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Oesophageal carcinoma demonstrated by whole-body nuclear magnetic resonance imaging

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Abstract

The quality of the images produced by nuclear magnetic resonance (NMR) imaging has steadily improved over the past five years. Images of the head, thorax, and abdomen have clearly shown the normal anatomy. A clinical trial of NMR imaging has therefore been started in Aberdeen to assess its diagnostic accuracy and compare it with conventional radiography and other imaging techniques. The first patient examined by whole-body NMR imaging had carcinoma of the oesophagus diagnosed on barium meal examination. A technetium-99m-sulphur colloid liver scan also showed hepatic metastases. NMR imaging showed a large tumour in the lower third of the oesophagus, and areas of increased proton spin-lattice relaxation time (T_1) on a section through the liver corresponded with the metastases shown on the radio-nuclide scan. Increased areas of T_1 were present in some vertebrae, and a technetium-99m bone scan confirmed the presence of bone metastases.

The NMR images in this patient compared well with the images from other techniques. The continuing clinical trial may show that NMR is an accurate diagnostic aid which will complement existing techniques for diagnosing intrathoracic and intra-abdominal conditions.

FIG 1—Anteroposterior view of lower oesophagus outlined with barium showing oesophageal carcinoma.

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Introduction

During the past five years there has been a steady improvement in the image quality produced by nuclear magnetic resonance (NMR) imaging of the human body. Early NMR images were reported which showed the normal cross-sectional anatomy of a finger¹ and of the wrist.² Transverse tomographic sections of the skull, demonstrating the normal anatomy, have shown a steady improvement in image quality.^{3,4} Imaging of the thorax and abdomen has proved more difficult, and early images of the abdomen were disappointing,^{5,6} but recent images of the thorax and abdomen produced by our group in Aberdeen have given a clear demonstration of the normal anatomy.^{7,8} Transverse

FIG 2—Anterior view ^{99m}Tc sulphur colloid liver scan showing multiple metastases.

FIG 3—Tomographic section through liver during liver scan showing metastases throughout liver.

FIG 4—NMR transverse section at level of T9 showing clearly the heart and aorta separated by the oesophageal carcinoma; anterior to normal vertebral body.

FIG 5—NMR transverse section at level of T12 showing the liver containing multiple metastatic deposits and a large metastasis in the body of T12. Note also the clear demonstration of the spleen and upper pole of left kidney.

FIG 6—Bone scan with ^{99m}Tc-methylene diphosphonate; posterior view of lower dorsal and lumbar spine demonstrating multiple metastases, which were unsuspected before NMR imaging.

tomographic sections of head, thorax, and abdomen of 11 healthy volunteers aged 20-25 years showed the normal anatomy in sufficient detail to recognise the major organs and blood vessels. We therefore embarked on a clinical trial of our NMR imager. To show the accuracy of this imager, the NMR images were compared with those on standard radiographic techniques, ultrasound, and radionuclide studies. We report here our findings in the first patient examined by whole-body NMR imaging in Aberdeen.

Methods

The Aberdeen nuclear magnetic resonance imager is based on a four-coil, air-cored magnet capable of accepting the whole human body. The magnet produces a static field of 0.04 tesla, giving a proton NMR frequency of 1.7 MHz for the hydrogen protons of the body. Full details of the instrumentation and imaging techniques are described in detail elsewhere.^{7,9}

The data for each section is collected in just over two minutes and

when displayed represents a section 18-mm thick through the body. The information gathered provides two images. The first uses proton density as the imaging value and the second uses proton spin-lattice relaxation time (T_1). We find the T_1 images more useful for showing normal anatomical structures and pathological lesions and have used them to illustrate this case.

Case report

A 66-year-old retired fish curer was admitted with a four-month history of increasing anorexia, nausea, and weight loss. In the previous two months he had experienced difficulty in swallowing solids. He also gave a history of right hypochondrial pain, which radiated through to his back. On examination he was found to be a thin anaemic man (haemoglobin 8.8 g/dl), whose abdomen was normal on palpation with no masses or hepatomegaly. A presumptive diagnosis of carcinoma of the oesophagus was made, which was subsequently proved by barium meal examination (fig 1) and oesophagoscopy. A biopsy of the tumour showed it to be a moderately differentiated adenocarcinoma. Because his alkaline phosphatase and gamma-glutamyl transferase activities were raised, at 557 U/l and 362 U/l respectively, a ^{99m}Tc sulphur colloid liver scan was performed, which showed hepatic metastases (figs 2 and 3).

The patient was referred for NMR imaging, which showed the large tumour in the lower third of the oesophagus (fig 4). Sections through the liver clearly showed a number of areas of increased T_1 (fig 5), corresponding to the metastases shown by the radionuclide liver scan. These lesions gave a T_1 of about 330 ms compared with a normal liver T_1 (measured in normal subjects) of 140-165 ms.

In addition to the hepatic metastases, several areas of increased T_1 were noted in some of the vertebral bodies (fig 5). When the vertebral body of T9 in fig 4 is compared with that of T12 in fig 5 a very definite difference in appearance is evident. The T_1 of T9 is the normal range of 190-220 ms and that of T12 291 ms. As the presence of bone metastases had hitherto been unsuspected, a bone scan with ^{99m}Tc -methylene diphosphonate was performed, which showed widespread bone metastases (fig 6).

Conclusion

We present in this paper the thoracic and abdominal images of what we believe to be the first patient to be examined by whole-body NMR imaging. These transverse tomographic images compared favourably with the other diagnostic techniques used to show the lesions in this patient. We believe that the continued clinical trial of this imager will prove it to be an accurate diagnostic aid, which will complement existing techniques for diagnosing intrathoracic and intra-abdominal conditions.

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Plasmatic regulation of vascular prostacyclin in pregnancy

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Abstract

Activity of prostacyclin-stimulating factor was measured in six normal, non-pregnant women, six women in early normal pregnancy, six in late normal pregnancy, and six in late pregnancy complicated by severe pre-eclampsia. The activity was lower in the women in late pregnancy than in those in early pregnancy and the

controls but was about normal in those with severe pre-eclampsia.

These results may be relevant to the physiology of pregnancy and the pathogenesis of pre-eclampsia.

Introduction

Pregnancy is physiologically associated with low blood pressure, although blood volume and cardiac output are increased.¹ This is facilitated by arteriolar vasodilatation inducing a reduction in total peripheral resistance. These haemodynamic changes are paradoxically accompanied by a striking activation of the renin-angiotensin-aldosterone system.¹ In contrast with normal pregnancy, pre-eclampsia is characterised by high blood pressure with increased peripheral resistance, low cardiac output, and relative suppression of the renin-angiotensin-aldosterone system.² The observation that pregnant animals and pregnant women have raised plasma concentrations of prostaglandins of the E type suggested that an increase in vasodilatory prostaglandins might account for the low peripheral resistance and high renin activity.³ Prostaglandin E_2 stimulates renin in different

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