Lung window in abdominal computed tomography of drug mules: is it really useful?

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Aims and objectives

"Drug mules" which are carriers with internal illicit drugs have been a real challenge for emergency radiologic departments for their medicolegal aspects. They are referred to as "swallowers", "couriers", "internal carriers" or commonly "body packers", however separate specific categories are applied for them in the literature. A "Body packer" swallows a large amount of specially prepared drug packets in an attempt to transport them across international borders without detection. "Body pushers" hide drug packets into the rectum or vagina. The number and size of the packets may vary, but each one will usually contain many times the toxic dose of the drug, which is commonly cocaine, heroin or opioids according to local demands. In contrast, "Body stuffers", which may be abusers themselves, spontaneously ingest small amounts of either unwrapped or poorly wrapped drugs pellets when fearing apprehension by the authorities, in order to dispose of evidence (1,2). Small pellets commonly measure less than one centimeter and contain equal or less than one gram of the drug, however leakage or rupture due to loose coverage can end fatally in an unhabituated user (3,4).

Diagnostic imaging has a crucial role in early and accurate detection of drug mules. Although plain abdominal x-ray is routinely used as the screening tool in evaluating suspects (5-8), it is of limited value in body stuffers and body packers who already partially excreted their main drug payload due to a small amount of drugs that may be superimposed on plain X-rays(9). Unenhanced computed tomography (CT) is widely accepted to be highly sensitive and specific in these cases (10,11) however false negative CT reports have been documented (12,13). Manipulation of the image widowing (level/width) in CT has revealed drug packets in the bowel which were undetected in abdominal windows (14). Therefore, reviewing of abdominal CT in lung window has been used recently for better delineation of body packets and pellets (15,16).

In this retrospective study we purposed to evaluate the usefulness of adding lung window to conventional abdominal window in detection of drug mules.

Methods and materials

Our hospital is a major toxicology referral center with the most experience in body packing cases in Tehran, Iran. The medical records of all persons with suspicion of internal concealment of drugs who were brought to our hospital by the narcotics police between April 2012 and July 2013 were reviewed. A total number of 40 suspects (35 males, 5 females) with average age of 32 ± 7.8 years, (range: 16-46 years) were included. The suspects underwent abdominal CT scan without oral contrast using a single slice CT scanner during their admission in hospital. Identification of drug carriers was based on retrieves of all packets from feces in a guarded drug toilet or surgery.
The CT scans were reviewed by a board-certified radiologist who was blinded to the results of the stool examinations or surgery using a Picture Archiving and Communication System in both abdominal (L: 50, W: 450) and lung windows (L: #500, W: 1500). Number and location of packets (stomach, small intestine, colon or rectum) were also determined.

All statistical analyses were performed using the SPSS 15.0.1 statistical package (SPSS, Inc., Chicago, IL, USA). Descriptive statistics was used. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy for drug concealment were calculated for CT scan evaluated only in abdominal window and CT scan evaluated in both abdominal and lung window in all "drug mules" and in each subgroup of body packers and stuffers.

Results

From forty suspects, drug containers were retrieved from 28 ones which seven suspect were body packers (17.5%) and 21 were body stuffers (52.5%). Illicit drugs were methamphetamine in 14, opioids in 9 and mixture of them with other hallucinogens in 5. Drugs were packed with nylon, digits and zipped packs in 14 (82%), 4 (14%) and 1 (4%) cases, respectively.

A total of 40 abdominal CT scans were evaluated using abdominal window and 14 true positive, 12 true negative, 14 false negative and no false positive were reported. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy were 50%, 100%, 100%, 46% and 65%, respectively. By adding lung window, true positive diagnosis increased to 15 cases which resulted in a sensitivity of 53.5%, NPV of 48% and accuracy of 67.5%.

Analyzing the results in subgroups showed that in body packers (seven cases), the sensitivity, specificity, PPV, NPV and accuracy were 100% for all parameters before and after using lung window. However, with adding lung window to abdominal window more number of packs could be detected (mean of 7.4 vs. 6.9 with standard deviation of 0.19) and the difference was significant (p=0.04) (Figure 1)

In twenty one body stuffers, abdominal window showed 7 true positive, 12 true negative, 14 false negative and no false positive report. The sensitivity, specificity, PPV, NPV and accuracy were 33%, 100%, and 100%, 46% and 57.5%, respectively. Adding lung window truly detected one more positive case due to its hypodense peripheral cover and increased the sensitivity to 38% and accuracy to 60.6% consequently (Figure 2).

Table 1 depicts an overview of total cases, body packers, and stuffers.

Images for this section:
Fig. 1: Abdominal window (A) depicts a single packet in distal part of stomach. Lung window (B) in the same slice, apparently shows more packets in stomach which are barely visible in abdominal window.

Fig. 2: Abdominal window (A) was reported negative in this body stuffer, however reviewing in lung window (B) two small pellets revealed due to their surrounding air halo and central solid component (arrows).
Table 1: Overview of diagnostic performance for total cases and subgroups (body packers and body stuffers).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Exam</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>PPV (%)</th>
<th>NPV (%)</th>
<th>Accuracy (%)</th>
</tr>
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<tr>
<td>Total cases</td>
<td>Abdominal window</td>
<td>50</td>
<td>100</td>
<td>100</td>
<td>46</td>
<td>65</td>
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<tr>
<td></td>
<td>Abdominal + Lung</td>
<td>53.5</td>
<td>100</td>
<td>100</td>
<td>48</td>
<td>67.5</td>
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<tr>
<td>Body packers</td>
<td>Abdominal window</td>
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<td>100</td>
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<td></td>
<td>Abdominal + Lung</td>
<td>100</td>
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<tr>
<td>Body stuffers</td>
<td>Abdominal window</td>
<td>33</td>
<td>100</td>
<td>100</td>
<td>46</td>
<td>57.5</td>
</tr>
<tr>
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<td>Abdominal + Lung</td>
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<td>100</td>
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PPV = Positive predictive value  
NPV = Negative predictive value
Conclusion

In examining the abdominal CT scan of drug mules, detection of illicit drugs in their gastrointestinal tract is usually made by either different density of the drug from other luminal contents or their distinct and often uniform shape or coverage. Packets composed of radio-dense material can be diagnosed easily, even in plain abdominal x-ray or CT scout view; however diagnosis of isodense or hypodense drugs is more difficult. In these cases, lung window will help us since very commonly the packet's cover is made of hypodense substance (e.g. latex or plastic) or there is a crescent of air trapped in the periphery of the packets while sealing, which was termed previously as "double condom" sign (17,18). By using lung window this hypodense halo is better depicted and accentuates the distinction of packages from the adjacent fecal material.

We depicted that accuracy of CT scan for detection of body packers were 100% which is in concordance with similar recent articles (15,16). However in body stuffers, the accuracy was much lower which is in contrast to study by Flach et al. (15). Likewise, adding lung window only detected one extra stuffer and this seems to be the clue to this low sensitivity. The stuffers in our study mainly ingested pellets with loose plastic bag devoid of sufficient hypodense cover or peripheral air for detection of these small particles. As Schmidt et al. (8) mentioned in their study, this outer halo surrounding an inner spherical high-attenuating structure, corresponding to the cocaine, is the key radiological feature in detection of small drug pellets and is better visualized by lung window. Therefore detection of stuffers in our study was limited to hyperdense pellets (Figure 3). The CT characteristics of drug pellets differ depending on their geographic origin and further studies are encouraged in this matter. Our study has several limitations; CT scans had been performed with a single row detector scanner and no multiplanar reconstructions were available which would partially explain our low sensitivity in body stuffers. The number of subjects in each subgroup (packers and stuffers) was small which would have decreased the validity of our statistical analysis.

Reviewing abdominal CT scans in lung window is a simple way without adding extra radiation or cost. Although adding lung window did not increase our accuracy in detection of drug mules significantly, we showed that by reviewing abdominal CT scans with lung window more number of packets could be detected in patients formerly diagnosed with drug packs.

Images for this section:
**Fig. 3:** Abdominal window (A,B) depicts small hyperdense pellets in ascending colon in this body stuffer which are not detectable in their respective slices in lung window (C,D) since they do not have enough covering wrap around to make them recognizable especially in lung window.
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References


