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Original communication

Diagnostic value of CT-localizer and axial low-dose computed tomography for the detection of drug body packing

Joel Aissa [a,*], Antonia Kohlmeier [a], Christian Rubbert [a], Ulrich Hohn [b], Dirk Blondin [c], Christoph Schleich [a], Patric Kröpil [a], Johannes Boos [a], Gerald Antoch [a], Falk Miese [a]

[a] University Dusseldorf, Medical Faculty, Department of Diagnostic and Interventional Radiology, Moorenstr. 5, D-40225 Dusseldorf, Germany
[b] Hauptzollamt Düsseldorf, Sachgebiet C/KE 23, Überwachungsgruppe Rauschgift/Waffen, Terminalring 1, D 40474, Germany
[c] Städtische Kliniken Mönchengladbach GmbH, Elisabeth-Krankenhaus Rheydt, Department of Radiology and Nuclear Medicine, D-41239 Mönchengladbach, Germany

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ABSTRACT

Objectives: The purpose of this study was to assess the diagnostic performance of CT-localizers in the detection of intracorporal containers.
Methods: This study was approved by the research ethics committee of our clinic. From March 2012 to March 2013, 108 subjects were referred to our institute with suspected body packing. The CT-localizer and the axial CT-images were compared by two blinded observers retrospectively. Presence of body packs was assessed in consensus. Sensitivity and specificity, PPV and NPV of the CT-localizer were calculated.
Results: Packets were detected in the CT-localizer of 19 suspects. In 28 of 108 cases packs were detected in axial CT-images. Sensitivity of CT-localizer for detection of packs was 0.68, and specificity was 1.00. There were no cases rated as false positive. The PPV was 1.0 and the NPV was 0.89. The omission of the axial CT-images would have led to a mean radiation dose reduction of 1.94 ± 0.5 mSv.
Conclusions: The value of CT-localizers lies in their high PPV. Localizers are limited by low sensitivity, compared to axial CT-images in screening of potential body packers. However, in positive cases their high PPV may possibly allow to omit the complete axial abdominal CT to achieve even lower radiation exposure.

1. Introduction

Subjects referred to radiology for suspicion of body packing are both, possible delinquents and patients at threat for lethal complications. Therefore the care of patients suspected of transporting intracorporeal drugs requires immediate radiological attention. Specific imaging investigations are unrenounceable to detect and to prove illegal drug containers.[1] A common setting is that law enforcement agencies refer suspected body packers, usually young persons, to a hospital to undergo a radiologic examination. The number of body packers increased over the last years.[2]

The non-contrast computed tomography (CT) is a fast, accurate and readily available diagnostic method for the detection of packets, with high sensitivity and specificity.[3] Especially for the detection of liquid drugs the diagnostic superiority of CT over X-ray has long been established.[3–5]

Body packers use several forms of incorporeal transportation; the packs are swallowed or stuffed in body cavities like the rectum or vagina for transportation of larger quantities.[6,7] The average body packer systematically learns to swallow up to 40–80 packs over several hours prior to boarding-time. Parasympathomimetic drugs are used to reduce the intestinal peristalsis in order to retain intestinal packs for a long-haul flight.[8] The body packer syndrome is a serious complication of body packing, first described in 1980: as packets leak or burst after ingestion, the patient is at risk of sudden overdose and death.[9,10]

The increased radiation exposure of CT compared to abdominal X-ray is a major limitation to its systematic use for screening of body packing.[11] This is of even higher relevance as body packers are not infrequently young patients with a mean age between 20 and 30 years.[11] Low-dose CT protocols may deliver a radiation dose close to that of abdominal radiography, but nevertheless in cases of

* Corresponding author. Tel.: +49 211 8117752; fax: +49 211 8119487.
E-mail address: Joel.Aissa@med.uni-duesseldorf.de (J. Aissa).

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Table 1
Demographics of suspected and convicted body packers study population.

	Suspected body packers (n = 108)	Positive result in low-dose CT (n = 28)	Negative result in low-dose CT (n = 80)
Mean age (years)	34.3 ± 8.70 (18–56)	31.78 ± 9.25 (19–53)	35.49 ± 8.78 (18–56)
Gender (female/male)	22/86	5/23	17/63

negative results low-dose CT remains an unnecessary radiation exposure in an otherwise healthy individual.[12–14]

For further reduction of radiation exposure, omission of abdomen CT in cases with positive CT-localizer would be desirable. The purpose of this study was to assess the diagnostic performance and image quality of CT-localizers in the detection of illegal intracorporal containers.

2. Materials and methods

2.1. Patients

This retrospective study was approved by the local research ethics committee of our clinic. Between March 2012 and March 2013, 108 consecutive patients (22 female, 86 male; mean age 34.3 ± 8.7 years) suspected of having ingested drug packets received a CT examination in our department and were retrospectively included in the study (Table 1). All subjects either gave informed consent to imaging or a judicial decision had been obtained. A pregnancy test was systematically obtained at our emergency unit in each woman of childbearing age who agreed to undergo imaging. Pregnant women and persons younger than 18 years of age were excluded from the evaluation. The CT was immediately read by the radiologist on duty. The final stool analysis in positive cases was performed at the custom administration of the related international airport.

2.2. CT protocol

CT examinations were performed on a 128-slice CT (SOMATOM Definition AS+, Siemens AG, Healthcare Sector, Forchheim, Germany). A non-contrast CT protocol was used.

The CT-localizer parameters were as follows for all groups:

- Reference tube potential 120 kV
- Slice acquisition 0.6 mm
- Tube current 35 mA
- Length of measurements 6 s

The CT imaging parameters were as follows for all groups:

- Reference tube potential 120 kV
- Tube current time product 40–60 mAs
- Slice acquisition 128 × 0.6 mm
- Gantry rotation time 0.5 s
- Pitch 0.6
- Length of measurements 12.58 s

Table 2
Evaluation of CT-localizers in detection of packets, with low-dose CT used as reference standard.

	Negative low-dose CT result	Positive low-dose CT result
Negative localizer result	80	9
Positive localizer result	0	19

2.3. Image processing

Raw data were reconstructed in transversal images of 1.0 mm and 5.0 mm slice thickness using a soft tissue kernel (H30f). Additionally, coronal and sagittal multiplanar reformations (MPR) with 5.0-mm were reconstructed and displayed in a soft tissue window. Image data were transferred to a picture archiving and communication system (PACS/Sectra Medical Systems GmbH, Linköping, Sweden) for further analysis.

2.4. Reference standard

All patients underwent a CT examination including a CT-localizer to document the detailed location of the smuggled packs (swallowed or stuffed). In this study, the complete axial abdominal CT-images served as reference standard.

2.5. Objective image quality

The objective image quality was determined by the contrast-to-noise ratio (CNR) and the signal-to-noise ratio (SNR) in the axial abdominal CT-images. For evaluation of the objective image quality, region of interest measurements were performed in the center of a representative pack (ROI1) in the 1 mm axial CT slices, as well as in the left erector spinae muscle (ROI2), and the adjacent air (ROI3).[15] The standard deviation (SD) of the air measurements was defined.

Contrast-to-noise-ratio and Signal-to-noise-ratio were calculated as follows[16]:

$$\mathrm{CNR} = \text{pack density (ROI1)} - \text{muscle signal (ROI2)} / \text{background noise (ROI3)}$$

$$\mathrm{SNR} = \text{pack density (ROI1)} / \text{background noise (ROI3)}.$$

2.6. Visual grading analysis (VGA)

To assess subjective image quality a five step scale was used.[17] Assessment was based on visualization of important structures from the European quality criteria (1 = excellent, 2 = good, 3 = moderate, 4 = poor, 5 = unacceptable, non-diagnostic).[17] For the CT the radiologists graded the visually sharp reproduction of the liver parenchyma, the splenic parenchyma, the intestine, the perivascular retroperitoneal space, the pancreatic contours, the duodenum, the kidneys, the aorta and vena cava. For the CT-localizer a sharp reproduction of the diaphragm and lateral costophrenic angles, visually sharp reproduction of the bones, visualisation of the M. psoas outlines was graded.

Table 3
Sensitivity, specificity and predictive values of CT-localizers in detection of packets, with low-dose CT as reference standard.

	Estimated value	95% Confidence interval
Sensitivity	0.68 (19/28)	(0.48–0.84)
Specificity	1.0 (80/80)	(0.93–1.00)
Positive predictive value	1.0 (19/19)	(0.75–1.00)
Negative predictive value	0.89 (80/89)	(0.82–0.95)