Case report: The "aurora sign"—a new sonographic sign of pneumatosis cystoides intestinalis

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Abstract

Pneumatosis cystoides intestinalis (PCI) is a rare condition characterized by multiple gas-filled cysts of varying size within the intestinal wall. Although the characteristic findings on plain abdominal radiograph, computed tomography (CT), and barium enema have been well described, the sonographic findings have not. We recently encountered a case of PCI in which abdominal sonography disclosed a unique finding. We were able to reproduce the finding experimentally and have coined it the "aurora sign".

Case report

A 51-year-old man presented with general fatigue, dyspnoea and fever. He had a 2 year history of radiochemotherapy for tongue cancer and lung metastases. Physical examination on admission revealed a chronically ill man with low-grade fever (38°C). The relevant laboratory data were as follows: anaemia (haemoglobin, 7.0 mg dl⁻¹; haematocrit, 21%), leucocytosis (white blood cell count, 1.8 x 10⁹/ml), and hypoproteinaemia (total protein, 5.8 mg dl⁻¹). A chest radiograph showed multiple lung metastases, but an abdominal radiograph was unremarkable. Corticosteroid (250 mg methylprednisolone sodium succinate) was administered from the eleventh day of admission. On the twenty-fifth day of admission the patient developed watery diarrhoea and abdominal fullness that gradually increased. An abdominal radiograph showed a cluster of radiolucent bubbles in the large intestinal wall, from the ascending to the descending colon. Abdominal sonography and computed tomography (CT) were recommended for further evaluation and performed on the same day. CT demonstrated a bubbly accumulation of intramural gas in the colon (Figure 1).

Abdominal sonography was performed using an electronic real-time scanning system (Sonolayer SS-A 270A, Toshiba, Japan) with a 3.75 MHz convex scanner. Long and short strips of bright echo separated by acoustic shadows were demonstrated behind the liver by the subcostal, intercostal and epigastric approaches (Figure 2). All of the bright echoes were found to arise from the wall of the ascending and transverse colon, displaying an antarctic "aurora-like" image. Sonography conducted without using the liver as an acoustic window showed only broad bright echoes indistinguishable from intraluminal gas artifact. The appearance was demonstrated constantly both with changes in the position of the patient and scanner and on the follow-up sonography. A diagnosis of PCI was made, and hyperbaric oxygen therapy was started. After 24 h, the patient's symptoms, including diarrhoea, abdominal fullness and pain, dramatically improved. However, he developed pleural effusion and hemoptyis and died of respiratory failure 3 days later. Autopsy was not performed.

Experimental study

We conducted an experimental study to reproduce and analyse the sonographic findings seen in this patient.

Received 7 March 1994 and in revised form 17 June 1994, accepted 13 July 1994.

Vol. 67, No. 804

Figure 1. CT scan at mid-abdomen with lung setting. Intramural gas is clearly demonstrated in the colon.
A sheet of vinyl packing material with a honeycomb pattern of air-filled capsules was attached to the bottom of a nylon bag filled with water (Figure 3). Scanning with the 3.75 MHz convex probe from within the bag showed long and short strips of bright echo separated by acoustic shadows identical to those in the patient (Figure 4). These bright echoes were found to arise from the air-filled capsules and to have acoustic shadows interposed between them. Although visible when the scanning probe was kept 2 cm or more from the vinyl packing material, the bright echoes disappeared when the probe was brought closer than 2 cm to the material.

Discussion

The unique antarctic aurora-like image observed in this patient was considered to arise from the wall of the colon containing gas-filled cysts. It was an unexpected finding, because air-filled bodies are usually undetectable on ultrasound examination. We were able to reproduce the findings experimentally and concluded that they may be diagnostic of PCI.

The experimental study showed two main factors associated with the sonographic findings. First, the air-filled capsules produce long and short strips of bright echo, while the areas between capsules produce interposed acoustic shadows. It is known that a small amount of gas produces reverberation artifact (bright echo), while a large amount of gas produces reflection artifact (acoustic shadow) [1]. In view of this fact, the bright echoes from the air-filled capsules may be reverberation artifacts created between the anterior and posterior walls of the capsules. Secondly, the distance between the scanning probe and the air-filled capsules must be at least 2 cm. This phenomenon may be explained by the limited range of the transducer focus; it corresponds to the fact that aurora-like images were seen only when scanning was performed using the liver as an acoustic window.

To our knowledge, the sonographic features of PCI have been reported in only one case, which showed a “continuous undulating reflection line on ultrasounds with a posterior acoustic shadow cone” similar to the finding in our case [2]. In the above case, however, the undulating appearance obtained with the use of a contact compound scanner was seen without using the liver as an acoustic window.

Conventional abdominal radiography is usually sufficient to detect the abnormalities associated with PCI. Recent experience, however, indicates that CT is
more accurate than radiography in the detection of this condition and in the evaluation of its extent and possible complications [3]. Although sonography is usually not necessary in the diagnosis of PCI, the radiologist should be aware of the sign reported in this study since sonography is frequently used as an initial screening examination for patients with abdominal symptoms.

In summary, we described the unique sonographic finding in a case of PCI and analysed the finding by an experimental study. The aurora-like image was considered to arise from the gas-filled cysts in the wall of the colon and possibly to be a diagnostic indicator of PCI.

References
Book reviews

This book is intended as an introductory text book on medical imaging, however the emphasis is very much on reconstruction techniques and imaging devices employing them. Readers expecting to read about filmscreens, image intensifier television systems and computed radiography, as implied by the general nature of the title, will be disappointed. The treatment of the subjects is rigorous though it is not a textbook for the mathematically compromised. The section on the photoelectric effect is shorter than that on the marked transform. The description of each modality included in the book is of a very high standard. It clearly indicates that the authors have a comprehensive knowledge and insight into the subject matter.
This book was written as a postgraduate student text book on medical imaging for physicists and engineers. However, I would say that it can only be recommended to anyone doing PhD research in computed tomography, magnetic resonance imaging, single photon emission computed tomography or quantitative ultrasound. Design engineers in a commercial organization producing any of the above items of equipment may also find this textbook useful. In the main, its contents are too detailed and specialized to be of great use to other students. Whilst it has been based on a postgraduate lecture course in medical imaging, there will be few courses in imaging taught to this depth.
In summary I thought this was an excellent reference book on the fundamental physics and applications of reconstruction techniques in medical imaging. There is a wealth of interesting and useful information and data. I wish it had been available when I studied for my PhD. The book has a clear concise style consistent with a well polished set of lecture notes. It may be recommended to any department with a particular interest in image reconstruction.

K Faulkner

Cardiac Ultrasound. By J R T C Roelandt, G R Sutherland, S Liliceto and D T Linder, pp.x+806, 1993 (Churchill Livingstone, Edinburgh), £175.00. ISBN 04430 46921
Today cardiologists use ultrasound on the majority of their patients. The stethoscope has been superseded by this versatile and cost-effective technology which delivers both anatomic and functional information. Cardiac Ultrasound is written by cardiologists for cardiologists. Practising radiologists will also find much of interest and importance. Ultrasound is only one of the present generation of rapidly developing cardiac imaging modalities. Those of us working in cardiac MRI or spectroscopy, SPECT and PET need to understand the present role and future of cardiac ultrasound as much as any radiologist already involved in providing an "echo" service.
Four highly respected cardiac clinicians and scientists linked through the Thoraxcenter in Rotterdam have produced and edited a definitive single volume practical introduction to cardiac ultrasound. 150 co-authors have written 95 chapters beginning with the development of ultrasound in medicine and finishing with the use of ultrasound for the in-flight monitoring of cardiac function in NASA astronauts. Cardiac Ultrasound covers in detail the techniques, principles and applications of echocardiography, including the trans thoracic, transoesophageal, intra operative and intra vascular approaches. Additional chapters include advice on quantifying flow and movement with ultrasound, the use of ultrasound contrast agents and myocardial perfusion imaging, the advent of echo CT and much more. Those of us seeking pointers to the future will find much of interest here.
The text is well written, readable, well illustrated and well referenced. Each chapter is summarized and practical advice is highlighted throughout the book. At £175.00 the book is expensive, but will be of value to anyone learning and performing echocardiography. It is a triumph of European collaboration, justified by the enormous contribution of Europeans to the development of cardiac ultrasound. It was even an Englishman, E G Richardson, who following the sinking of the Titanic in 1912, first conceived the idea of using an ultrasound beam and looking for returning echoes to identify submerged structures.

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The British Journal of Radiology, December 1994