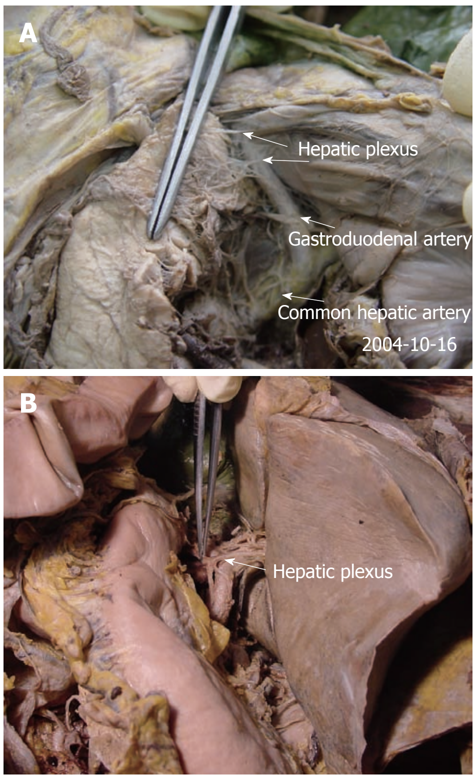

Figure 7 The anatomy of the hepatic plexus in cadavers (A, B). This route goes from the liver to the back and superior border of the pancreatic head, along the common hepatic and gastroduodenal artery (arrows).

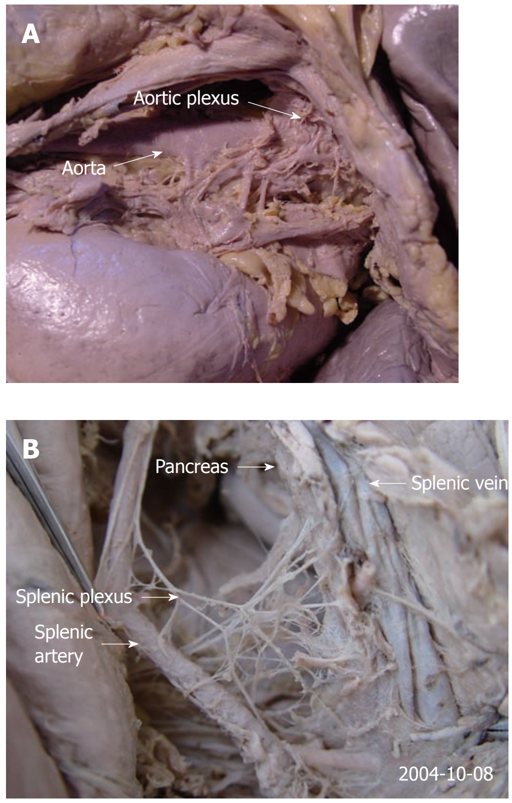

Figure 8 The anatomy of the aortic plexus in a cadaver. A: This route and its branches surround the aorta and extend to the head and uncinate process of the pancreas; B: The route travels along the splenic artery, and the main route and its many branches reach the tail of the pancreas.

The neural plexus of the pancreatic head can be demonstrated clearly with CT imaging (Figures 9 and 10), showing a characteristic strand-like structure (Figure 10). Dal Pozzo *et al*[37] performed CT at the level of the celiac trunk and the SMA to identify the celiac ganglia. The celiac ganglia appeared as small lines, oval or laminar structures lower in density than the diaphragm; some were the same density as the diaphragm. In cadavers, the celiac ganglia on CT thus indicated corresponded exactly-by position, morphology, and dimensions-to the anatomic structures previously described *in vivo* (Figures 11 and 12). Rathmell *et al*[38] report the anatomy of the celiac plexus block using CT. We performed CT scanning on six cadavers and found that all of the left celiac ganglia were satisfactorily observed, whereas five out of six of the right celiac ganglia were satisfactorily shown. All of the celiac ganglia in the 6 cadavers were located between T12- L1, and their morphology was primarily laminar. The appearance of the celiac ganglia was high density (Figure 11). In addition, we also observed celiac ganglion in normal adults using CT. We found that both sides of the ganglia were of moderate density, the same as the liver and spleen or slightly lower than the diaphragma crura, in 650 cases (Figure 12).

MR FINDINGS OF EXTRAPANCREATIC NERVE PLEXUS

We studied the magnetic resonance imaging (MRI) findings of the celiac ganglia in cadavers and found that MRI can show the celiac ganglia accurately when the ganglia are large and labeled with gadolinium. These findings in cadavers can be a reference for identifying the celiac ganglia *in vivo*[26] (Figure 13).

On MRI in cadavers, all of the right and left ganglia were identified and found to be hyperintense relative to the liver and spleen (Figure 13). Seventy-five percent (75%) of celiac ganglia were located at the level between the celiac artery and the SMA, in front of the diaphragmatic crura and close and medial to the aorta. Twenty-five percent (25%) of celiac ganglia were at the level of

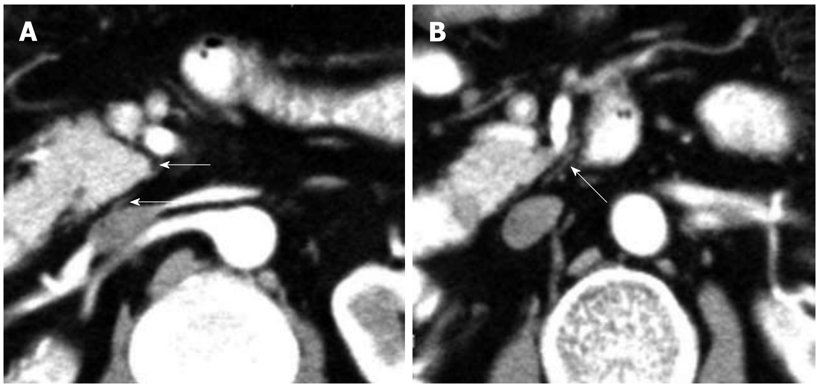

Figure 9 A contrast-enhanced computed tomography shows the plexus (PLX-Ⅱ) (A, B). The PLX-Ⅱ extends to the left margin of the uncinate process *via* the plexus surrounding the superior mesenteric artery (arrows).

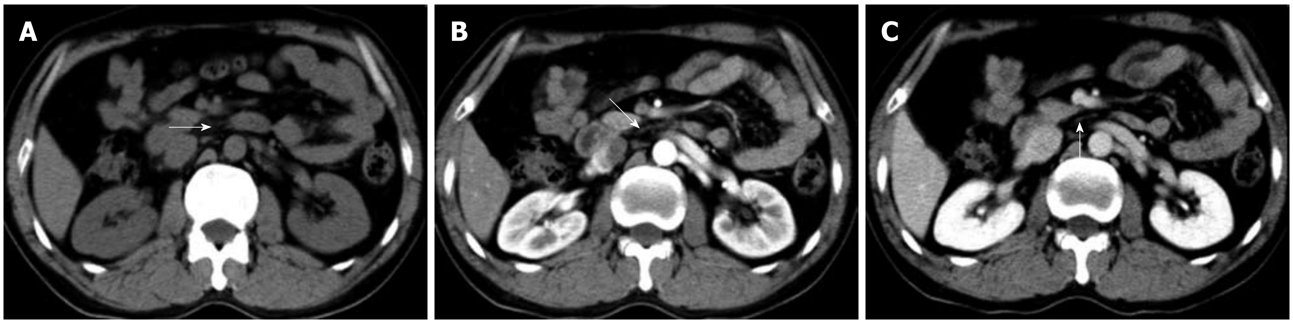

Figure 10 Non-enhanced computed tomography and contrast-enhanced computed tomography images show the neural plexus of the head of the pancreas (A-C). The plexus was a strand-like structure located in the area bound by the superior mesenteric artery, the inferior vena cava and the abdominal aorta (arrows).

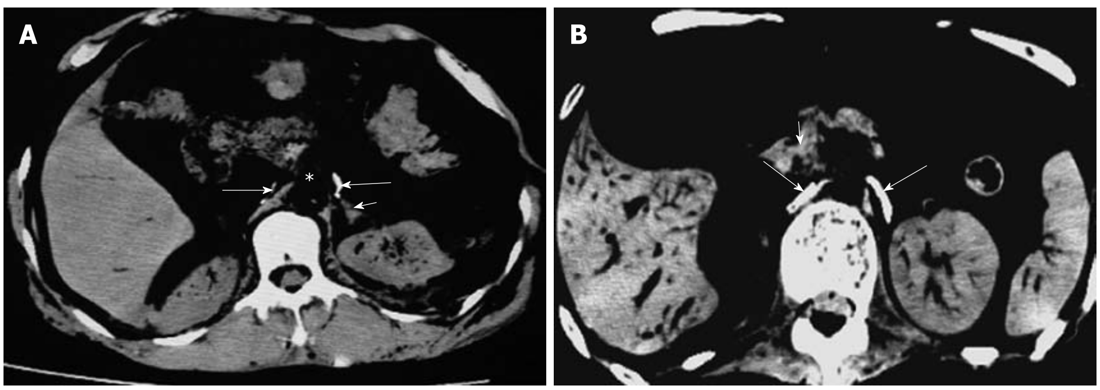

Figure 11 Computed tomography images of celiac ganglion in cadavers (labeled with contras media). The left was crescent-shaped and in front of the left adrenal gland, and the right was line-shaped and adjacent to the right crura of diaphragm (long arrows). Short arrows indicate left adrenal gland (A) and superior mesenteric artery (B).

the SMA. The celiac ganglion appeared lamina-shaped (85.38%), nodule-shaped (10%) and sickle-shaped (4.62%) (Figure 13). Both celiac ganglia were depicted at the same level on 83.33% of MRI images. Almost all celiac ganglia could be seen at the level of the pancreas. At the level of the head and body of the pancreas, the right (41.67%) and left (58.33%) celiac ganglia could be seen; at the level of the head of the pancreas, the right (25%) and left (16.67%) celiac ganglia could be seen; at the level of the body and tail of the pancreas, the right (33.33%) and the left (25%) celiac ganglia could be seen[26]. In healthy adults, the celiac ganglia characteristics were identical, in terms of position, morphology, and dimensions, to the anatomic structures previously described in cadavers. Most of the celiac ganglia were lamina- or line-shaped (Figures 13 and 14).

CONCLUSION

The anatomy of extrapancreatic neural plexus should be emphasized. The plexus includes six main parts, and the neural plexus of the pancreatic head is very important because it is easily invaded. These modern imaging techniques (CT and MRI) satisfactorily demonstrated the

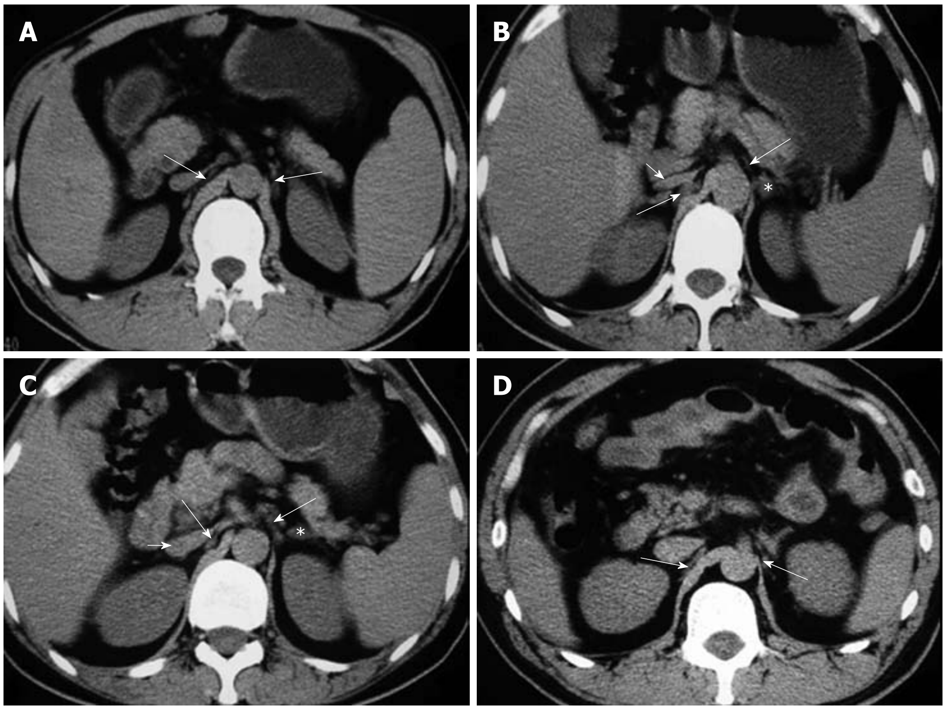

Figure 12 Computed tomography images show the celiac ganglia at different levels. A: A celiac ganglion (long arrows) at the root of the superior mesenteric artery; its density is the same as the liver and spleen or slightly less than the diaphragma crura; B: The celiac ganglia (long arrows) at the level of the pancreatic head and neck. The left celiac ganglia were lamina-shaped and located lengthwise in the space in the front of the left adrenal gland (*); the right celiac ganglia were a thick, line-shaped structure dorsal to the inferior vena cava (IVC) and lateral to the right diaphragma crura; C: A celiac ganglion (long arrows) at the level of the root of the celiac trunk. It appeared lamina- and nodule-shaped; D: The celiac ganglia (long arrows) at the level of the uncinate process, with well-defined margins. The left ganglia were lamina-shaped and located lengthwise in the space to the front and the left of the adrenal gland (*); the right ganglia were thick and line-shaped, located dorsal to the IVC and lateral to the right diaphragma crura. Short arrows indicate IVC (B, C).

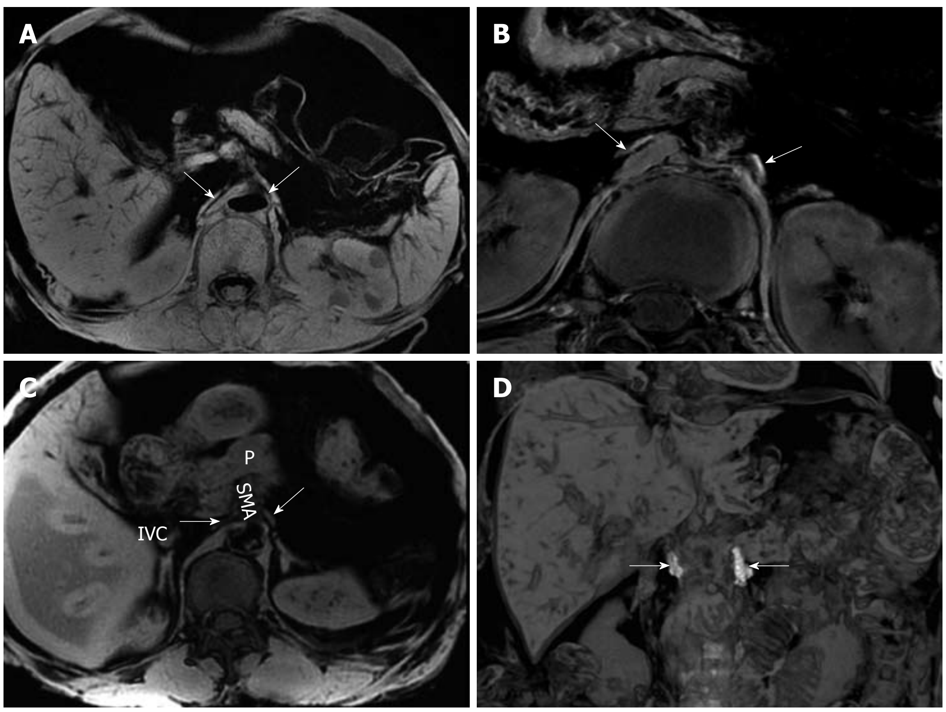

Figure 13 The celiac ganglia on an magnetic resonance imaging. A: A gradient-refocused-echo T1-weighted image shows that both the right and left celiac ganglia (arrows), labeled with Gd-DTPA, have a higher signal intensity than that of the viscus, such as the liver and spleen; B: 3D T1-weighted image shows that both the right and left celiac ganglia labeled with Gd-DTPA (arrows) have a higher signal intensity than the kidneys; C: A gradient-refocused-echo, T1-weighted, out-of-phase image shows the right and left celiac ganglia (labeled with arrows). The right celiac ganglion was located in the space formed by the inferior vena cava (IVC), right adrenal gland, right diaphragmatic crura, head of pancreas, and superior mesenteric artery (SMA). The left ganglion was located in the open space formed by the left adrenal gland, left diaphragmatic crura, and SMA. The celiac ganglia are labeled with gadolinium; D: Coronal imaging on T1-weighted images shows the celiac ganglia labeled with Gd-DTPA (arrows). P: Pancreas.

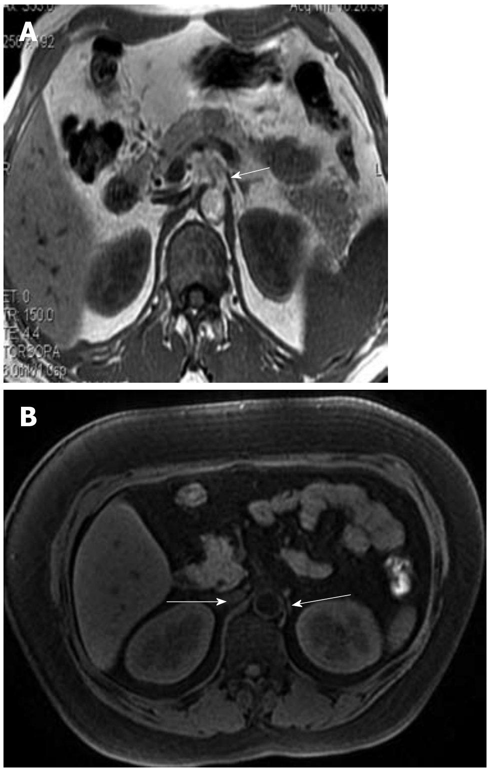

Figure 14 The magnetic resonance imagings of normal adults clearly show the celiac ganglia (A, B). Both celiac ganglia were seen at the level between the celiac artery and the superior mesenteric artery (arrows).

anatomy of the extrapancreatic nerve, which corresponded to the anatomy of the cadaver. The clear recognition and understanding of the innervation of the pancreas is necessary for surgical treatment of patients who have suffered nerve invasion by pancreatic carcinoma.

REFERENCES

1 **Tian H**, Mori H, Matsumoto S, Yamada Y, Kiyosue H, Ohta M, Kitano S. Extrapancreatic neural plexus invasion by carcinomas of the pancreatic head region: evaluation using thin-section helical CT. *Radiat Med* 2007; **25**: 141-147

2 **Takahashi T**, Ishikura H, Kato H, Tanabe T, Yoshiki T. Intra-pancreatic, extra-tumoral perineural invasion (nex). An indicator for the presence of retroperitoneal neural plexus invasion by pancreas carcinoma. *Acta Pathol Jpn* 1992; **42**: 99-103

3 **Yi SQ**, Miwa K, Ohta T, Kayahara M, Kitagawa H, Tanaka A, Shimokawa T, Akita K, Tanaka S. Innervation of the pancreas from the perspective of perineural invasion of pancreatic cancer. *Pancreas* 2003; **27**: 225-229

4 **Kayahara M**, Nagakawa T, Konishi I, Ueno K, Ohta T, Miyazaki I. Clinicopathological study of pancreatic carcinoma with particular reference to the invasion of the extrapancreatic neural plexus. *Int J Pancreatol* 1991; **10**: 105-111

5 **Kayahara M**, Nagakawa T, Tsukioka Y, Ohta T, Ueno K, Miyazaki I. Neural invasion and nodal involvement in distal bile duct cancer. *Hepatogastroenterology* 1994; **41**: 190-194

6 **Kayahara M**, Nagakawa T, Ueno K, Ohta T, Tsukioka Y, Miyazaki I. Surgical strategy for carcinoma of the pancreas head area based on clinicopathologic analysis of nodal involvement and plexus invasion. *Surgery* 1995; **117**: 616-623

7 **Kayahara M**, Nagakawa T, Futagami F, Kitagawa H, Ohta T, Miyazaki I. Lymphatic flow and neural plexus invasion associated with carcinoma of the body and tail of the pancreas. *Cancer* 1996; **78**: 2485-2491

8 **Nagakawa T**, Kayahara M, Ohta T, Ueno K, Konishi I, Miyazaki I. Patterns of neural and plexus invasion of human pancreatic cancer and experimental cancer. *Int J Pancreatol* 1991; **10**: 113-119

9 **Nagakawa T**, Mori K, Nakano T, Kadoya M, Kobayashi H, Akiyama T, Kayahara M, Ohta T, Ueno K, Higashino Y. Perineural invasion of carcinoma of the pancreas and biliary tract. *Br J Surg* 1993; **80**: 619-621

10 **Nakao A**, Harada A, Nonami T, Kaneko T, Nomoto S, Koyama H, Kanazumi N, Nakashima N, Takagi H. Lymph node metastasis in carcinoma of the body and tail of the pancreas. *Br J Surg* 1997; **84**: 1090-1092

11 **Ozaki H**, Hiraoka T, Mizumoto R, Matsuno S, Matsumoto Y, Nakayama T, Tsunoda T, Suzuki T, Monden M, Saitoh Y, Yamauchi H, Ogata Y. The prognostic significance of lymph node metastasis and intrapancreatic perineural invasion in pancreatic cancer after curative resection. *Surg Today* 1999; **29**: 16-22

12 **Ochotorena IJ**, Kiyosue H, Hori Y, Yokoyama S, Yoshida T, Mori H. The local spread of lower bile duct cancer: evaluation by thin-section helical CT. *Eur Radiol* 2000; **10**: 1106-1113

13 **Kaneko T**, Inoue S, Sugimoto H, Takeda S, Harada A, Nakao A. Intraoperative diagnosis of pancreatic cancer extension using IVUS. *Hepatogastroenterology* 2001; **48**: 944-948

14 **Nano M**, Lanfranco G, Ferronato M, Dal Corso H, Solej M. [Contribution to the study of innervation of the pancreas with a view to its relevance to neoplasm surgery]. *Chir Ital* 2001; **53**: 587-594

15 **Hirai I**, Kimura W, Ozawa K, Kudo S, Suto K, Kuzu H, Fuse A. Perineural invasion in pancreatic cancer. *Pancreas* 2002; **24**: 15-25

16 **Kimura W**, Watanabe T. [Anatomy of the pancreatic nerve plexuses and significance of their dissection]. *Nihon Geka Gakkai Zasshi* 2011; **112**: 170-176

17 **Mitchell GAG**. Anatomy of the autonomic nervous system. 1st ed. Edinburgh: Livingstone, 1953: 147-200

18 **Williams PL**, Bannister LH, Berry MM, Collins P, Dyson M, Dussek JE, Ferguson MWJ. Gray's Anatomy. 38th ed. Edinburgh: Churchill Livingstone, 1995: 1292-1312

19 **Makino I**, Kitagawa H, Ohta T, Nakagawara H, Tajima H, Ohnishi I, Takamura H, Tani T, Kayahara M. Nerve plexus invasion in pancreatic cancer: spread patterns on histopathologic and embryological analyses. *Pancreas* 2008; **37**: 358-365

20 **Mitsunaga S**, Hasebe T, Kinoshita T, Konishi M, Takahashi S, Gotohda N, Nakagohri T, Ochiai A. Detail histologic analysis of nerve plexus invasion in invasive ductal carcinoma of the pancreas and its prognostic impact. *Am J Surg Pathol* 2007; **31**: 1636-1644

21 **Zhang XM**, Mitchell DG, Byun JH, Verma SK, Bergin D, Witkiewicz A. MR imaging for predicting the recurrence of pancreatic carcinoma after surgical resection. *Eur J Radiol* 2010; **73**: 572-578

22 **Yang IY**, Oraee S, Viejo C, Stern H. Computed tomography celiac trunk topography relating to celiac plexus block. *Reg Anesth Pain Med* 2011; **36**: 21-25

23 **Garcia-Eroles X**, Mayoral V, Montero A, Serra J, Porta J. Celiac plexus block: a new technique using the left lateral approach. *Clin J Pain* 2007; **23**: 635-637

24 **Zhang CL**, Zhang TJ, Guo YN, Yang LQ, He MW, Shi JZ, Ni JX. Effect of neurolytic celiac plexus block guided by computerized tomography on pancreatic cancer pain. *Dig Dis Sci* 2008; **53**: 856-860

25 **Konan AV**, Rajhi H, Mnif N, Hamza R. [Treating pain related to inoperable pancreatic cancer in tropical areas: the advantage of CT-guided celiac plexus block and splanchnic nerves neurolysis]. *Sante* 2005; **15**: 105-107

26 **Zhang XM**, Zhao QH, Zeng NL, Cai CP, Xie XG, Li CJ, Liu

J, Zhou JY. The celiac ganglia: anatomic study using MRI in cadavers. *AJR Am J Roentgenol* 2006; **186**: 1520-1523
27 **Mochizuki K**, Gabata T, Kozaka K, Hattori Y, Zen Y, Kitagawa H, Kayahara M, Ohta T, Matsui O. MDCT findings of extrapancreatic nerve plexus invasion by pancreas head carcinoma: correlation with en bloc pathological specimens and diagnostic accuracy. *Eur Radiol* 2010; **20**: 1757-1767
28 **Teff KL**. Visceral nerves: vagal and sympathetic innervation. *JPEN J Parenter Enteral Nutr* 2008; **32**: 569-571
29 **Berthoud HR**. Anatomy and function of sensory hepatic nerves. *Anat Rec A Discov Mol Cell Evol Biol* 2004; **280**: 827-835
30 **Japan Pancreas Society**. The general rules of clinical and pathological management for carcinoma of the pancreas. 3rd ed. Tokyo: Kanehara Pubcomp, 1986: 35-37
31 **Kuroda A**, Nagai H. Surgical anatomy of the pancreas. In: Howard JM, Idezuki Y, Ihse I, Prinz RA, editors. Surgical diseases of the pancreas. 3rd ed. Baltimore: Williams and Wilkins, 1998: 11-21
32 **Yoshioka H**, Wakabayashi T. Therapeutic neurotomy on head of pancreas for relief of pain due to chronic pancreatitis; a new technical procedure and its results. *AMA Arch Surg* 1958; **76**: 546-554
33 **Kaneko T**, Nakao A, Inoue S, Nomoto S, Nagasaka T, Nakashima N, Harada A, Nonami T, Takagi H. Extrapancreatic nerve plexus invasion by carcinoma of the head of the pancreas. Diagnosis with intraportal endovascular ultrasonography. *Int J Pancreatol* 1996; **19**: 1-7
34 **Jin G**, Sugiyama M, Tuo H, Oki A, Abe N, Mori T, Masaki T, Fujioka Y, Atomi Y. Distribution of lymphatic vessels in the neural plexuses surrounding the superior mesenteric artery. *Pancreas* 2006; **32**: 62-66
35 **Liu B**, Lu KY. Neural invasion in pancreatic carcinoma. *Hepatobiliary Pancreat Dis Int* 2002; **1**: 469-476
36 **Prokesch RW**, Schima W, Chow LC, Jeffrey RB. Multidetector CT of pancreatic adenocarcinoma: diagnostic advances and therapeutic relevance. *Eur Radiol* 2003; **13**: 2147-2154
37 **Dal Pozzo G**, Bozza A, Fargnoli R, Brizzi E. CT identification of coeliac ganglia. *Eur J Radiol* 1985; **5**: 24-26
38 **Rathmell JP**, Gallant JM, Brown DL. Computed tomography and the anatomy of celiac plexus block. *Reg Anesth Pain Med* 2000; **25**: 411-416

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BRIEF ARTICLE

Health care reform in the USA: Recommendations from USA and non-USA radiologists

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Abstract

AIM: To compare the opinions and recommendations of imaging specialists from United States (USA) and non-USA developed nations for USA health care reform.

METHODS: A survey was emailed out to 18 imaging specialists from 17 non-USA developed nation countries and 14 radiologists within the USA regarding health care reform. The questionnaire contained the following questions: what are the strengths of your health care system, what problems are present in your nation's health care system, and what recommendations do you have for health care reform in the USA. USA and non-USA radiologists received the same questionnaire.

RESULTS: Strengths of the USA health care system include high quality care, autonomy, and access to timely care. Twelve of 14 (86%) USA radiologists identified medicolegal action as a major problem in their health care system and felt that medicolegal reform was a critical aspect of health care reform. None of the non-USA radiologists identified medicolegal aspects as a problem in their own country nor identified it as a subject for USA health care reform. Eleven of 14 (79%) USA radiologists and 16/18 (89%) non-USA radiologists identified universal health care coverage as an important recommendation for reform.

CONCLUSION: Without full universal coverage, meaningful health care reform will likely require medicolegal reform as an early and important aspect of improved and efficient health care.

Key words: Health Care Reform; Health Care Policy

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INTRODUCTION

Through the legislative process, a health care reform bill passed through the United States (USA) congress on March 23, 2010 marking an effort to improve the USA health care system. Although the bill does not cover 100% of USA citizens, it potentially represents a major advance in the American health care system[1]. Many challenges remain ahead, including refining major initiatives in the reform measures. Critical flaws in the USA health care system have been at least partly addressed in the bill, such as prohibiting denial of health care insurance for patients with pre-existing conditions and extending health care coverage for young adults on their parental insurance programs[2,3]. Since the changes have primarily focused on health insurance reform, many key aspects that may have an enormous impact on the health care system have not been adequately addressed, such as access to adequate health care and safety of delivered health care.

The intention of this current survey-based study is to perform a small scale preliminary study to allow radiologists who are both practicing in non-USA developed nations and in the USA to voice their concerns about their respective health care systems and to convey what they believe is essential to achieve meaningful health care reform in the USA.

MATERIALS AND METHODS

A survey on health care reform was emailed to 18 imaging specialists [17 radiologists, 1 cardiologist (Italy)] living in 17 developed nations, all with a universal health care system [Australia (2 radiologists), Austria, Belgium, Canada, Denmark, Germany, France, Ireland, Italy, Japan, Netherlands, Portugal, South Korea, Spain, Sweden, Switzerland, United Kingdom]. Findings from the survey administered to non-USA imaging specialists alone have been reported[4]. The identical survey was emailed to 14 USA radiologists located in the following states/districts (California, District of Columbia, Georgia, Florida, Illinois, Maryland, Nebraska, New York, North Carolina, Oregon, Pennsylvania). The survey asked: (1) what are the strengths of your health care system; (2) what problems are present in your nation's health care system; and (3) what recommendations do you have for the USA as it embarks upon health care reform.

The respondents were all acquaintances of the senior author on the study. No specific communications were held with the respondents by authors on this study to guide their responses, so that the information they provided could be considered unbiased by the authors.

The answers from all respondents were tabulated by one of the investigators. Descriptive statistical analysis was performed.

RESULTS

Strengths

All of the USA radiologists included in this survey praised the USA health care system for the high quality of care that is provided to patients nationwide. Eleven of 14 respondents (79%) felt that the high degree of innovation, research, and state-of-the-art technology provided in the USA makes the USA health care system one of the best health care systems worldwide. However, 3 of 14 (21%) respondents stated that access to state-of-the-art health care is dependent on adequate health insurance. This high technology-based quality of care that leads to outstanding health care comes with a cost; 7 of 14 (50%) respondents felt that this was a primary factor in the rising health care costs. Of the non-USA radiologists, 14 of 18 (77%) felt that despite offering universal health care coverage their nation was able to provide state-of-the-art health care.

Five USA respondents (36%) described access to timely care as a strength of the USA health care system. These five felt that one advantage that the USA health care system has over those countries that offer universal health care is the fast access to care, including medical appointments, imaging, and surgical interventions.

Patient autonomy was named by 4 of 14 (29%) USA respondents as a great strength of our USA health care system. One USA respondent felt that this autonomy comes at a high cost; an educated patient may demand to see subspecialists as opposed to a generalist or demand further work-up with expensive exams. The respondent stated that, while this free market environment inspires innovation, he believed that the cost of health care rises as a result.

Weaknesses

USA respondents overwhelmingly cited two weaknesses in the USA healthcare system: the current medicolegal environment and lack of universal insurance coverage. Twelve of 14 (86%) USA radiologists identified the current medicolegal environment as a critical short-coming in the USA health care system and an important reason for continuously rising healthcare costs in the US. These respondents felt that medical liability is unpredictable, often arbitrary, and a strong player in the over-utilization of tests. These 12 respondents questioned why medicolegal reform has not already been addressed at a national level given the long-standing and escalating problems with medical liability. Nine USA radiologists felt this was due to the lack of physician input in health care policy decisions. These opinions are in contrast to the non-USA imaging specialists, of whom none cited medicolegal concerns in their health care system or included medicolegal reform as a potential component to USA healthcare reform.

The second commonly cited weakness by the USA physicians [11/14 (79%)] is the lack of universal insurance coverage for USA citizens. In discussing this weakness, these USA respondents are critical of the for-profit companies that currently provide health care insurance. Ten (71%) of the respondents blamed the growing number of uninsured citizens on the insurance industry for setting limitations on who qualifies for healthcare policies and denying coverage for pre-existing conditions.

Recommendations

The two commonly cited recommendations stemmed from the cited major weaknesses of the USA health care system. First, the need for medicolegal reform was emphasized by 12/14 (86%) USA radiologists. Potential solutions include capping financial penalties and capping the financial award to attorneys, including physician representation in all medicolegal policy reform, and establishing an alternative to the medicolegal system, such as expert medical panels.

Second, 11 of 14 (79%) USA radiologists recommended universal health care as a critical part of health care reform; one respondent stated "failure to provide basic health care insurance to all citizens is an inexcusable moral failure". This mirrored recommendations by the non-USA radiologists; 16 of 18 (89%) non-USA respondents recommended that the USA move to a universal health care system. As part of the health care reform process, 8 of 14 (57%) USA respondents recognized the need to have more physician involvement in health care reform; 10 of 18 (56%) non-USA radiologists cited lack of physician representation as a limitation in their own systems.

DISCUSSION

Although there are many other health care providers who occupy important positions in the health care delivery system, physicians hold a key role: physicians are the primary managers in meeting patient health care needs. Acknowledging the importance of the role of physicians, governmental representatives have emphasized that new health care measures should not interfere with the physician-patient interaction. However, ironically, there is little representation by physicians in the health care reform discussion and legislation.

In this preliminary study, the imaging specialists praised the USA health care system for high quality and autonomy of care as well as access to timely care; nevertheless, the majority of respondents felt that lack of universal health care is a disservice to USA citizens. Additionally, respondents felt that our medicolegal practice in the USA is a costly short-coming that needs to be addressed during health care reform. This opinion is supported by a recent analysis by Price Waterhouse determined there was approximately $1 trillion in waste in the USA health care system with $200 billion attributable to defensive health care practice[5]. Similarly, Lubell reports, "Medical malpractice costs average about $55.6 billion annually, or 2.4% of annual health care spending"[6]. In reality, due to the pervasive nature of defensive health care practice, the real cost may be considerably larger.

There is a complex interplay between several factors that may account for the difference in perception between USA and non-USA radiologists in the need for medicolegal reform in their respective countries, including cultural differences amongst physicians, the public, physician-patient interaction, and differences in legal systems. However, it is notable that the great majority of USA radiologists in our study considered medicolegal reform an important goal, whereas none of the non-USA radiologists cited medicolegal issues as an important limitation in their own national health care systems. This raises the question of how did the USA system evolve so differently from other developed nations that medicolegal concerns should be perceived by radiologists to be an enormous impediment in the USA but not of any special concern in other developed countries?

In a prior study which evaluated Standard of Care in medicolegal practice, the authors postulate that in a non-universal coverage system, if a patient loses health insurance and has continued (often expensive) health care needs, that patient has essentially no option but to litigate against some party in order to get funds to continue to pay for their health care[7]. The obvious parties to litigate against are those with the greatest financial resources, which are often the health care providers and the hospitals involved. Thus, financial need likely represents one of the main drivers of litigious activity, even if the injured party feels that the health care providers are not responsible. We propose that the absence of a comprehensive and universal healthcare plan in the USA is one of the key factors related to the disproportionate degree of healthcare litigation. The disconnect between medicolegal practice and quality of health care is best expressed by studies that show that the USA has the greatest affliction of medicolegal action (including this current study)[8-13], while at the same time possessing the best-trained, best-qualified physicians, and the latest health care innovations and hospital systems[14,15]. However, universal health care systems have their own drawbacks, such as long wait times[4].

A down-side of a system that relies on litigation settlements to compensate for shortcomings in healthcare coverage is that a relatively small percentage of those injured are able to win a medicolegal case[16]. In addition, a confrontational culture develops mistrust in the doctor-patient relationships. A manifestation of this phenomenon may account for the pattern of practice referred to as "defensive medicine"; physicians feel compelled to perform additional tests and procedures, some of which increases cost and/or risk to the patient (for example, the over-utilization of CT)[17-21].

The major limitation of our study is the relatively small number of respondents included in this survey. As such, this study should be considered a preliminary investigation. We attempted to compensate for the low number of respondents by selecting for wide geographic variation within both the non-USA group (17 different countries) and the USA group (representation from states widely distributed). Furthermore, our finding that 86% of our USA respondent radiologists considered the current medicolegal environment as a major limitation in the American system concurs with an earlier survey of 1231 physicians, in which 91% of the responders stated that they believed physicians in the USA order excess tests for medicolegal reasons and not for patient care reasons[22]. In addition, all respondents were acquaintances with one of authors (RS). It would be of interest to carry out a large-scale survey to hundreds or thousands of radiologists across the US; however, this would require access to central databases and likely incentives for responses in order to achieve adequate response rates.

Health care reform should address the core issues of excessive medicolegal actions, relative to other countries. Increasing the number of individuals covered by health care, reduction in denials and improved long-term care coverage may decrease the number of patients who seek legal action. Meaningful medicolegal reform should have as overarching goals the reduction of defensive medical practices. It is our opinion that meaningful cost reductions can only occur if physicians do not work under the constant threat of litigation.

In summary, our small-scale study has described results from a survey administered to non-USA and USA radiologists, which mirror larger scale national surveys. Both groups separately considered that universal health care was important for health care reform in the US. Non-USA radiologists did not identify medicolegal issues as a drawback in their health care system, whereas the majority of USA radiologists did, indicating that this is perceived by healthcare providers to be a fundamental issue of the USA health care system that needs to be addressed within the healthcare reform process.

COMMENTS

Background

To compare the opinions and recommendations of imaging specialists from United States (USA) and non-USA developed nations for USA health care reform with the attempts to determine important factors in refining the USA health care system.

Research frontiers

The future delivery of health care is an important issue world wide. How best to allocate resources for this purpose remains an extremely controversial subject and one that is in need for quality research studies.

Innovations and breakthroughs

Without full universal coverage, meaningful health care reform will likely require medicolegal reform as an early and important aspect of improved and efficient health care.

Applications

This is an opportunity for radiologists in the USA and in non-USA countries to have their opinions heard regarding the state of health care and their recommendations for the delivery of future health care.

Peer review

This is a small scale survey-based study to allow radiologists who are both practicing in non-USA developed nations and in the USA to voice their concerns of their respective health care systems and to convey what they believe is essential to achieve meaningful health care reform in the USA. The results are interesting, with a large percentage of physicians surveyed stressing the need for medico legal reform.

REFERENCES

1 **Sommers BD**, Swartz K, Epstein A. Policy makers should prepare for major uncertainties in Medicaid enrollment, costs, and needs for physicians under health reform. *Health Aff* (Millwood) 2011; **30**: 2186-2193

2 **Collins SR**, Nicholson JL. Realizing health reform's potential: young adults and the Affordable Care Act of 2010. *Issue Brief* (Commonw Fund) 2010; **101**: 1-20

3 **Hall J**, Moore J. Realizing health reform's potential: Pre-Existing Condition Insurance Plans created by the Affordable Care Act of 2010. *Issue Brief* (Commonw Fund) 2010; **100**: 1-20

4 **Brubaker LM**, Picano E, Breen DJ, Marti-Bonmati L, Semelka RC. Health care systems of developed non-U.S. nations: strengths, weaknesses, and recommendations for the United States--observations from internationally recognized imaging specialists. *AJR Am J Roentgenol* 2011; **196**: W30-W36

5 **PriceWaterHouseCoopers' Health Research Institute.** The price of excess: Identifying waste in healthcare spending. 2008

6 **Lubell J**. Researchers peg malpractice costs at over $55 billion. ModernHealthcare.com. September 7, 2010. Available from: URL: http://www.modernhealthcare.com/article/20100907/NEWS/309039975. On December 13, 2010

7 **Semelka RC**, Ryan AF, Yonkers S, Braga L. Objective determination of standard of care: use of blind readings by external radiologists. *AJR Am J Roentgenol* 2010; **195**: 429-431

8 **Baicker K**, Fisher ES, Chandra A. Malpractice liability costs and the practice of medicine in the Medicare program. *Health Aff* (Millwood) 2007; **26**: 841-852

9 **Barringer PJ**, Studdert DM, Kachalia AB, Mello MM. Administrative compensation of medical injuries: a hardy perennial blooms again. *J Health Polit Policy Law* 2008; **33**: 725-760

10 **De Ville K**. Act first and look up the law afterward?: medical malpractice and the ethics of defensive medicine. *Theor Med Bioeth* 1998; **19**: 569-589

11 **Friedenberg RM**. Malpractice reform. *Radiology* 2004; **231**: 3-6

12 **Kessler DP**, Summerton N, Graham JR. Effects of the medical liability system in Australia, the UK, and the USA. *Lancet* 2006; **368**: 240-246

13 **Mello MM**, Brennan TA. The role of medical liability reform in federal health care reform. *N Engl J Med* 2009; **361**: 1-3

14 **Gatta G**, Capocaccia R, Coleman MP, Gloeckler Ries LA, Hakulinen T, Micheli A, Sant M, Verdecchia A, Berrino F. Toward a comparison of survival in American and European cancer patients. *Cancer* 2000; **89**: 893-900

15 **Coleman MP**, Quaresma M, Berrino F, Lutz JM, De Angelis R, Capocaccia R, Baili P, Rachet B, Gatta G, Hakulinen T, Micheli A, Sant M, Weir HK, Elwood JM, Tsukuma H, Koifman S, E Silva GA, Francisci S, Santaquilani M, Verdecchia A, Storm HH, Young JL. Cancer survival in five continents: a worldwide population-based study (CONCORD). *Lancet Oncol* 2008; **9**: 730-756

16 **Jena AB**, Seabury S, Lakdawalla D, Chandra A. Malpractice risk according to physician specialty. *N Engl J Med* 2011; **365**: 629-636

17 **Smith-Bindman R**. Is computed tomography safe? *N Engl J Med* 2010; **363**: 1-4

18 **Kassirer JP**. Our stubborn quest for diagnostic certainty. A cause of excessive testing. *N Engl J Med* 1989; **320**: 1489-1491

19 **Lauer MS**. Elements of danger--the case of medical imaging. *N Engl J Med* 2009; **361**: 841-843

20 **Hillman BJ**, Goldsmith JC. The uncritical use of high-tech medical imaging. *N Engl J Med* 2010; **363**: 4-6

21 **Hatch SO**. Invited commentary--it is time to address the costs of defensive medicine: comment on "physicians' views on defensive medicine: a national survey". *Arch Intern Med* 2010; **170**: 1083-1084

22 **Bishop TF**, Federman AD, Keyhani S. Physicians' views on defensive medicine: a national survey. *Arch Intern Med* 2010; **170**: 1081-1083

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BRIEF ARTICLE

Initial assessment of chest X-ray in thoracic trauma patients: Awareness of specific injuries

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Abstract

AIM: To compare the reported injuries on initial assessment of the chest X-ray (CXR) in thoracic trauma patients to a second read performed by a dedicated trauma radiologist.

METHODS: By retrospective analysis of a prospective database, 712 patients with an injury to the chest admitted to the University Medical Center Utrecht were studied. All patients with a CXR were included in the study. Every CXR was re-evaluated by a trauma radiologist, who was blinded for the initial results. The findings of the trauma radiologist regarding rib fractures, pneumothoraces, hemothoraces and lung contusions were compared with the initial reports from the trauma team, derived from the original patient files.

RESULTS: A total of 516 patients with both thorax trauma and an initial CXR were included in the study. After re-evaluation of the initial CXR significantly more lung contusions (53.3% *vs* 34.1%, $P < 0.001$), hemothoraces (17.8% *vs* 11.0%, $P < 0.001$) and pneumothoraces (34.4% *vs* 26.4%, $P < 0.001$) were detected. During initial assessment significantly more rib fractures were reported (69.8% *vs* 62.3%, $P < 0.001$).

CONCLUSION: During the initial assessment of a CXR from trauma patients in the emergency department, a significant number of treatment-dictating injuries are missed. More awareness for these specific injuries is needed.

Key words: Thoracic radiography; Rib fractures; Hemothorax; Pneumothorax; Pulmonary contusion

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INTRODUCTION

Chest X-ray (CXR) is the main modality in screening for and diagnosing thoracic injuries in trauma patients. It is considered as a primary initial diagnostic test. This modality is part of the advanced trauma life support work up[1] and it is widely available in hospitals. The CXR is used to visualize AO classified rib fractures, lung contusions, pneumothorax, and hemothorax. Apart from these, subcutaneous and mediastinal emphysema, diaphragmatic and aortic injury, fractures of the axial skeleton and malposition of tubes and catheters can also be evaluated. The CXR is a quick modality with a high diagnostic yield which is crucial in the early work up of trauma patients. Radiation exposure for the patient is minimal[2].

In common practice, the CXR undertaken in the emergency department is assessed by the trauma team, frequently by residents on call. Although the trauma team may have adequate interpretive skills, they do not routinely have the luxury of prolonged interpretation times and have to work under difficult conditions. Occult pneumothoraces can be missed in up to 76% of all seriously injured patients when CXRs are interpreted by a trauma team[3]. Potentially, the diagnostic performance of CXR might increase if a dedicated trauma radiologist could detect specific injuries not seen by the trauma team, during a second read.

The aim of the present study was to evaluate the reported injuries on initial assessment of the CXR in thoracic trauma patients by comparing with a double read performed by a dedicated trauma radiologist for rib fractures, pneumothorax, hemothorax and lung contusion.

MATERIALS AND METHODS

From the prospective trauma database of the University Medical Center Utrecht, all patients admitted to the Emergency Department of the University Medical Center Utrecht over a period of 5 years were evaluated. We retrospectively searched the database for thoracic trauma patients with a CXR.

The following pathologic entities were assessed on CXR: rib fractures, pneumothorax, hemothorax and lung contusion. The included patients were diagnosed with at least one of the assessed pathologic entities on the initial CXR.

The following factors were retrieved from the database: patients' age, sex, total hospital stay, intensive care unit (ICU) stay, thorax-related complications and mortality. For every patient, the initial reported findings of the admission CXR by the trauma team were placed in a database. All CXR were retrospectively assessed by a trauma radiologist (LB) blinded for clinical outcome and original report.

Statistical analysis

Statistical analyses were performed by using SPSS 15 (Version 15, for Windows, SPSS Inc., Chicago, IL, USA). Statistical testing was achieved using the McNemar test for related samples. Statistical significance was defined as P value < 0.05.

RESULTS

Demographics

Screening CXR was obtained in 516 patients. The study cohort had a median age of 43 years (range 1-92 years). The study population was predominately male: 375 males (73%) and 141 females. The median overall hospital length of stay was 23 d (range 1-257 d). Two hundred and seventy-one patients were admitted to the ICU; the median ICU stay was 8 d (range 1-198 d). Two hundred and thirty-three patients were ventilated; the median mechanical ventilation duration was 7 d (range 1-190 d). Demographic data are presented in Table 1.

Table 1 Patient demographics

Number of patients	516
Mean age (yr)	43
Sex of patient *n* (%)	
Male	375 (73)
Female	141 (27)
Days of hospital stay (median)	23
Patients in ICU *n* (%)	271 (53)
Median length of ICU stay (d)	8
Ventilated patients *n* (%)	233 (45)
Median duration of ventilation (d)	7
Mortality *n* (%)	52 (10)

ICU: Intensive care unit.

Rib fractures

Initial assessment of the CXR showed rib fractures in 69.8% of the patients. After a second read by the trauma radiologist, rib fractures were diagnosed in 62.3% of the patients (Figure 1A, $P < 0.001$). Initially, 7.4% of the patients were diagnosed with bilateral rib fractures and the range of number of rib fractures was 1-16. After assessment by the trauma radiologist, 7.6% of the patients showed bilateral rib fractures and the range was 1-14 ($P = 1.0$).

Pneumothorax

Initial CXR assessment by the trauma team revealed a pneumothorax in 26.4% of the patients. The trauma radiologist diagnosed a pneumothorax in 34.4% of the patients (Figure 1B, $P < 0.001$). Bilateral pneumothorax was initially seen in 3.5% of the patients; after assessment by the trauma radiologist in 2.8% of the patients ($P = 0.13$).

Hemothorax

Initial assessment of the CXR by the trauma team revealed hemothoraces in 11.0% of the thoracic trauma patients. After a second read by the dedicated trauma radiologist, hemothoraces were diagnosed in 17.8% of the patients (Figure 1C, $P < 0.001$). Initially, 1.0% of the patients were diagnosed with bilateral hemothoraces; after a second read by the dedicated trauma radiologist bilateral hemothoraces were seen in 0.8% of the patients ($P = 1.0$).

Lung contusion

Initial assessment of the CXR showed a lung contusion in 34.1% of the patients. After evaluation by the dedicated trauma radiologist, a lung contusion was seen in 53.3% of the patients (Figure 1D, $P < 0.001$).

DISCUSSION

This study demonstrates that there is a discrepancy between the initial assessment of the CXR in thoracic trauma patients by the trauma team and a second read by a dedicated trauma radiologist. During initial evaluation significantly more patients with rib fractures are diagnosed

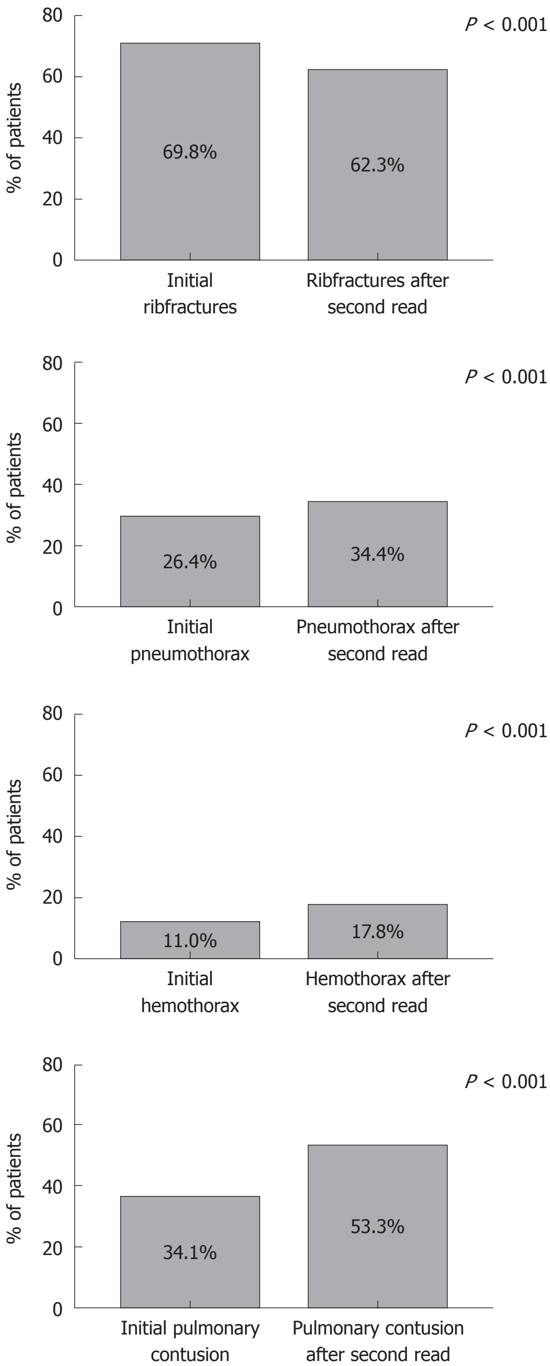

Figure 1 Percentage of patients initially diagnosed with rib fractures, pneumothoraces, hemothoraces and pulmonary contusion on chest X-ray and percentage of patients diagnosed after a second read by a dedicated radiologist. A:Rib fractures ; B:Paneumothoraces; C: Hemothoraces; D: Pulmonary contusion.

on CXR and during the second read significantly more pneumothoraces, hemothoraces and pulmonary contusions are seen.

Our results suggest that a second read by a dedicated trauma radiologist increases the diagnostic performance of CXR for these thoracic injuries. The enhanced diagnostic performance subsequently improves treatment of thoracic trauma patients since the injuries can be treated more adequately or can be monitored closely.

The cause of the missing injuries on radiographs during initial assessment by the trauma team, mostly residents, can be diverse. Ball *et al*[3] suggested that missed injuries were likely based on the difficult conditions in which the trauma team functions. They do not have prolonged interpretation times, a perfectly lit environment and premium digital monitors, which most radiologists benefit from. Other studies have compared the performance of residents in the interpretation of radiographs with that of a radiologist and found their performance suboptimal[4,5]. A combination of both factors could account for the discrepancy between the initial results and those obtained on second read by a trauma radiologist.

In this study, 7.5% more rib fractures were diagnosed during the initial assessment by the trauma team than during the second read by the dedicated trauma radiologist. The clinical value of a single rib fracture can be questioned. Indeed, multiple rib fractures and rib fractures in older patients require adequate patient management[6-10]. However, the prognosis of a patient with a single rib fracture is good if treatment consists of appropriate pain management and pulmonary rehabilitation[11,12].

Missed pneumothoraces on CXR are a known cause of preventable death, for which relatively simple interventions may be life-saving[13]. This study demonstrates that 8% more pneumothoraces can be detected on CXR during a second look by a dedicated trauma radiologist. Although a minor pneumothorax may not be clinically important initially, it can become a dangerous entity when trauma patients require positive-pressure mechanical ventilation or when patients are exposed to decreased atmospheric pressure during air transport. In the case of unawareness of this initially non-life threatening condition, there is an increased risk of adverse outcome during rapid progression to a tension pneumothorax[14,15]. Currently, there is an ongoing debate on observing all the occult pneumothorax without chest tube drainage[16-18] *vs* the standard treatment of placing thoracic drainage in every ventilated patient[1,19]. Either way, patients with an occult pneumothorax require additional observation, thus identification of this type of injury is essential.

This study demonstrates that 6.8% more hemothoraces can be detected after initial CXR during a second look by a dedicated trauma radiologist. In contrast to the extensive literature on occult pneumothoraces, little is known about the incidence of, and associated management outcomes of, occult hemothorax in thoracic trauma patients. Several studies suggest that small, isolated, occult hemothoraces can be observed without initial placement of a chest tube in the stable patient[20,21]. In our institute every patient with a hemothorax is treated with a chest tube. In both treatment strategies, it is clinically relevant to detect hemothoraces on CXR.

Pulmonary contusion is an independent risk factor for the development of acute respiratory distress syndrome (ARDS)[22,23]. Although fatal outcome of ARDS has declined over the last decade, ARDS still is one of the most serious thorax trauma-related complications with a mortality rate up to 20%-43%[24,25]. This study demonstrates that 19.2% more patients are diagnosed with pulmonary contusion on the initial CXR after a second read by a dedicated trauma radiologist, which is 19% higher than the initial assessment. These additional findings place the patients in a high-risk group for subsequent respiratory failure. These findings also have important implications on resource utilization such as admission to a monitored or intensive care unit bed.

Some limitations of this study should be acknowledged. This study was performed retrospectively which makes the results subject to bias. In an attempt to limit ascertainment bias, a single examiner performed all chart reviews. In addition, the dedicated trauma radiologist was blinded for the initial results from the CXR during the second read. Another potential limitation is the lack of control for interobserver or intraobserver variability in interpretation of the CXR findings. Brar *et al*[26] demonstrated that the inter- and intraobserver variability to detect occult pneumothoraces is moderate. Szucs-Farkas showed that the kappa agreement was 0.23 for detecting rib fractures on CXRs[27]. However, none of the studies differentiated between conventional reading of the X-ray and reading by a dedicated radiologist.

During the initial assessment of a CXR of thoracic trauma patients by the trauma team a significant number of thoracic injuries are missed. A second read by a trauma radiologist can improve the detection of these injuries. This conclusion translated into clinical practice: CXR in trauma patients - take a second look.

COMMENTS

Background

In common practice, the chest X-ray (CXR) of trauma patients in the emergency department is assessed by the trauma team, frequently by residents on call. Although the trauma team may have adequate interpretive skills, they do not routinely have the luxury of unrestricted interpretation times and have to work under difficult conditions.

Research frontiers

In the literature, little has been published on the difference in detecting injuries on a CXR by a dedicated radiologist and by a trauma team. This study shows how to focus on the detection of injuries on the routinely used CXR for patients in the emergency room.

Innovations and breakthroughs

There is an ongoing discussion regarding improving the detection of thoracic injuries by using a computed tomography (CT)-scan of the thorax instead of a CXR. However, the CT-scan is more expensive, not every trauma department is equipped with a CT-scanner in the trauma room and a CT-scan significantly increases the radiation dose of the patient. Few studies have focused on how to improve the detection rate of the conventional CXR.

Applications

A dedicated radiologist detects more pneumothoraces, hemothoraces and pulmonary contusions on a CXR than a conventional trauma team. One could consider adding a dedicated radiologist to the trauma team.

Peer review

The paper is well written with a clear hypothesis and study design, appropriate statistics and conclusions.

REFERENCES

1 **Kortbeek JB**, Al Turki SA, Ali J, Antoine JA, Bouillon B, Brasel K, Brenneman F, Brink PR, Brohi K, Burris D, Burton RA, Chapleau W, Cioffi W, Collet e Silva Fde S, Cooper A, Cortes JA, Eskesen V, Fildes J, Gautam S, Gruen RL, Gross R, Hansen KS, Henny W, Hollands MJ, Hunt RC, Jover Navalon JM, Kaufmann CR, Knudson P, Koestner A, Kosir R, Larsen CF, Livaudais W, Luchette F, Mao P, McVicker JH, Meredith JW, Mock C, Mori ND, Morrow C, Parks SN, Pereira PM, Pogetti RS, Ravn J, Rhee P, Salomone JP, Schipper IB, Schoettker P, Schreiber MA, Smith RS, Svendsen LB, Taha W, van Wijngaarden-Stephens M, Varga E, Voiglio EJ, Williams D, Winchell RJ, Winter R. Advanced trauma life support, 8th edition, the evidence for change. *J Trauma* 2008; **64**: 1638-1650

2 **Berrington de González A**, Darby S. Risk of cancer from diagnostic X-rays: estimates for the UK and 14 other countries. *Lancet* 2004; **363**: 345-351

3 **Ball CG**, Ranson K, Dente CJ, Feliciano DV, Laupland KB, Dyer D, Inaba K, Trottier V, Datta I, Kirkpatrick AW. Clinical predictors of occult pneumothoraces in severely injured blunt polytrauma patients: A prospective observational study. *Injury* 2009; **40**: 44-47

4 **Benger JR**, Lyburn ID. What is the effect of reporting all emergency department radiographs? *Emerg Med J* 2003; **20**: 40-43

5 **Perron AD**, Huff JS, Ullrich CG, Heafner MD, Kline JA. A multicenter study to improve emergency medicine residents' recognition of intracranial emergencies on computed tomography. *Ann Emerg Med* 1998; **32**: 554-562

6 **Bansidhar BJ**, Lagares-Garcia JA, Miller SL. Clinical rib fractures: are follow-up chest X-rays a waste of resources? *Am Surg* 2002; **68**: 449-453

7 **Holcomb JB**, McMullin NR, Kozar RA, Lygas MH, Moore FA. Morbidity from rib fractures increases after age 45. *J Am Coll Surg* 2003; **196**: 549-555

8 **Flagel BT**, Luchette FA, Reed RL, Esposito TJ, Davis KA, Santaniello JM, Gamelli RL. Half-a-dozen ribs: the breakpoint for mortality. *Surgery* 2005; **138**: 717-723; discussion 723-725

9 **Bulger EM**, Arneson MA, Mock CN, Jurkovich GJ. Rib fractures in the elderly. *J Trauma* 2000; **48**: 1040-1046; discussion 1046-1047

10 **Cameron P**, Dziukas L, Hadj A, Clark P, Hooper S. Rib fractures in major trauma. *Aust N Z J Surg* 1996; **66**: 530-534

11 **Gabram SG**, Schwartz RJ, Jacobs LM, Lawrence D, Murphy MA, Morrow JS, Hopkins JS, Knauft RF. Clinical management of blunt trauma patients with unilateral rib fractures: a randomized trial. *World J Surg* 1995; **19**: 388-393

12 **Kerr-Valentic MA**, Arthur M, Mullins RJ, Pearson TE, Mayberry JC. Rib fracture pain and disability: can we do better? *J Trauma* 2003; **54**: 1058-1063; discussion 1063-1064

13 **Stocchetti N**, Pagliarini G, Gennari M, Baldi G, Banchini E, Campari M, Bacchi M, Zuccoli P. Trauma care in Italy: evidence of in-hospital preventable deaths. *J Trauma* 1994; **36**: 401-405

14 **Baumann MH**, Sahn SA. Tension pneumothorax: diagnostic and therapeutic pitfalls. *Crit Care Med* 1993; **21**: 177-179

15 **Plewa MC**, Ledrick D, Sferra JJ. Delayed tension pneumothorax complicating central venous catheterization and positive pressure ventilation. *Am J Emerg Med* 1995; **13**: 532-535

16 **Barrios C**, Tran T, Malinoski D, Lekawa M, Dolich M, Lush S, Hoyt D, Cinat ME. Successful management of occult pneumothorax without tube thoracostomy despite positive pressure ventilation. *Am Surg* 2008; **74**: 958-961

17 **Collins JC**, Levine G, Waxman K. Occult traumatic pneumothorax: immediate tube thoracostomy versus expectant management. *Am Surg* 1992; **58**: 743-746

18 **Jenner R**, Sen A. Best evidence topic report. Chest drains in traumatic occult pneumothorax. *Emerg Med J* 2006; **23**: 138-139

19 **Enderson BL**, Abdalla R, Frame SB, Casey MT, Gould H, Maull KI. Tube thoracostomy for occult pneumothorax: a prospective randomized study of its use. *J Trauma* 1993; **35**:

726-729; discussion 729-730
20 **Bilello JF**, Davis JW, Lemaster DM. Occult traumatic hemothorax: when can sleeping dogs lie? *Am J Surg* 2005; **190**: 841-844
21 **Stafford RE**, Linn J, Washington L. Incidence and management of occult hemothoraces. *Am J Surg* 2006; **192**: 722-726
22 **Miller PR**, Croce MA, Kilgo PD, Scott J, Fabian TC. Acute respiratory distress syndrome in blunt trauma: identification of independent risk factors. *Am Surg* 2002; **68**: 845-850; discussion 850-851
23 **Wu JS**, Sheng L, Wang SH, Gu J, Ma YF, Zhang M, Gan JX, Xu SW, Zhou W, Xu SX, Li Q, Jiang GY. The impact of clinical risk factors in the conversion from acute lung injury to acute respiratory distress syndrome in severe multiple trauma patients. *J Int Med Res* 2008; **36**: 579-586
24 **Plurad D**, Martin M, Green D, Salim A, Inaba K, Belzberg H, Demetriades D, Rhee P. The decreasing incidence of late posttraumatic acute respiratory distress syndrome: the potential role of lung protective ventilation and conservative transfusion practice. *J Trauma* 2007; **63**: 1-7; discussion 8
25 **Zambon M**, Vincent JL. Mortality rates for patients with acute lung injury/ARDS have decreased over time. *Chest* 2008; **133**: 1120-1127
26 **Brar MS**, Bains I, Brunet G, Nicolaou S, Ball CG, Kirkpatrick AW. Occult pneumothoraces truly occult or simply missed: redux. *J Trauma* 2010; **69**: 1335-1337
27 **Szucs-Farkas Z**, Lautenschlager K, Flach PM, Ott D, Strautz T, Vock P, Ruder TD. Bone images from dual-energy subtraction chest radiography in the detection of rib fractures. *Eur J Radiol* 2011; **79**: e28-e32

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CASE REPORT

Primary lymphoma of the liver - A complex diagnosis

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Abstract

A 59-year-old woman presented with the clinical symptoms and radiologic investigations of a liver lesion suspect of metastasis. However, postoperative histopathology revealed a primary hepatic lymphoma (PHL). The case of a patient with a solitary PHL, which was treated by resection and subsequent chemotherapy, will be discussed with a short overview of the literature.

Key words: Primary; Hepatic; Lymphoma; Liver; Diagnosis; Computed tomography; Magnetic resonance imaging

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INTRODUCTION

Primary tumors of the liver are difficult to characterize and are frequently associated with a poor prognosis. Primary hepatic lymphoma (PHL) is a rare primary liver tumor. Due to its clinical and radiological resemblance to liver metastases of adenocarcinoma, PHL is frequently diagnosed intra- or post-operatively. Since chemotherapy is the treatment of first choice for lymphoma, adjuvant chemotherapy should be given to patients for optimal treatment[1]. The existing literature on PHL reveals the difficulties involved in diagnosis and treatment. Here we present a case of an immunocompetent patient with a large primary lymphoma of the liver. This case study can provide references for the diagnosis and treatment of patients suspected of having PHL. Due to the rarity of the disease controlled studies are lacking, thus the recommendations made are based almost completely on case reports.

CASE REPORT

A 59-year-old woman without prior medical history was referred to our clinic with a computed tomography (CT) confirmed 10 cm liver lesion. During the previous year she complained of fatigue and weight loss of 13 kg. Physical examination only indicated paleness. Lymph

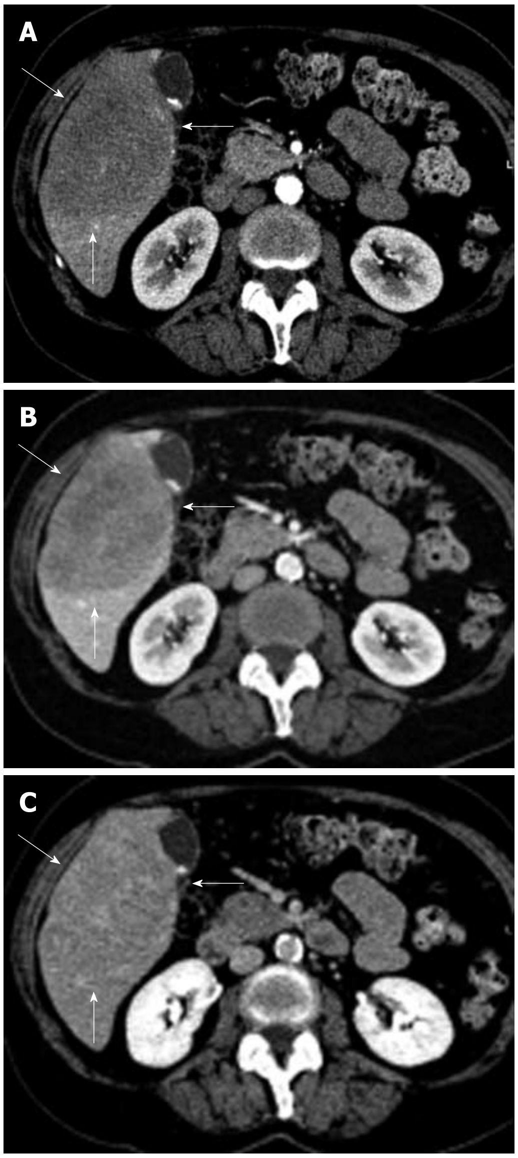

Figure 1 Radiological depiction of the liver lesion. Arterial (A), portal (B) and equilibrium phase (C) computed tomography scan with a large (10 cm × 8 cm × 7.5 cm) hypovascular lesion in segments V and VI of the liver with some inhomogeneity and without calcifications (lesion indicated by 3 white arrows).

nodes were not enlarged. Blood analysis revealed iron deficiency anemia and biliary obstruction. The tumor markers α fetoprotein, carcinoembryonic antigen, carbohydrate antigen and 5-hydroxyindoleacetic acid were not elevated.

No positive antigens to human immunodeficiency virus (HIV), Ebstein-Barr virus (EBV), cytomegalovirus, toxoplasmosis or hepatitis A, B, or C (hep A, B, C) were observed. Chest X-ray, gastric and colon endoscopy did not show any abnormalities. A 3-phase (arterial, portal/venous and equilibrium phase) iodinated contrast enhanced CT-scan (Siemens Somatom Sensation 10) revealed a 10 cm × 8 cm × 7.5 cm hypovascular, inhomogeneous lesion in segments V and VI of the liver without calcifications (Figure 1). Supplemental magnetic resonance imaging (MRI) (Philips Achieva 1.5 T), performed at our hospital, using gadolinium-EOB-DTPA (Primovist®; Bayer Schering) (Figure 2) confirmed the presence of a hypovascular, inhomogeneous solitary lesion, without contrast uptake in the hepatobiliary phase. The periphery of the lesion was accompanied by hyperattenuated regions in the arterial phase, some of which show diminished contrast uptake in the hepatobiliary phase. These findings suggest the radiological differential diagnosis of metastases of adeno- or squamous tumors or cholangiocarcinoma.

Treatment consisted of an *en-bloc* resection of tumor, gallbladder, and hepatoduodenal lymphadenectomy (Figure 3). Postoperative recovery was uncomplicated.

Histopathology revealed a diffuse, large B-cell, non-Hodgkin lymphoma (NHL) with negative surgical margins (Figure 4). Immunostaining of the tumor showed reactivity for CD45, CD20, CD79a, BCL6, MIB1 and BCl2. Postoperative investigations for disseminated NHL by CT scan, FDG-PET scan and bone marrow biopsy were negative. Adjuvant chemotherapy consisted of 6 cycles of cyclophosphamide, hydroxydaunorubicin (Adriamycin), oncovin (Vincristine), prednisone (CHOP) and rituximab.

During 24-mo follow-up our patient showed no symptoms or signs of recurrent disease.

DISCUSSION

PHL was first described in 1965 by Ata *el al*[2]. In 1986 Caccamo *et al*[3] defined PHL as a lymphoma localized and limited to the liver without extrahepatic involvement[3]. Symptoms should be explainable by involvement of the liver. Furthermore, superficial lymphadenopathy, splenomegaly, abnormal hematological parameters, spleen or bone marrow localization cannot be present for at least 6 mo after appearance of the hepatic lesion[3].

Primary hepatic NHL is very rare, only 0.016% of all NHL. Of all primary extranodal NHL only 0.4% arise in the liver[4]. 1.1% of all primary hepatic tumors in 30 years in the Johns Hopkins tumor registry consisted of PHL[5]. The incidence of hepatic involvement in NHL is described between 16% and 22%, stressing the importance of careful investigation to disseminated disease outside of the liver[6]. Associations in the literature have been made with HIV, hep B and C, EBV, liver cirrhosis, primary biliary cirrhosis, immunosuppressive therapy, and autoimmune disease. However, until now the pathogenesis of PHL is still unclear[7].

Clinical presentation of PHL is nonspecific. Most often fever, loss of weight and night sweats (also known as ‘B’ symptoms) occur. Alternative symptoms described are: right upper abdominal pain, epigastric pain, abdominal distension, nausea, vomiting, asthenia or itch. No specific physical complaints are typical for PHL. Abdominal pain, jaundice and hepatomegaly are the only physical findings described for various patients. Blood count can show abnormal aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, total and direct bilirubin and LDH[7]. Hypercalcemia and Bence Jones protein peak are rare but have been described[7].

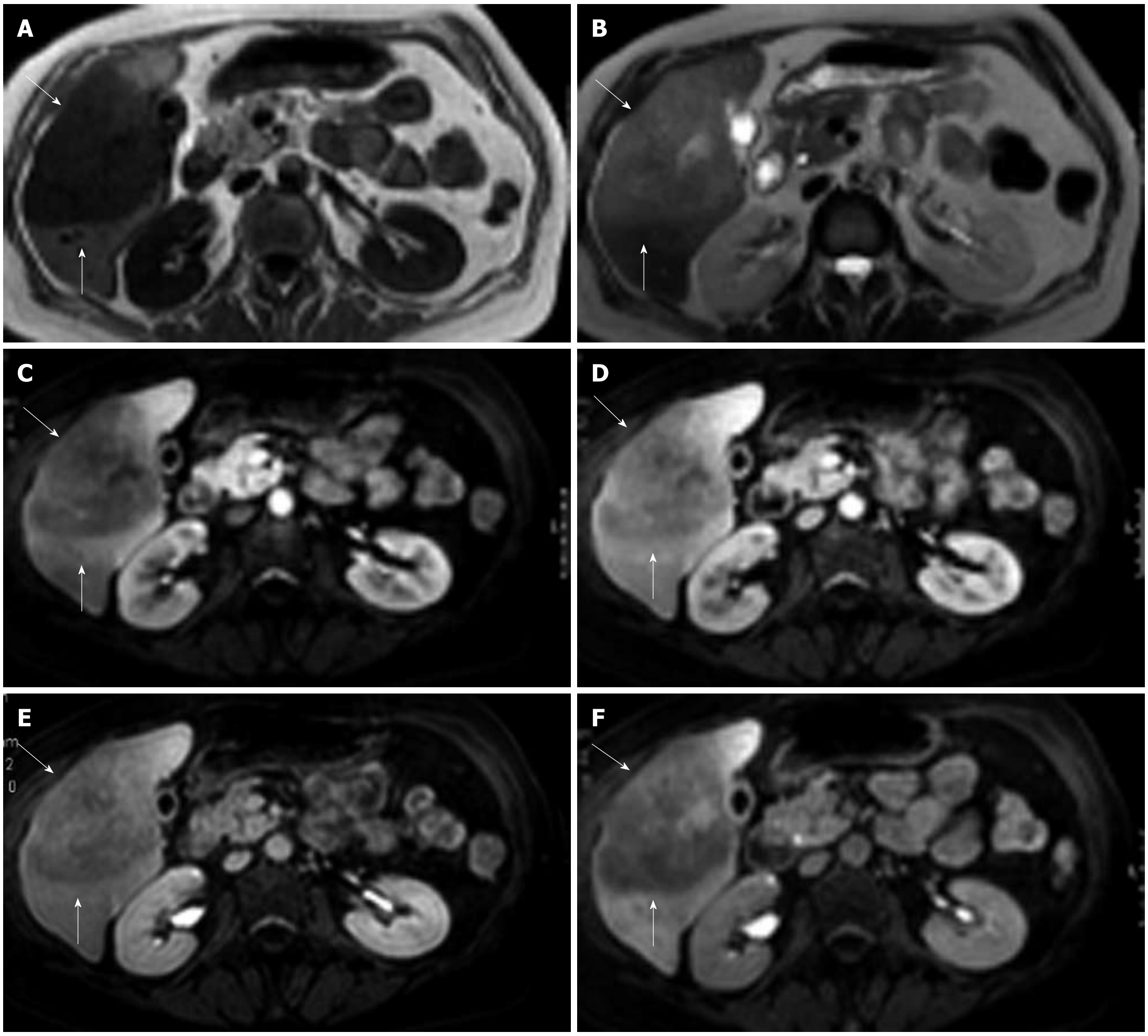

Figure 2 Magnetic resonance imaging showing a large, sharply demarcated lesion measuring 11 cm in the right liver lobe. The lesion is hypointense on T1 (A) and hyperintense on T2 (B) weighed images with slight inhomogeneity. Arterial (C), portal (D), equilibrium (E) and hepato-biliary (20 min) (F) phase magnetic resonance imaging after Gd-EOB-DTPA contrast enhancement reveal a hypovasular lesion without uptake in the hepato-biliary phase (lesion indicated by white arrows).

At initial presentation a third of patients present with a solitary liver nodule while another third have multiple lesions, and the remaining cases have diffuse infiltration of the liver[7]. Radiological investigation consists of an ultrasound of the liver, on which the tumor is hypo-attenuating or iso-attenuating[8]. On tri-phasic liver CT scan PHL usually presents itself as a hypodense lesion, with possible areas of inhomogeneity. Occasionally local areas of rim enhancement or calcifications may be seen[8]. On MRI, lesions tend to be hypointense compared to healthy liver parenchyma at T1, and have slight enhanced signal intensity on T2 weighed images. Hepato-biliary specific contrast does not show any enhancement of PHL either in the early dynamic or late hepato-biliary phase. This is similar for gadobenate and gadopentate dimeglumine[9].

The majority of PHL consist of B-cell NHL (63%) and T-cell lymphoma (25%)[10]. Diagnosis is often made upon histopathological investigation of the resection specimen. This is due to the hesitance in obtaining tissue biopsies of suspect liver lesions and risking needle track metastases[11,12]. Further differentiation can be done by immunohistochemical investigation[7,10]. The tumor has a nodular or diffuse growth pattern, in which the lymphoma cells expand into the liver parenchyma[13]. Tumor tissue consists of atypical cells with little basophilic cytoplasm, large vesicular nucleus, irregular nuclear membrane and often multiple prominent nucleoli[14].

Additional diagnostic methods could be flow cytometry, gene rearrangement and cytogenetic studies. However, the histopathology can vary considerably, complicating the diagnosis.

Chemotherapy is the recommended therapeutic treatment for all extranodal diffuse large B-cell lymphoma and T-cell lymphoma, making it the treatment of choice

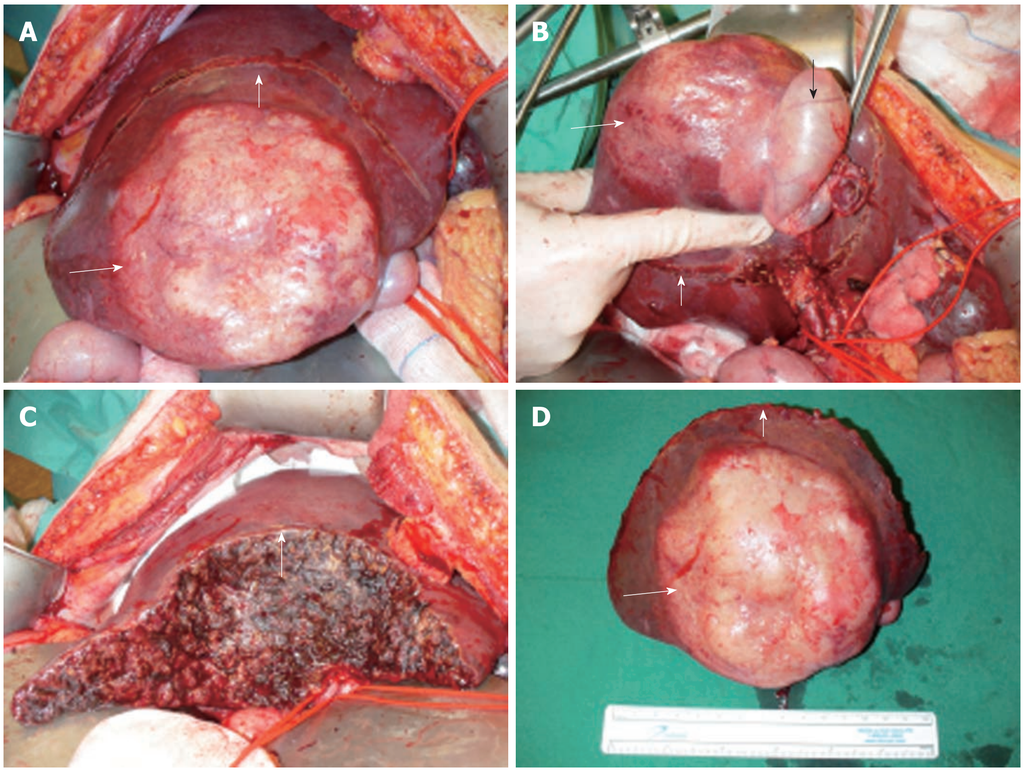

Figure 3 Intraoperative aspect of lesion. A: Tumor presentation intra-operatively; B: Tumor in segment V/VI of the liver with *en bloc* in the resection specimen the gall bladder (black arrow indicates gall bladder); C: Resection plane of the liver; D: Resection specimen with centrally white/yellow shiny tumor (small white arrow indicates resection plane, long white arrow indicates tumor).

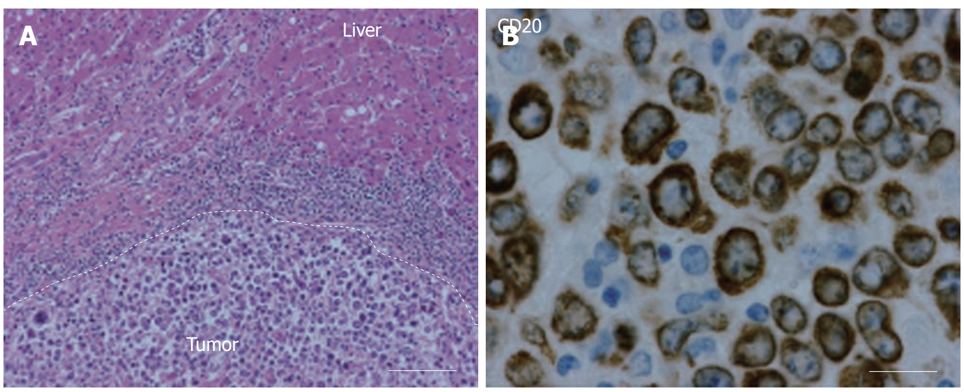

Figure 4 Histopathological results. A: Hematoxylin eosin staining (150 ×) shows a large cell malignancy with mostly loose tumor cells with nuclear polymorphism. Furthermore, frequent giant nuclear bodies with macro-nucleoli and numerous cell mitoses. No central necrosis is observed; B: A photomicrograph (400 ×) showing lymphocytic tumor cells which are positive for CD20 staining around the plasma membrane, indicating non-Hodgkin lymphoma of B-cell origin.

when PHL is diagnosed preoperatively[1]. Indications for surgical treatment are localized disease, which can be resected completely, or surgical debulking[10]. However, due to the radiological resemblance to liver metastases of adeno- or squamous carcinoma and the accompanying risk of needle track metastases from biopsies, most patients will be diagnosed after resection and will receive adjuvant chemotherapy[11,12].

Reports in literature discuss one or a combination of treatments. The lack of controlled studies, due to the low incidence of PHL, make well supported treatment recommendations based on available literature difficult.

Survival rates for PHL vary considerably among reported cases, largely depending on co-morbidity[7]. Page *et al*[15] discuss the 20-year experience of The University of Texas MD Anderson Cancer Center. Twenty-four cases with varying co-morbidity and treated only with chemotherapeutics resulted in an overall 5-year survival of 83%[15].

PHL is associated with a poor prognosis due to its aggressive nature and frequent severe co-morbidity. Of 72 PHL patients described in literature the median survival is only 15.3 mo. The co-morbidity, especially immunoincompetence, causes a large variation in survival of 3 to 123.6 mo[10]. Previous reports suggest an association between survival and histopathological subtype of the tumor, based upon analysis of case reports. Emile *et al*[16] show a significant difference between 1- and 3-year survival (70% and 57%) for nodular PHL and 1- and 3-year survival (38% and 18%) for diffuse PHL (P = 0.0033).

In conclusion, PHL is rare, occurring often in immunoincompetent patients. The presented case of PHL in an immunocompetent patient emphasizes the difficulties of diagnosing PHL and shows that PHL should be included in the differential diagnosis of solid, hypovascular liver lesions. Although the primary treatment should be chemotherapy, the current consensus not to take preoperative biopsies from solitary liver lesions, usually results in resection followed by chemotherapy as the most frequently performed treatment strategy.

REFERENCES

1 **Sehn LH**, Donaldson J, Chhanabhai M, Fitzgerald C, Gill K, Klasa R, MacPherson N, O'Reilly S, Spinelli JJ, Sutherland J, Wilson KS, Gascoyne RD, Connors JM. Introduction of combined CHOP plus rituximab therapy dramatically improved outcome of diffuse large B-cell lymphoma in British Columbia. *J Clin Oncol* 2005; **23**: 5027-5033

2 **Ata AA**, Kamel IA. Primary reticulum cell sarcoma of the liver. A case report. *J Egypt Med Assoc* 1965; **48**: 514-521

3 **Caccamo D**, Pervez NK, Marchevsky A. Primary lymphoma of the liver in the acquired immunodeficiency syndrome. *Arch Pathol Lab Med* 1986; **110**: 553-555

4 **Freeman C**, Berg JW, Cutler SJ. Occurrence and prognosis of extranodal lymphomas. *Cancer* 1972; **29**: 252-260

5 **Craig JR**, Peters RL, Edmondson HA. Tumors of the liver and intrahepatic bile ducts. 2nd Series. Washington, DC: Armed Forces Institute of Pathology, 1989: 244-246

6 **Civardi G**, Vallisa D, Bertè R, Lazzaro A, Moroni CF, Cavanna L. Focal liver lesions in non-Hodgkin's lymphoma: investigation of their prevalence, clinical significance and the role of Hepatitis C virus infection. *Eur J Cancer* 2002; **38**: 2382-2387

7 **Santos ES**, Raez LE, Salvatierra J, Morgensztern D, Shanmugan N, Neff GW. Primary hepatic non-Hodgkin's lymphomas: case report and review of the literature. *Am J Gastroenterol* 2003; **98**: 2789-2793

8 **Gazelle GS**, Lee MJ, Hahn PF, Goldberg MA, Rafaat N, Mueller PR. US, CT, and MRI of primary and secondary liver lymphoma. *J Comput Assist Tomogr* 1994; **18**: 412-415

9 **Maher MM**, McDermott SR, Fenlon HM, Conroy D, O'Keane JC, Carney DN, Stack JP. Imaging of primary non-Hodgkin's lymphoma of the liver. *Clin Radiol* 2001; **56**: 295-301

10 **Avlonitis VS**, Linos D. Primary hepatic lymphoma: a review. *Eur J Surg* 1999; **165**: 725-729

11 **Durand F**, Regimbeau JM, Belghiti J, Sauvanet A, Vilgrain V, Terris B, Moutardier V, Farges O, Valla D. Assessment of the benefits and risks of percutaneous biopsy before surgical resection of hepatocellular carcinoma. *J Hepatol* 2001; **35**: 254-258

12 **Rockey DC**, Caldwell SH, Goodman ZD, Nelson RC, Smith AD. Liver biopsy. *Hepatology* 2009; **49**: 1017-1044

13 **Noronha V**, Shafi NQ, Obando JA, Kummar S. Primary non-Hodgkin's lymphoma of the liver. *Crit Rev Oncol Hematol* 2005; **53**: 199-207

14 **Collins MH**, Orazi A, Bauman M, Vik T, West K, Heerema NA, Klatte E, Neiman RS. Primary hepatic B-cell lymphoma in a child. *Am J Surg Pathol* 1993; **17**: 1182-1186

15 **Page RD**, Romaguera JE, Osborne B, Medeiros LJ, Rodriguez J, North L, Sanz-Rodriguez C, Cabanillas F. Primary hepatic lymphoma: favorable outcome after combination chemotherapy. *Cancer* 2001; **92**: 2023-2029

16 **Emile JF**, Azoulay D, Gornet JM, Lopes G, Delvart V, Samuel D, Reynès M, Bismuth H, Goldwasser F. Primary non-Hodgkin's lymphomas of the liver with nodular and diffuse infiltration patterns have different prognoses. *Ann Oncol* 2001; **12**: 1005-1010

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CASE REPORT

Diagnostic challenge of lipomatous uterine tumors in three patients

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Abstract

Lipomatous uterine tumors are uncommon benign neoplasms, with incidence ranging from 0.03% to 0.2%. They can generally be subdivided into two types: pure or mixed lipomas. A third group of malignant neoplasm has been proposed, which is liposarcoma; however, this is very rare. In this article, we report three patients having lipomatous uterine tumors, including one uterine lipoma and two uterine lipoleiomyomas. All our patients are postmenopausal women, which is the typical presenting age group. They did not have any symptoms and the tumors were only found incidentally on imaging. However, in some patients, symptoms may uncommonly occur. If symptoms occur, these are similar to those of leiomyoma. We illustrate the imaging features of the tumors in our patients with ultrasound, computed tomography (CT) scan and magnetic resonance imaging (MRI). The tumor typically appears as a well-defined homogenously hyperechoic lesion on ultrasound. It shows fat density on CT scan and signal intensity of fat on MRI. MRI is the modality of choice because of its multiplanar capability and its ability to demonstrate fat component of the lesion, as illustrated in our cases. We also discuss the importance of differentiating lipomatous uterine tumors from other lesions, especially ovarian teratoma which requires surgical intervention. Despite the rarity and the common asymptomatic nature of the tumors, we believe that this series of three cases demonstrates a review of a rare tumor which provides important knowledge for patient management.

Key words: Uterus; Uterine neoplasms; Magnetic resonance imaging; Leiomyoma; Lipomatous

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INTRODUCTION

Lipomatous uterine tumors are rare benign uterine tumors, with only approximately 180 cases reported in the literature[1]. Although it is rare, correct diagnosis of lipomatous uterine tumor is important. Differentiation from other fat-containing tumors in the female pelvis, such as ovarian teratoma, may save a patient from unnecessary surgery[2,3]. We would like to present a series of three cases of these rare uterine tumors and provide a review of the imaging characteristics.

CASE REPORT

Case 1

A 79-year-old woman, with past medical history of diabe-

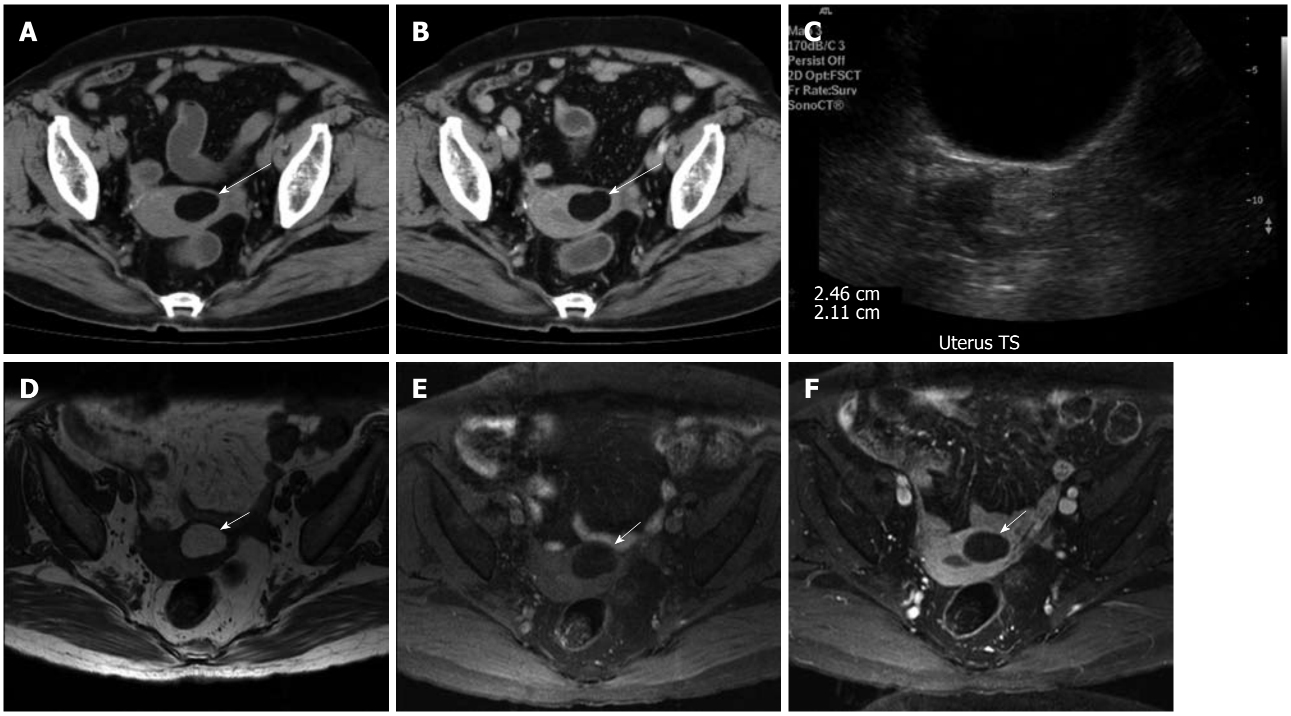

Figure 1 Computed tomography, ultrasound and magnetic resonance images of lipomatous uterine tumor in a 79-year-old woman. A and B: Computed tomography axial images of the pelvis without contrast (A) and with intravenous contrast (B) show a non-enhancing lesion in left side of the uterine fundus (long arrows); C: The density is similar to that of subcutaneous fat. Ultrasound of pelvis in transverse view shows a hyperechoic lesion (2.46 cm × 2.11 cm) in the uterine fundus; D: T1-weighted axial MRI image shows a homogeneous hyperintense lesion in left side of uterine fundus; E: The lesion shows complete suppression of signal intensity in T1-weighted fat-suppressed sequence, suggestive of fat component; F: No contrast enhancement is seen after intravenous gadolinium is administered. Compression of the uterine cavity is clearly demonstrated. Magnetic resonance imaging (MRI) images of the lesion (short arrows) (D-F).

tes mellitus, hypertension, presbyacusis, cholecystectomy and right Warthin's tumor which was being conservatively treated, complained of "on and off" abdominal pain. Mild splenomegaly was detected on ultrasound of the abdomen. A computed tomography scan was then performed in view of the splenomegaly. On computed tomography (CT) scan, hepatosplenomegaly, colonic polyp and a pancreatic tail tumor were found. Moreover, there was incidentally a well-defined mass of fat density (-82 HU units) arising from the wall of the uterine fundus (Figure 1A and B). The mass lesion showed no significant contrast enhancement. Distortion of the uterine cavity by the mass lesion was also noted. Intrauterine lipoma was the provisional diagnosis based on the CT findings.

Transabdominal sonography of the pelvis was performed and showed a well-defined echogenic lesion in the uterine fundus (Figure 1C). A better characterization of the tumor was noted on magnetic resonance imaging (MRI) (Figure 1D-F). The mass was found to be arising from the anterior wall of uterus. It appeared homogeneously hyperintense on T1- and T2-weighted images, with signal intensity similar to that of peritoneal fat. On fat-saturated images, complete suppression of the hyperintense signal of the lesion was noted. No contrast enhancing component was seen. Compression on the endometrial cavity by the mass lesion was also noted. Based on the imaging features, the final diagnosis was uterine lipoma.

The patient was followed up by a gynecologist for the uterine lipoma. Since the patient was asymptomatic, no surgery or biopsy of the mass lesion was performed. The patient is now being followed up by surgeons in view of CT scan findings of a pancreatic tail tumor and hepatosplenomegaly. The patient is now under conservative management for all her conditions. She has not had any symptoms during her 2 years of follow-up.

Case 2

A 61-year-old female patient, with past history of cholecystectomy, complained of intermittent abdominal pain for 2 years. Upper endoscopy and colonoscopy both showed no abnormality. A CT scan of the abdomen and pelvis was performed in view of chronic abdominal pain.

On the CT scan, a well-defined lesion of fat density with intralesional septa was incidentally found in the body of the uterus (Figure 2A). No intralesional calcification was seen. No other abnormality was noted in the rest of the abdomen and pelvis. A transabdominal ultrasound revealed a homogeneously hyperechoic lesion in the uterus. (Figure 2B).

MRI was subsequently performed to further characterize the lesion (Figure 2C-F). A well-defined T1 and T2 hyperintense lesion was seen in the uterine fundus. Intralesional septa were seen, which showed contrast enhancement. No solid component was seen in the lesion. The final diagnosis was uterine lipoleiomyoma.

The patient prefers conservative management and is now under follow up by a gynecologist. She remains asymptomatic 6 mo after the diagnosis.

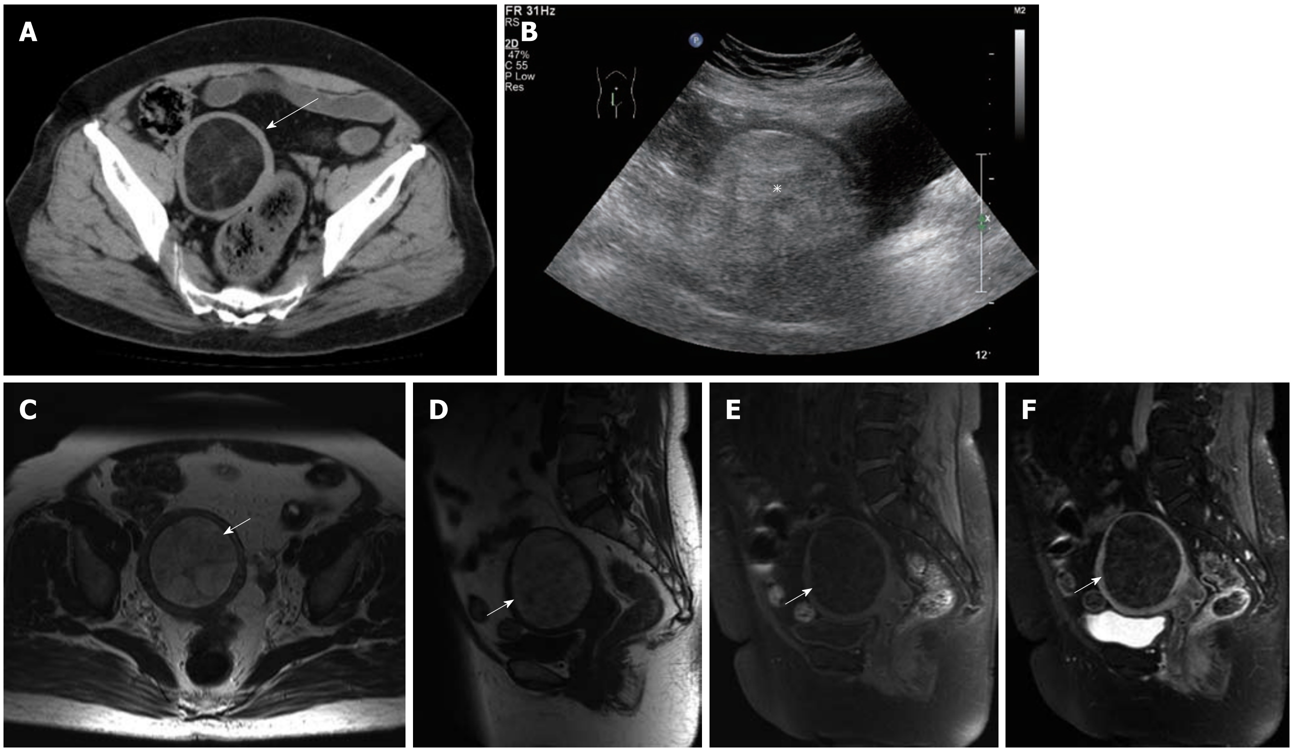

Figure 2 Computed tomography, ultrasound and magnetic resonance images of lipomatous uterine tumor in a 61-year-old woman. A: Computed tomography axial image of the pelvis with no contrast shows a hypodense lesion in the uterine fundus with thin internal septa (long arrow); B: Ultrasound in longitudinal view reveals a rather homogeneous and hyperechoic lesion (asterisk) in the uterus, just superior to the urinary bladder; C-F: Magnetic resonance imaging (MRI) images of the lesion. T1-weighted MRI images in axial plane (C) and in sagittal plane (D) show a T1 hyperintense lesion in the uterine fundus with thin hypointense septa (short arrows); E: Suppression of signal is seen in the T1-weighted fat-suppressed sequence, suggestive of fatty component of the lesion; F: Thin enhancing septa are seen inside the lesion after gadolinium contrast is administered.

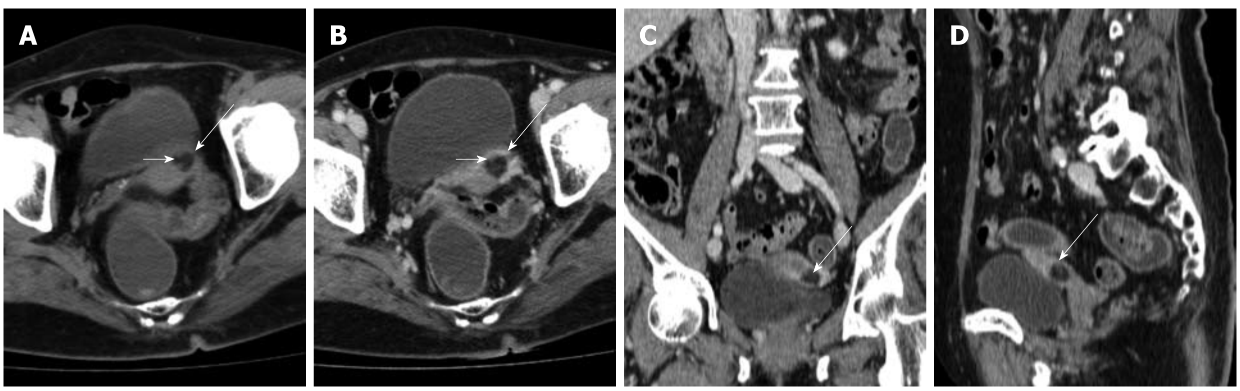

Figure 3 Computed tomography images of uterine lipoma in a 72-year-old woman. A and B: Axial computed tomography images without contrast (A) and after intravenous contrast (B) show a non-enhancing hypodense lesion (long arrows) in left side of the uterine fundus. Small amount of soft tissue density (short arrows) is noted inside the lesion; C and D: Coronal (C) and Sagittal (D) reformatted images also reveal the relationship of the lesion with the uterus.

Case 3

A 72-year-old female patient, with history of depression, was referred by her general practitioner to a gynecologist because of intermittent abdominal pain. She did not have any other symptoms. An ultrasound scan performed in China showed an unknown tumor in the pelvis. Therefore, a transvaginal ultrasound scan was performed and this showed a highly hyperechoic lesion over the left side of the pelvis. However, the exact nature could not be determined by the ultrasound at that time.

A subsequent contrast CT scan of the abdomen and pelvis was performed. It revealed a roundish lesion of fat density over the left side of the uterine body, with no intralesional calcification (Figure 3). A small amount of soft tissue density was seen inside the lesion (Figure 3). No adnexal mass lesion was detected. The lesion was decided to most likely represent a uterine lipoleiomyoma.

Transvaginal sonography was repeated during follow up and showed no growth of the tumor. The patient is now asymptomatic and, as a result, no resection of the tumor has been needed. She now has been followed up by a gynecologist for 1 year, with no complaints of symptoms. She is now under conservative management for the lipomatous uterine tumor.

DISCUSSION

Clinical and general

Lipomatous uterine tumors are uncommon benign neoplasms, with incidence ranging from 0.03% to 0.2%[1,3-5]. They can generally be subdivided into two types: pure or mixed lipomas[6,7]. The latter consist of lipoleiomyoma, angiomyolipoma, fibromyolipoma[1]. A third group of malignant neoplasm has been proposed, which is liposarcoma; however, this is very rare[1]. Mixed lipoma contains variable amounts of fat, fibrous tissue and smooth muscle while pure lipoma is composed of encapsulated adipose tissue with thin septa of fibrous tissue only[6]. Most of the reported cases are of mixed type and lipoleiomyoma is the most common[1,2]. Pure lipoma of the uterus is extremely rare, with only a handful of cases reported[7].

Uterine lipoleiomyoma is typically seen in postmenopausal women, with the majority found in patients between 50-70 years of age[1,8,9]. Most of the patients are asymptomatic. On the other hand, the presentation is similar to that of leiomyoma if there is any symptom[3-5]. For example, the patient may complain of a palpable mass, urinary frequency, constipation, pelvic discomfort, uterine bleeding or hypermenorrhea. These are related to the size and location of the lesion[3-5,9]. Malignant degeneration in uterine lipoleiomyoma is extremely rare, although it has been reported in the literature[3,9].

The most common location is in the uterine corpus. The tumors are usually intramural[3,4,6,7,9]; however, they can be found anywhere in the uterus or cervix and can be subserosal or submucosal[3,4]. Average size of the lesion is usually between 5 and 10 cm[1,2,8,9]. Concomitant uterine leiomyoma is commonly found, although this is not present in all patients, including ours[1-3,6,7,9].

Pathology

The pathogenesis of the lesion remains unknown[1,3-5,8,9]. Several theories have been proposed, including misplaced embryonic fat cells, perivascular extension of peritoneal or retroperitoneal fat, lipocytic differentiation of primitive connective or mesenchymal tissue, and metaplasia of smooth muscle cells or connective tissue into adipose cells[3,4]. The last theory regarding metaplasia is so far the most widely accepted underlying mechanism of uterine lipoleiomyoma[3,4].

Imaging findings

Ultrasound: On ultrasound, the lesion is echogenic and is usually partially encased by a hypoechoic rim[2,3,6,7,9]. The hypoechic rim is thought to represent a layer of myometrium surrounding the fatty component[6,7,9]. However, ultrasound findings are not specific to the diagnosis[6,7]. The sonographics findings of the tumors in our first and second patients were compatible with these characteristics, being homogenously echogenic although the hypoechoic rim was not seen.

CT: CT findings are more specific since CT scan can clearly demonstrate a fat component of the lesion, which appears low in attenuation with Hounsfield units between -40 and -100[5,6,9]. A CT scan may also help differentiate uterine lipoleiomyoma from pure uterine lipoma. On CT scan, uterine lipoleiomyoma is well-circumscribed showing heterogeneous fat density while uterine lipoma demonstrates homogeneous density[8]. Based on this feature, uterine lipoma is the most likely diagnosis in our first patient. Enhancing septa were found in the CT images of our second patient while soft tissue density components were noted in our third patient. Therefore, uterine lipoleiomyomas were the more likely diagnoses in our second and third patients. Although CT is more specific than ultrasound, it has it own disadvantages, including inability to illustrate detailed uterine anatomy and confusion between an adnexal mass and a lesion arising from the uterus, particularly exophytic or pedunculated lesions[5].

MRI: MRI, with its multiplanar capabilities, is the most useful modality in demonstrating the organ of origin[3,5]. MRI is also the best tool for diagnosing a lipomatous tumor[6]. On MRI, the fatty component is high in signal intensity on both T1- and T2-weighted images[4]. Chemical shift artifacts along the frequency-encoding axis may be seen, which further verify the fatty component[9]. The fatty component of the lesion can also be confirmed by fat suppression sequence, which demonstrates decrease in signal intensity in fat components of the lesion[6,7].

MRI enables better tissue characterization than CT[6,7]. Septa inside the mass can be seen on T1-weighted images[6,7]. MRI sometimes shows a peripheral low signal intensity rim which corresponds to a thin fibrous pseudocapsule. This feature is not demonstrated on CT scan[6,7].

MRI can also help differentiate pure lipoma from uterine lipoleiomyoma[5,7]. On MRI, pure lipoma shows absence of nonadipose components, the presence of a homogeneous mass with a large amount of fat and signal decrease in the whole mass on fat-saturated images. On the other hand, lipoleiomyoma demonstrates heterogeneous signal intensity with fat and non-fat soft tissue content, and decrease in signal only in part of the lesion on fat-saturated images[7]. In the MR images of our first patient, only signal intensity of fat was seen, suggestive of pure lipoma in the uterus. Enhancing septa seen in our second patient favor uterine lipoleiomyoma.

The various imaging features of the tumor in different modalities are important to guide the final diagnosis. Knowledge of these is also important to radiologists since most of the tumors are incidental findings on imaging. Although ultrasound and CT scan findings may be non-specific, any presence of the previously mentioned imaging features should raise the suspicion of a lipomatous uterine tumor. MRI is the modality of choice for the final diagnosis. If there is any uncertainty despite the use of MRI, combination of clinical history, physical examination and all imaging features will probably provide the accurate diagnosis in the majority of cases.

Management and treatment

There are a number of differential diagnoses for a fat-containing tumor in the female pelvis, such as benign cystic ovarian teratoma, malignant degeneration of a benign cystic ovarian teratoma, non-teratomatous lipomatous ovarian tumor, benign pelvic lipoma, liposarcoma, extra-adrenal myelolipoma in pelvis, lipoblastic lymphadenopathy and retroperitoneal cystic hamartoma. Among the long list of differentials, the most common one is benign cystic ovarian teratoma, which usually requires surgical excision[2]. On the other hand, asymptomatic uterine lipoleiomyoma can be managed conservatively because of its benign nature[2]. Therefore, correct diagnosis of uterine lipoma/lipoleiomyoma and differentiation from other fat-containing pelvic tumors are important in the patient's management and can prevent unnecessary surgery[2,3].

In conclusion, we report a case series of 3 rare lipomatous uterine tumors. The ultrasound, CT and MRI features of the tumors have been illustrated. MRI with its multiplanar capabilities, better tissue characterization and the ability to demonstrate fat component by fat-saturated sequences is the best modality for diagnosis. With better understanding of the imaging characteristics, we can make a correct pre-operative diagnosis, differentiate the lesion from other fat-containing tumors in the female pelvis and choose the optimal management for patients.

REFERENCES

1. **Kitajima K**, Kaji Y, Imanaka K, Sugihara R, Sugimura K. MRI findings of uterine lipoleiomyoma correlated with pathologic findings. *AJR Am J Roentgenol* 2007; **189**: W100-W104
2. **Dodd GD**, Budzik RF. Lipomatous uterine tumors: diagnosis by ultrasound, CT, and MR. *J Comput Assist Tomogr* 1990; **14**: 629-632
3. **Chan HHL**, Chau MT, Lam CHL, Cheung SCW. Uterine lipoleiomyoma: ultrasound and computed tomography findings. *J HK Coll Radiol* 2003; **6**: 30-32
4. **Loffroy R**, Nezzal N, Mejean N, Sagot P, Krausé D. Lipoleiomyoma of the uterus: imaging features. *Gynecol Obstet Invest* 2008; **66**: 73-75
5. **Senior EL**, Taylor HL. Uterine leiomyolipoma - incidental finding on screening CT. *Eur J Radiol Extra* 2006; **59**: 63-65
6. **Coumbaras M**, Validire P, Strauss C, Herry M, Dahan H, Palau R. Uterine lipoma: MRI features with pathologic correlation. *Abdom Imaging* 2005; **30**: 239-241
7. **Erdem G**, Celik O, Karakas HM, Alkan A, Hascalik S. Pure uterine lipoma. *Magn Reson Imaging* 2007; **25**: 1232-1236
8. **Maebayashi T**, Imai K, Takekawa Y, Sasaki J, Otsuka H, Katsura Y, Mochizuki T. Radiologic features of uterine lipoleiomyoma. *J Comput Assist Tomogr* 2003; **27**: 162-165
9. **Lau LU**, Thoeni RF. Case report. Uterine lipoma: advantage of MRI over ultrasound. *Br J Radiol* 2005; **78**: 72-74

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MEETINGS

Events Calendar 2012

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January 12-14, 2012
IROS 2012: Interventionell Radiologischen Olbert Symposium
Salzburg, Austria

January 26-29, 2012
American Society of Neuroimaging 2012 35th Annual Meeting
Miami, FL 33169, United States

February 9-11, 2012
JIM joint interventional meeting 2012
Rome, Italy

February 13-16, 2012
Emergency Radiology
Palm Beach, FL 33480, United States

February 16-19, 2012
ASSR 2012 Annual Symposium
Miami Beach, FL 33169, United States

February 19-23, 2012
Internal Derangements of Joints: Advanced and Intensive MR Imaging/With a Special Symposium on Ankle and Foot
Coronado, CA 92118, United States

February 21-24, 2012
MRI in Practice
Oslo, Norway

March 1-5, 2012
ECR 2012
Vienna, Austria

March 7-10, 2012
ISCD's 18th Annual Meeting
Los Angeles, CA 90001, United States

March 7-11, 2012
7th Annual Fundamentals of Musculoskeletal Ultrasound
San Diego, CA 92111, United States

March 25-30, 2012
Diseases of the Brain, Head and Neck Spine
Davos, Switzerland
April 13-15, 2012
ACR 35th National Conference on Breast Cancer
Hollywood, FL 33019, United States

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Euroson 2012
Madrid, Spain

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MRI in Practice
Aalst, Belgium

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Florence, Italy

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EURO PCR
Paris, France

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ECTS 2012
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May 28-June 01, 2012
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ASCI 2012 6th Congress of Asian Society of Cardiovascular Imaging
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June 14-16, 2012
ICCIR 2012 – International Conference on Complications in Interventional Radiology
Poertschach, Austria

June 16-19, 2012
2nd IDKD Hong Kong 2012, Diseases of the Abdomen and Pelvis
Hong Kong, China

June 17-20, 2012
14th Annual International Symposium on Multidetector-Row CT
San Francisco, CA 94103, United States

June 27-30, 2012
CARS 2012
Pisa, Italy

July 1-3, 2012
16th Symposium Mammographicum
Harrogate, United Kingdom

July 19-22, 2012
Society of Cardiovascular Computed Tomography 6th Annual Scientific Meeting
Baltimore, Maryland

August 30-2, 2012
14th Asian Oceanian Congress of Radiology
Sydney, Australia

September 6-8, 2012
Update in Abdominal and Urogenital Imaging
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Nice, France

September 13-16, 2012
18th Annual Symposium ESUR
Edinburgh, United Kingdom

September 15-19, 2012
CIRSE 2012
Lisbon, Portugal

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2012 SDMS Annual Conference
Seattle, WA 98113, United States

September 24-27, 2012
MRI in Practice
Ballerup, Denmark

October 4-6, 2012
ESMRMB congress 2012 29th Annual Scientific Meeting
Lisbon, Portugal

October 12-13, 2012
EUSOBI Annual Scientific Meeting 2012
Barcelona, Spain

October 26-28, 2012
22th Annual Meeting of the Society of Radiologists in Ultrasound
Baltimore, MD 21213, United States

November 10-14, 2012
13th congress of WFITN
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November 14-17, 2012
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December 2-4, 2012
ICI 2012 - Innovations in Cardiovascular Interventions Meeting
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December 4-8, 2012
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INSTRUCTIONS TO AUTHORS

GENERAL INFORMATION

World Journal of Radiology (*World J Radiol*, *WJR*, online ISSN 1949-8470, DOI: 10.4329), is a monthly, open-access (OA), peer-reviewed journal supported by an editorial board of 319 experts in Radiology from 40 countries.

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Maximization of personal benefits

The role of academic journals is to exhibit the scientific levels of a country, a university, a center, a department, and even a scientist, and build an important bridge for communication between scientists and the public. As we all know, the significance of the publication of scientific articles lies not only in disseminating and communicating innovative scientific achievements and academic views, as well as promoting the application of scientific achievements, but also in formally recognizing the "priority" and "copyright" of innovative achievements published, as well as evaluating research performance and academic levels. So, to realize these desired attributes of *WJR* and create a well-recognized journal, the following four types of personal benefits should be maximized. The maximization of personal benefits refers to the pursuit of the maximum personal benefits in a well-considered optimal manner without violation of the laws, ethical rules and the benefits of others. (1) Maximization of the benefits of editorial board members: The primary task of editorial board members is to give a peer review of an unpublished scientific article via online office system to evaluate its innovativeness, scientific and practical values and determine whether it should be published or not. During peer review, editorial board members can also obtain cutting-edge information in that field at first hand. As leaders in their field, they have priority to be invited to write articles and publish commentary articles. We will put peer reviewers' names and affiliations along with the article they reviewed in the journal to acknowledge their contribution; (2) Maximization of the benefits of authors: Since *WJR* is an open-access journal, readers around the world can immediately download and read, free of charge, high-quality, peer-reviewed articles from *WJR* official website, thereby realizing the goals and significance of the communication between authors and peers as well as public reading; (3) Maximization of the benefits of readers: Readers can read or use, free of charge, high-quality peer-reviewed articles without any limits, and cite the arguments, viewpoints, concepts, theories, methods, results, conclusion or facts and data of pertinent literature so as to validate the innovativeness, scientific and practical values of their own research achievements, thus ensuring that their articles have novel arguments or viewpoints, solid evidence and correct conclusion; and (4) Maximization of the benefits of employees: It is an iron law that a first-class journal is unable to exist without first-class editors, and only first-class editors can create a first-class academic journal. We insist on strengthening our team cultivation and construction so that every employee, in an open, fair and transparent environment, could contribute their wisdom to edit and publish high-quality articles, thereby realizing the maximization of the personal benefits of editorial board members, authors and readers, and yielding the greatest social and economic benefits.

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Columns

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In press

3 **Tian D**, Araki H, Stahl E, Bergelson J, Kreitman M. Signature of balancing selection in Arabidopsis. *Proc Natl Acad Sci USA* 2006; In press

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4 **Diabetes Prevention Program Research Group**. Hypertension, insulin, and proinsulin in participants with impaired glucose tolerance. *Hypertension* 2002; **40**: 679-686 [PMID: 12411462 PMCID:2516377 DOI:10.1161/01.HYP.0000035706.28494.09]

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5 **Vallancien G**, Emberton M, Harving N, van Moorselaar RJ; Alf-One Study Group. Sexual dysfunction in 1, 274 European men suffering from lower urinary tract symptoms. *J Urol* 2003; **169**: 2257-2261 [PMID: 12771764 DOI:10.1097/01.ju.0000067940.76090.73]

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6 21st century heart solution may have a sting in the tail. *BMJ* 2002; **325**: 184 [PMID: 12142303 DOI:10.1136/bmj.325.7357.184]

Volume with supplement

7 **Geraud G**, Spierings EL, Keywood C. Tolerability and safety of frovatriptan with short- and long-term use for treatment of migraine and in comparison with sumatriptan. *Headache* 2002; **42** Suppl 2: S93-99 [PMID: 12028325 DOI:10.1046/j.1526-4610.42.s2.7.x]

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9 Outreach: Bringing HIV-positive individuals into care. *HRSA Careaction* 2002; 1-6 [PMID: 12154804]

Books

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10 **Sherlock S**, Dooley J. Diseases of the liver and billiary system. 9th ed. Oxford: Blackwell Sci Pub, 1993: 258-296

Chapter in a book (list all authors)

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12 **Breedlove GK**, Schorfheide AM. Adolescent pregnancy. 2nd ed. Wieczorek RR, editor. White Plains (NY): March of Dimes Education Services, 2001: 20-34

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13 **Harnden P**, Joffe JK, Jones WG, editors. Germ cell tumours V. Proceedings of the 5th Germ cell tumours Conference; 2001 Sep 13-15; Leeds, UK. New York: Springer, 2002: 30-56

Conference paper

14 **Christensen S**, Oppacher F. An analysis of Koza's computational effort statistic for genetic programming. In: Foster JA, Lutton E, Miller J, Ryan C, Tettamanzi AG, editors. Genetic programming. EuroGP 2002: Proceedings of the 5th European Conference on Genetic Programming; 2002 Apr 3-5; Kinsdale, Ireland. Berlin: Springer, 2002: 182-191

Electronic journal (list all authors)

15 Morse SS. Factors in the emergence of infectious diseases. Emerg Infect Dis serial online, 1995-01-03, cited 1996-06-05; 1(1): 24 screens. Available from: URL: http://www.cdc.gov/ncidod/eid/index.htm

Patent (list all authors)

16 **Pagedas AC**, inventor; Ancel Surgical R&D Inc., assignee. Flexible endoscopic grasping and cutting device and positioning tool assembly. United States patent US 20020103498. 2002 Aug 1

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