Multidetector-row computed tomography in the preoperative diagnosis of clinically unsuspected intestinal perforation/obstruction by ingested calcified foreign bodies: the value of maximum intensity projection and volume rendering

Poster No.: C-2261
Congress: ECR 2013
Type: Scientific Exhibit
Authors: A. C. V. TEIXEIRA\textsuperscript{1}, U. S. Torres\textsuperscript{2}, F. Gual\textsuperscript{3}, T. N. El-Kadri, Jr.\textsuperscript{3}, L. V. Cardoso\textsuperscript{3}, T. Bauab\textsuperscript{4}; \textsuperscript{1}São José do rio Preto, Sâ/BR, \textsuperscript{2}Bady Bassitt, SP/BR, \textsuperscript{3}São José do Rio Preto/BR, \textsuperscript{4}Sao Jose Do Rio Preto/BR

Keywords: Abdomen, Emergency, CT, Image manipulation / Reconstruction, Computer Applications-General, Foreign bodies

DOI: 10.1594/ecr2013/C-2261
Purpose

Accidental ingestion of foreign bodies (FB) is relatively common in the general population. In a small proportion of cases, complications such as perforations are observed [1-4], especially when involving long, hard, or sharp objects [4]. Because intestinal complications may lead to severe clinical outcomes or even death, and as clinical and even preoperative diagnoses are unfrequently performed [1,5], radiologists may have an important role in first suggesting this diagnosis.

The role of multidetector-row CT (MDCT) in the preoperative diagnosis of gastrointestinal (GI) tract complications secondary to ingestion of FBs has been described in the literature [1,4-9]. In many clinical situations, however, axial MDCT images solely may be insufficient for reaching an appropriate diagnosis [10]. Although the paramount importance of curved multiplanar reconstructions (curved MPR) and MDCT volumetric rendering techniques (VRT), such as maximum intensity projection (MIP) and volume rendering (VR) is well documented in many clinical contexts, the use of MDCT VRT for assessing GI tract complications caused by dietary FBs, for example, have received little attention in the literature [6,9]. We hypothesized that in some cases MDCT VRT and curved MPR might facilitate the identification of clinically unsuspected ingested dietary FB and also provide a better depiction of their morphology.
Methods and Materials

We reviewed the medical records of all patients admitted to our institution between May 2010 and October 2012 who had a confirmed surgical diagnosis of GI tract perforation and/or obstruction caused by dietary foreign bodies. We included only patients who underwent a preoperative CT scan and with complications involving any location between duodenum and rectum. Eight patients underwent emergency surgical procedures due to GI tract complications secondary to ingested alimentary foreign bodies. All the patients were unaware of having ingested an FB preoperatively. Three patients did not undergo a preoperative CT scan and were then excluded.

We retrospectively analyzed the five patients' case notes, including clinical and surgical data. The following parameters were studied: clinical history, laboratory tests, involved site and type of FB. In all these five cases plain radiographs and abdominal ultrasound examinations were performed without a conclusive diagnosis.

We identified in which cases a conclusive preoperative diagnosis was originally reached based on conventional MDCT findings, further conducting a retrospective imaging analysis of these corresponding CT examinations. Finally, we employed additional VRT (MIP and VR in all cases) and curved MPR (as necessary in three cases) and compared these resulting images with those conventional ones.

All patients underwent CT scans with intravenous contrast medium and a bolus injection rate of 3-5ml/s. CT scans were performed on a 16-slice scanner (Philips 16 Brilliance CT, Philips Medical Systems, Best, the Netherlands) using the following parameters: 2mm collimation, 120 kVp and 260-295 mAs. MIP reformations were obtained with 8 mm thick slices. Both curved multiplanar reformations and 3D reconstructions (MIP and 3D VR) were performed on a dedicated workstation (ViewForum, Philips Medical Systems, Best, the Netherlands). Informed consent was waived by the Institutional Review Board.
Results

The five patients had a median age of 67.6 years (range, 59-85 years). There were three men (65, 67 and 85 years) and two women (59 and 62 years). All patients presented to the emergency department with acute abdominal symptoms with a median duration of 3.8 days (range, 2-8 days).

Laboratory tests were altered in all patients, with white cell count at 7,450 to 14,320 and C reactive protein at 10.0-29.2 mg (reference value 0 - 0.5 mg) on admission. In all patients laparotomy was performed for management of intestinal complications; the involved site was the ileum in two cases, sigmoid colon in two cases and the rectosigmoid junction and high rectum in one case.

The identified FB were fish bones in three patients and chicken bones in two patients. Mural thickening of an intestinal segment (3/5 patients) with extraluminal gas (localized pneumoperitoneum) (3/5 patients) and surrounding infiltrated fat (4/5 patients) were the most common CT signs. According to the original CT reports, intestinal complications were correctly identified in all five cases, but the causes of these complications were originally seen in four cases, as in one case of ileal perforation by fish bone (Fig. 1 on page 6), the long axis of the FB was in a oblique plan related to the bowel wall, which dificulted its depiction originally; in such case, therefore, the use of VRT and curved MPR allowed an easier and better identification of the FB. In the remainder four cases (Fig. 2 on page 6, Fig. 3 on page 7, Fig. 4 on page 8, Fig. 5 on page 9), although were not critical for the diagnosis, VRT techniques provided a better depiction of the FB and facilitated the assessment of their morphology (Figures 1-4), also enabling in a single slice the demonstration of a unique whole FB (Figures 1, 3, 4, 5) or two consecutive but distinctly oriented FB when using curved MPR associated to MIP (Figure 2).
Fig. 1: (A) Axial unenhanced CT scan shows a small linear hyperdensity within a thickened ileal bowel (white arrow) associated with extraluminal air (red arrow) and minor infiltration of surrounding fat; (B) axial oblique reformation with MIP allow the depiction of the whole linear FB (a fish bone) clearly transfixing the ileal wall.

© Department of Radiology, Hospital de Base, São José do Rio Preto Medical School, Brazil.
Fig. 2: (A,B) Axial contrast-enhanced CT scan through two different levels depicts two intraluminal hyperdense FB (chicken bones) in the sigmoid colon, which demonstrates mural thickening with marked enhancement and discrete surrounding fat stranding; note the findings of sigmoid diverticula, with no evidence of localized pneumoperitoneum. (C) Coronal oblique reformation of the unenhanced phase with MIP depicts in a single slice the two FB, confirming the absence of sigmoid wall transfixation, and better revealing the immediately distal occlusion induced by the inflammatory process. (D) VR image complementarily shows the morphology of FB.

© Department of Radiology, Hospital de Base, São José do Rio Preto Medical School, Brazil.
**Fig. 3:** (A) Axial contrast-enhanced CT scan demonstrates mural thickening of the sigmoid colon with extraluminal gas (arrow) and infiltration of surrounding fat; (B) more caudally, a calcified structure representing a FB is seen transfixing the sigmoid wall. (C) Axial MIP image better depicts in a single slice the curvilinear nature of the whole FB (a fish bone), whose morphology is complementarily appreciated through a VR image (D).

© Department of Radiology, Hospital de Base, São José do Rio Preto Medical School, Brazil.
**Fig. 4:** (A) Axial contrast-enhanced CT scan shows an intraluminal linear calcified FB (a fish bone) transversely oriented in an ileal bowel and transfixing its wall, associated with minimal surrounding fat stranding and free pneumoperitoneum seen in a very small quantity (arrow). (B) Coronal oblique reformation of the unenhanced phase with MIP allows to visualize the whole FB and to better detail its morphology (note the bifurcate ending).

© Department of Radiology, Hospital de Base, São José do Rio Preto Medical School, Brazil.
**Fig. 5:** (A) Axial and (B) sagittal reformatted contrast-enhanced CT scan shows an intraluminal calcified FB (chicken bone) in the rectosigmoid junction transfixing its posterior wall as well the left lateral wall of the high rectum, which is adherent; given the particular orientation of the FB, axial MIP images were of no additional value in this case. (C,D) VR images in two different planes provide additional morphologic details of the FB.

© Department of Radiology, Hospital de Base, São José do Rio Preto Medical School, Brazil.
Conclusion

Dietary bone fragments represent a challenge in the diagnosis of FB perforation, as these objects are swallowed numerous times, ingested accidentally and forgotten [1]. Therefore, because of the inability in obtaining a history of FB ingestion, the consequent low degree of clinical suspicion, and also the non-specificity of clinical presentation [1,5], perforations secondary to dietary FB are extremely difficult to diagnose [1]. In this sense, imaging examinations should be assessed with a high index of suspicion [5,7], as a precise preoperative diagnosis may guide the appropriate treatment, either surgical or clinical [7].

In this study we aimed to assess if the use of additional tools to conventional axial CT scans, such as VRT and, in some cases, curved MPR, might facilitate the identification of ingested dietary FB or better depict their morphology. We based this on the assumption that as these FB appear as hyperdense structures on CT scans (although some of them may be only slightly hyperdense or appear as very faint structures depending on their spatial orientation), techniques such as MIP might highlight them. After the identification of such structures, curved MPR may be used to follow them spatially along their whole extension. Finally, by creating and displaying from any perspective a 3D visual illustration of CT volumetric data [10], VR can be a complementary mode to depict FB and easily understand its morphology.

As in only one case in this series a FB was originally missed on axial slices, the use of VRT and curved MPR at that time would not have had a direct impact on diagnostic performance in most cases. However, these techniques provided a better depiction of the FB and facilitated the assessment of their morphology, which might be useful in a clinical scenario where the lack of observer awareness is a known problematic issue [1]. In addition, VR advantages of providing a sensation of three-dimensionality [10] facilitate a rapid and clear identification of FB, which may be useful for documentation purposes.

We conclude that in some very restricted emergency cases of patients with nonspecific abdominal complaints and unexplained intestinal alterations depicted in CT scans (e.g., mural thickening, localized pneumoperitoneum, fat stranding), VRT and curved MPR might be used to better search for an unsuspected dietary FB that may have been overlooked in a first read.
References


Personal Information

Augusto César Vieira Teixeira, M.D.
Ulysses S. Torres, M.D. *
Fabiana Gual, M.D.
Tarik Nagib El Kadri, Jr., M.D.
Luciana Vargas Cardoso, M.D.
Tufik Bauab, Jr., M.D., PhD.

Department of Radiology, Hospital de Base, São José do Rio Preto Medical School, Brazil.

* usantor@yahoo.com.br