peer reviewed **ARTICLE OF INTEREST**

The 'dense waterfall' sign. What is it and what causes it?

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Abstract

The 'dense waterfall' sign is an artefact seen on some CT colonography images. The reason for this sign is presented with examples.

Keywords

opacified luminal fluid, arciform artefact, CT colonography

Introduction

Cathartic bowel preparation, and tagging agents are pivotal in computer tomographic colonography (CTC). For a successful study it is important that a clean bowel is well distended, and that residual fluid is tagged.[1,2] Bowel preparation involves the following: (i) 2 dulcolax tablets at 11:00, (ii) 296 mL solution of magnesium citrate ingested at 14:00 and a further 296 mL at 17:00 on the day before the study, (iii) tagging agent 250 mL of 2.1% w/v Readi-Cat® is ingested at 17:00; it stains any remaining stool, and (iv) at 20:00 two bottles of 30 mL bottles of diatrizoate (Gastrografin), are ingested, to stain any residual fluid white.[1]

The findings of a comparative study of nonionic iohexol and ionic diatrizoate showed patient preference for the more palatable iohexol (Ominpaque).[3] Professor Pickhardt at Wisconsin University now uses 50 cc Omnipaque for CTC studies (personal communication on 7 September 2016). It is as effective as Gastrografin in staining residual fluid.

There are two prongs to CTC competency: performing the study and interpreting the images. It is important that patients understand the need to follow instructions during a CTC examination to obtain optimal images.[4] There are many factors, including patient-based artefacts (Figure 1), that may reduce optimal image acquisition. Artefacts are unwanted features on a CTC image that may obscure or simulate pathology.[5] To minimise the risk of movement artefacts, patient cooperation during scanning is essential.[4] For all scans a patient is instructed to inhale, then exhale and to suspend breathing during scanning. Scanning is performed in exhalation as this elevates the diaphragm and allows the colon and flexures to expand. The first breath hold (usually 5 s) allows for acquisition of the scout film.[1] Technological advances in CT allows scanning to be performed in a few seconds. Very short scanning times should reduce movement artefacts at CTC.

This paper describes an artefact that is not related to voluntary patient movement or breathing.

'Dense waterfall' sign (DWS)

The DWS was first described by Boyce *et al.*[6] in 2012. It is a luminal artefact, which occurs when opacified luminal fluid flows from a higher to a lower level relative to the patient position on the scanner table. It is caused by the CT scanner catching the movement of the opacified fluid at a moment in time. A distinctive arciform artefact is created, which is not due to patient breathing, patient movement, spasm or beam hardening. It is best seen on 2D views where the artefact is most prominent.[7] It may occur in the sigmoid colon, descending colon, transverse colon, ascending colon, and caecum (Figures 2 to 8).

This artefact may also be seen on ab-

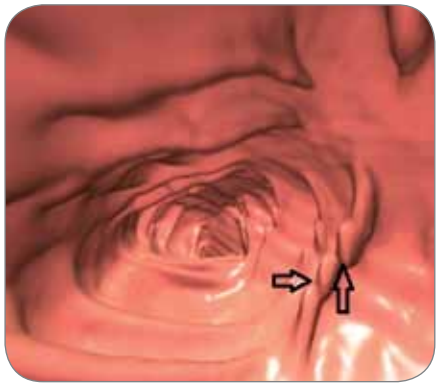

Figure 1. 3D endoluminal view shows stepped breathing artefact (open black arrows).

Figure 2. 2D axial view showing the arciform artefact of the 'dense waterfall' sign (DWS) in the sigmoid colon (open green arrows).

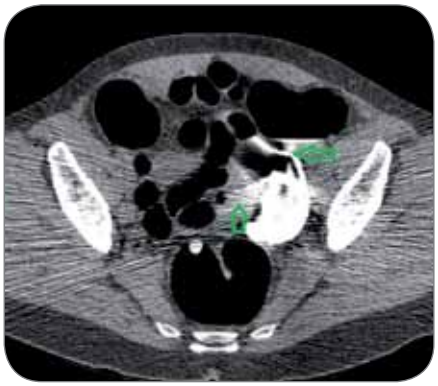

Figure 3. 2D axial view showing the arciform artefact from the DWS in the sigmoid colon.

Figure 4(i). 2D axial showing the DWS in the sigmoid colon (open black arrows).

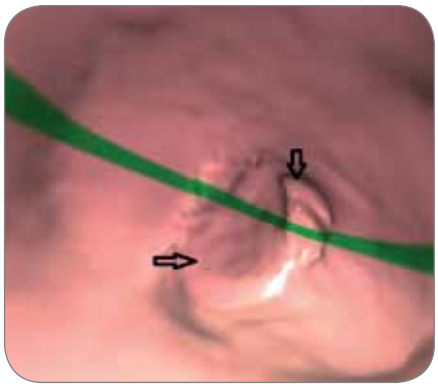

Figure 4 (ii). 3D endoluminal view showing the artefact caused by the DWS (open black arrows).

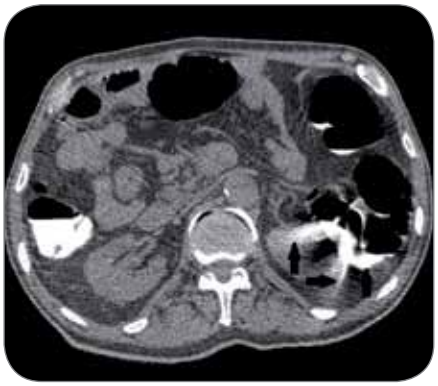

Figure 5 (i). 2D axial view showing the DWS (black arrows).

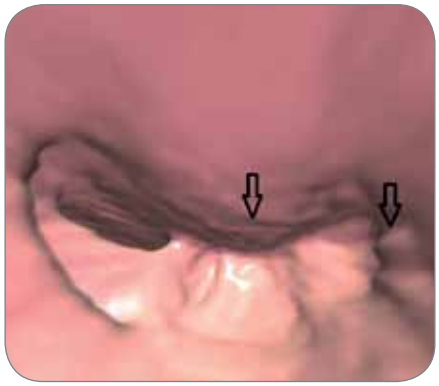

Figure 5 (ii). 3D endoluminal view showing the artefact caused by the DWS (open black arrows).

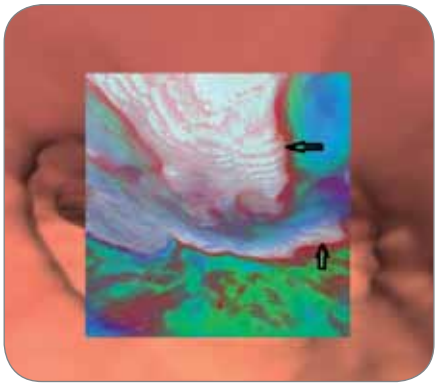

Figure 5 (iii). Translucent display showing contrast fluid artefact (white and open black arrows).

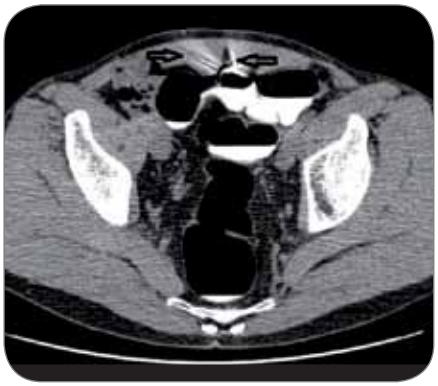

Figure 6. 2D axial view showing the alternating dark and light appearance of the DWS artefact in the transverse colon (open black arrows).

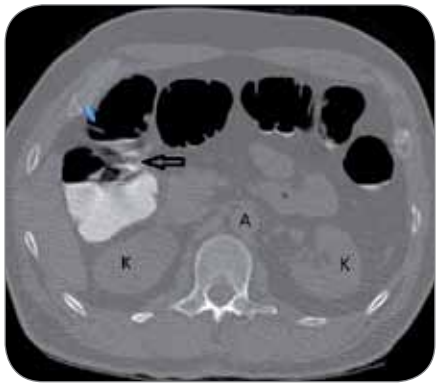

Figure 7 (i). 2D axial showing DWS (open black arrows) in the ascending colon. K=kidneys; A=aorta.

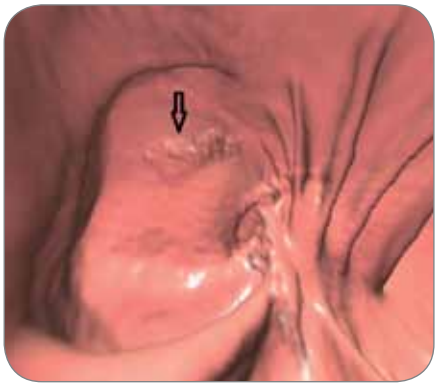

Figure 7 (ii). 3D endoluminal view showing the artefact caused by the DWS (open black arrow).

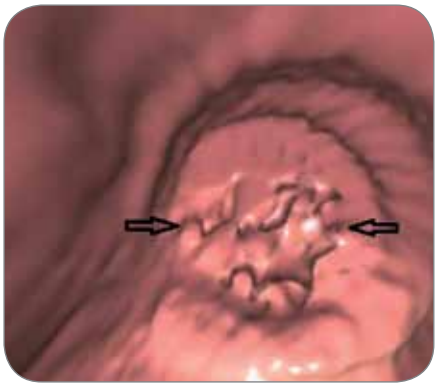

Figure 8 (ii). 3D endoluminal view showing the artefact caused by the DWS (open black arrow).

Figure 8 (i). 2D axial showing the DWS artefact in the ascending colon (open black arrow). K = kidneys; A = aorta.

dominal MDCT studies.[6] It occurs in approximately 25% of studies, but does not usually obscure pathology. It may however potentially obscure pertinent CTC findings.[6]

Conclusion

The 'dense waterfall' sign (DWS) is a recently described artefact in CTC, and abdominal MDCT studies. This artefact should not be confused with pathology. Readers of CTC studies should however be aware of this sign as it could potentially obscure relevant findings.

Competing interests

This paper was not funded from any sources. The authors do not have any financial/ corporate affiliations to disclose.

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