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The role of ultrasonography in the imaging of body packers comparison with CT: a prospective study

Ferhat Cengel,[1] Mesut Bulakci,[2] Tuba Selcuk,[1,3] Yildiray Savas,[1] Muhammet Ceyhan,[1] Ayhan Kocak,[1] Cigdem Ozkara Bilgili[4]

[1]Department of Radiology, Haseki Training and Research Hospital, Millet Caddesi, Aksaray, 34096 Istanbul, Turkey
[2]Department of Radiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Turkey
[3]Department of Medical Sciences, Istanbul Gelisim University, Istanbul, Turkey
[4]Department of Radiology, Bayrampasa State Hospital, Istanbul, Turkey

Abstract

Purpose: This study investigated the sonographic properties of drug packets containing narcotic drugs and the diagnostic role of ultrasonography in detecting body packing in comparison with CT.
Methods: Forty-five suspects admitted to our hospital for diagnosis and management were routinely evaluated by non-contrast CT for the presence of drug packets. A single radiologist blind to CT data independently performed the abdominal ultrasonographic scans.
Results: Thirty-five of 45 suspects were carrying packets. In positive cases, two types of packets with different properties were noted. Twenty-eight cases had type 1 packets (solid form drug) and 7 had type 2 packets (liquid form cocaine). The sensitivity, specificity, positive, and negative predictive values of ultrasonography for detecting drug packets were 91%, 70%, 91%, and 70%, respectively. Ultrasonography accurately determined the presence or absence of packs in 39 of 45 suspects.
Conclusion: Ultrasonography was found to have a high sensitivity but a low specificity in suspected cases. A negative ultrasonography cannot rule out the diagnosis of body packing. However, it may be preferred as the initial imaging method or for follow-up of suspected cases as a radiation-free, easy-to-use, and inexpensive technique.

Key words: Body packing—Drug smuggling—Abdominal ultrasound—Computed tomography

Correspondence to: Ferhat Cengel; *email:* doc_20_1@hotmail.com

Currently, illegal drug smuggling cannot be fully prevented despite all efforts. Carrying packets containing narcotic drug materials in body cavities is a type of smuggling called *body packing* that has been known for many years. It was first introduced into medical literature in 1973 by a report of a 21-year-old patient with small bowel obstruction after ingestion of a hashish-containing packet [1].

Body packing defines ingestion of hand-made or automatically manufactured packets containing narcotic drugs to carry them inside gastrointestinal system lumen (GIS) or placing them into vaginal or rectal lumen [2]. The term "*body stuffer*" refers to a person carrying a reduced number of smaller packets hastily packed with fear of being caught [3]. Smugglers may resort to less suspicious methods. Cases of pediatric [4] or pregnant [5] body packers have been reported in the literature.

Body packers usually ingest to carry 2–5 cm long packets made of narcotic drugs with high financial value, such as cannabis products (marijuana, hashish, etc.), heroin, or cocaine, wrapped by certain materials such as balloon, condom, latex gloves, cellophane, or aluminum foil. Smaller packets are ingested while larger ones are typically placed into the vagina or rectum [2]. A body packer can carry an average number of 40–80 packets in GIS lumen. Body packers use antimotility drugs such as diphenoxylate or loperamide after ingesting packets to prolong intestinal passage time, and they take laxatives to facilitate defecation of packets via physiological ways after arriving at target location [2, 3, 6].

As clinical history is not reliable in body packing suspects, plain X-ray films, ultrasonography (US), and computed tomography (CT) have been used for many years for diagnosing and scanning for drug packets.

Magnetic resonance imaging (MRI) has also been reported to be a reliable method for use in these cases [7]. Plain X-ray films, despite having a low sensitivity, have been used as scanning method in many countries due to their wide availability and low radiation dose [3, 8, 9]. Despite US being a radiation-free, cheap, and rapid technique, literature data on its use for this indication are fairly limited. This prospective study investigated the types (solid form drug-type 1 and liquid form drug-type 2) of drug packets, ultrasonographic imaging findings of drug packets and aimed to stress the points to consider in order to distinguish them from intestinal gas and contents by US in comparison with CT, the gold standard imaging modality for drug packs [8, 9].

Materials and methods

Study design and subjects

This prospective study was approved by our hospital ethics committee. Informed consent was obtained from all individual participants included in the study. Persons taken into custody for suspected body packing by narcotic police at two international airports in our city were brought to our hospital for diagnosis and management between March 2014 and January 2015. Following completion of airport and hospital bureaucratic procedures, 45 suspects underwent abdominal US and our hospital's routine suspect imaging modality, non-contrast whole abdomen CT, for drug packets. Following completion of all clinical, biochemical, and radiological examinations, all suspects were monitored for defecation of all packets. The number and weights of all packets were calculated in each case. Detailed chemical analyses of the packets were carried out in narcotic criminal laboratories.

Imaging techniques

Ultrasonographic evaluation was performed by a radiologist (FC) with a 4-year experience in abdominal US using a low-frequency (3.5 MHz) convex probe (Toshiba Aplio 500, Toshiba Medical Systems, Otawara, Japan and Mindray DC-7, Mindray Bio-Medical Electronics, Shenzhen, China) with the subjects in supine position and right or left lateral positions as needed. The estimated examination time varied between 5 and 15 min (mean 7 ± 2 min). The suspects were asked to drink approximately 500 mL water just before imaging to better visualize the gastric lumen. Fluid-filled gastric lumen, cecum, and rectosigmoid region, where drug packs are commonly found and ultrasonographic evaluation is relatively simple, were evaluated by US for the presence of drug packets. In the case of absence of packets being found in the mentioned localizations, other colonic segments and loops of small intestine were subjected to additional scanning for the presence of drug packets.

Abdominal CT scans included in this study were obtained standard dose protocol of our hospital with a 16-slice CT scanner (Brilliance 16, Philips Medical Systems, Cleveland, Ohio, USA) without any contrast medium administration. The following CT parameters were used: collimation, 16×1.5 mm; tube current, 150 mA; tube potential, 120 kVp; gantry rotation time, 0.5 s; pitch value, 0.93. The scan range was from the dome of the diaphragm to the symphysis pubis. All images were reconstructed with an image matrix of 512×512 pixels, an image thickness of 3 mm, and a slice increment of 1.5 mm using B/C reconstruction filter.

Image interpretation

In our study, we have encountered two types of packet including solid or liquid form drugs (Fig. 1). On US, multiple, uniform, immobile hyperechogenic structures with posterior acoustic shadowing and a linear or arcuate contour in long axis and arcuate contour in short axis were considered positive for type 1 packets (Figs. 2, 3, 4). Type 2 packets, on the other hand, appeared as multiple, hyperechogenic structures with posterior acoustic shad-

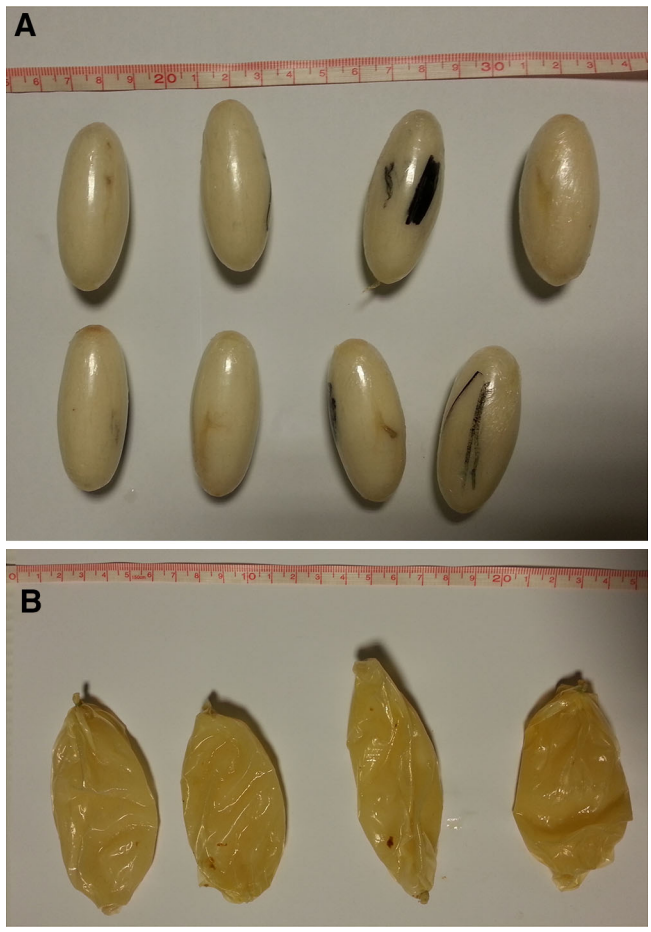


Fig. 1. Packet samples containing solid form drug (**A**) and liquid cocaine (**B**).

owing and irregular contour (Fig. 5). Differentiation of both packet types from intestinal loops was made on the basis of packets being immobile, multiple, and producing clean posterior acoustic shadowing instead of dirty shadowing.

The evaluation by CT examination was carried out using the criteria prespecified elsewhere [3, 8]. All images were evaluated in both abdomen (C: 50; W: 450) and lung (C: −500; W: 1500) window settings. CT served as the reference standard. Positive CT findings were validated by clinical follow-up (expulsion of drug packets) or surgical findings. All CT images were interpreted by two radiologists (FC and MB) on a Picture Archiving and Communication System (PACS) imaging workstation (Infinitt PACS, Infinitt Healtcare, Seoul, Korea) with a consensus reading obtained.

CT dose estimation

For each CT examination, computed tomography dose index (CTDI) and dose-length product (DLP) values were obtained on the basis of scanner output (dose report), which was automatically generated by the system. The effective radiation dose delivered at abdomen CT effective dose (mSv) was calculated from DLP multiplied by a conversion factor (0.015 mSv/mGy cm) as published by Deak et al. [10]. The mean DLP values for CT of the whole abdomen were 584.85 mGy cm (range 488–819). In 45 patients, the estimated mean effective radiation dose was 8.77 mSv (range 7.3–12.3).

Statistical analysis

All statistical analyses were performed using the SPSS 15.0.1 statistical package (SPSS, Inc., Chicago, IL, USA). Descriptive statistics are given as means/medians (±SD) for quantitative variables and as proportions for qualitative variables. Sensitivity, specificity, and positive and negative predictive values (PPV and NPV) of abdominal US were calculated. The difference between abdominal CT and abdominal US with respect to success at detecting drug-containing packets was calculated by

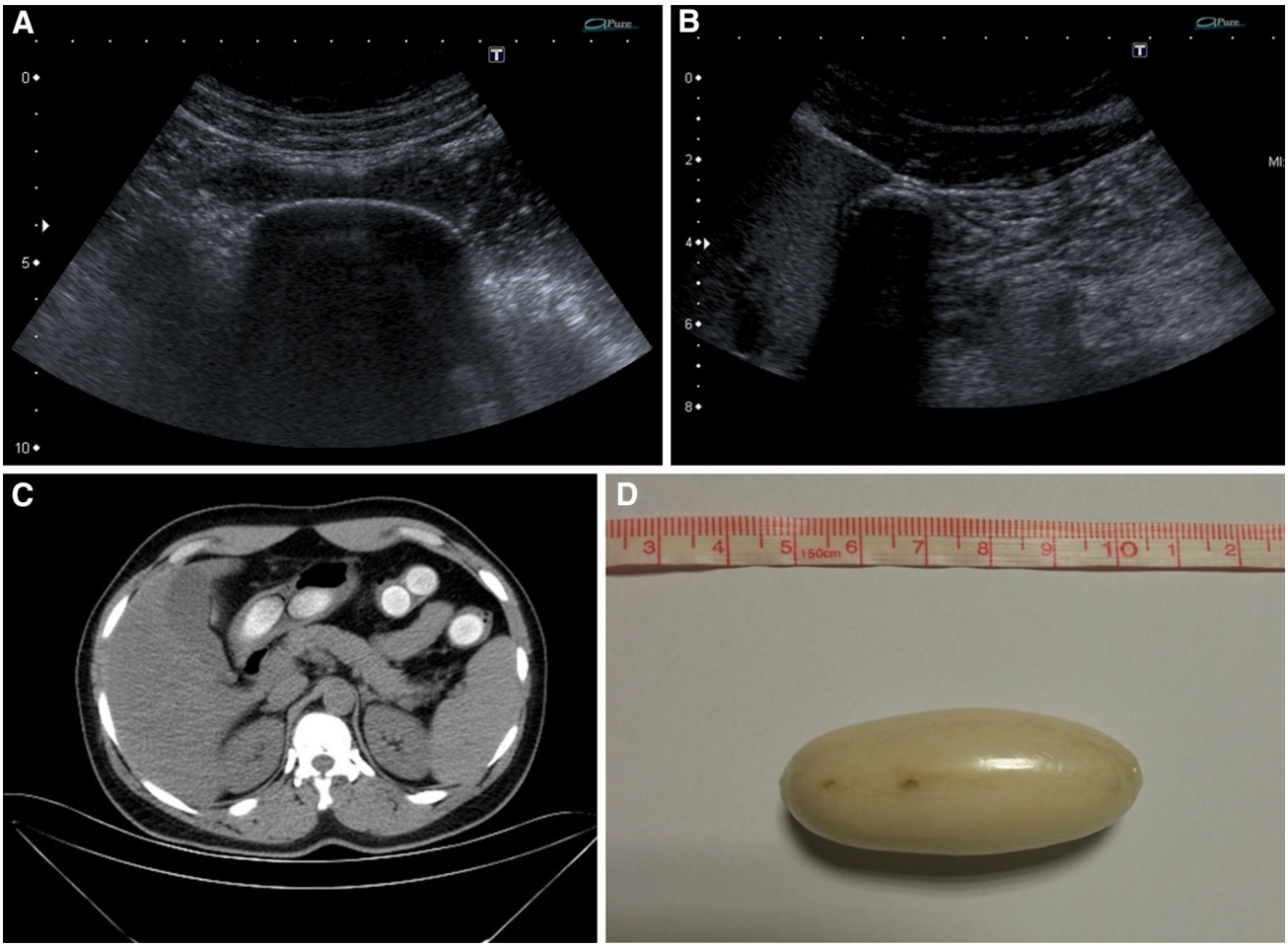


Fig. 2. A 41-year-old male with arcuate hyperechogenic packet and clean posterior acoustic shadowing in long (**A**) and short (**B**) axis at the level of gastric antropyloric lumen. Its appearance on axial non-contrast CT (**C**). Some packets are also seen in transverse colon lumen (**C**).

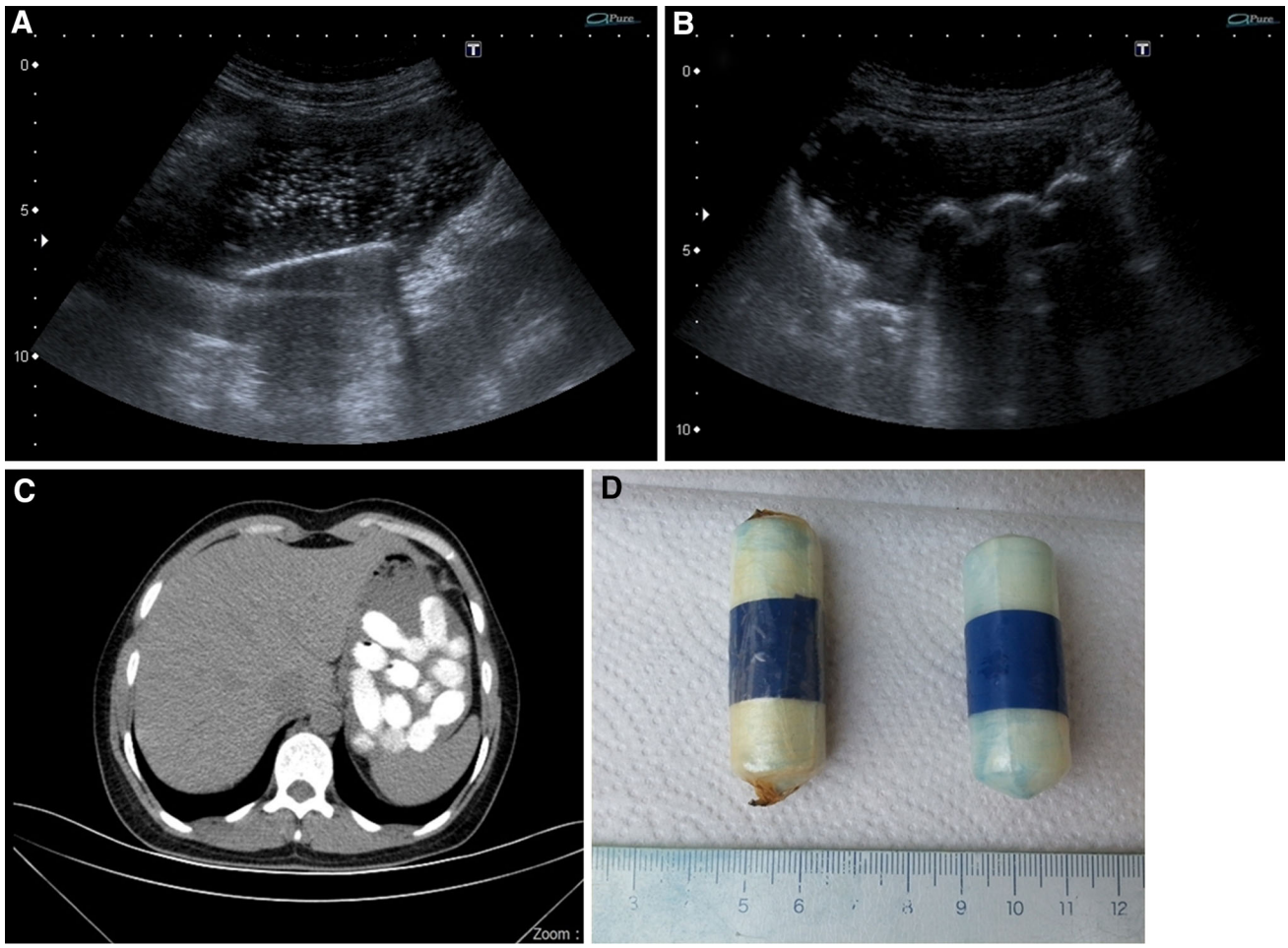


Fig. 3. A 30-year-old female. A linear in long (**A**) and arcuate in short (**B**) axis hyperechogenic packet and posterior acoustic shadowing in gastric lumen after drinking water. Its appearance on axial non-contrast CT (**C**).

the Chi-square test in 45 subjects who underwent both modalities. The difference between both packet types with respect to time to complete expulsion of all packets from body was analyzed by the Mann–Whitney *U* test. A *p* value of less than 0.05 was interpreted as statistically significant.

Results

Thirty-five of 45 suspected cases were diagnosed by CT as body packer. Individuals who are free of drug packets were discharged. Twenty-eight males and 7 females diagnosed as body packers (age range 22–57 years, mean age 37 years) underwent clinical and laboratory examinations followed by a period monitoring for physiological discharge of the packets. Chemical analysis showed the contents of the packets to be cocaine of varying purity in 26 patients, heroin in 2, and liquid cocaine in 7. The mean number of packets carried at each time by one body packer was 61 (23–109). Each packet was containing drugs between 6.3 and 57.1 g, and the average amount of material carried by each subject was 1074 g. As previously described by two other studies [3, 7], type 1 packets in this study were smooth, spherical, or ovoid in shape containing narcotic drugs in solid form (Fig. 1A). Type 2 packets, on the other hand, contained liquid form cocaine within a condom and had an irregular contour (Fig. 1B).

On CT, type 1 packets were determined as having a homogenous or heterogenous inner structure with varying densities depending on the content, whereas type 2 packets were appeared as homogenously hyperdense.

According to CT data of 35 subjects for the presence of drug packets in three localizations, packets were found to be localized in stomach in 15 (15/35, 43%) of cases, cecum in 27 (27/35, 77%), and rectosigmoid region in 34 (34/35, 97%). Type 1 packets were localized in stomach in 14 (14/28, 50%) suspects, cecum in 21 (21/28, 75%), and rectosigmoid region in 27 (27/28, 96%). Type 2 packets were localized in stomach in 1 (1/7, 14%) suspect, cecum in 6 (6/7, 86%), and rectosigmoid region in 7 (7/7, 100%) suspects (Table 1).

Of 35 suspects carrying packets, 32 had a positive US. Of 10 suspects not carrying packets, 7 were determined

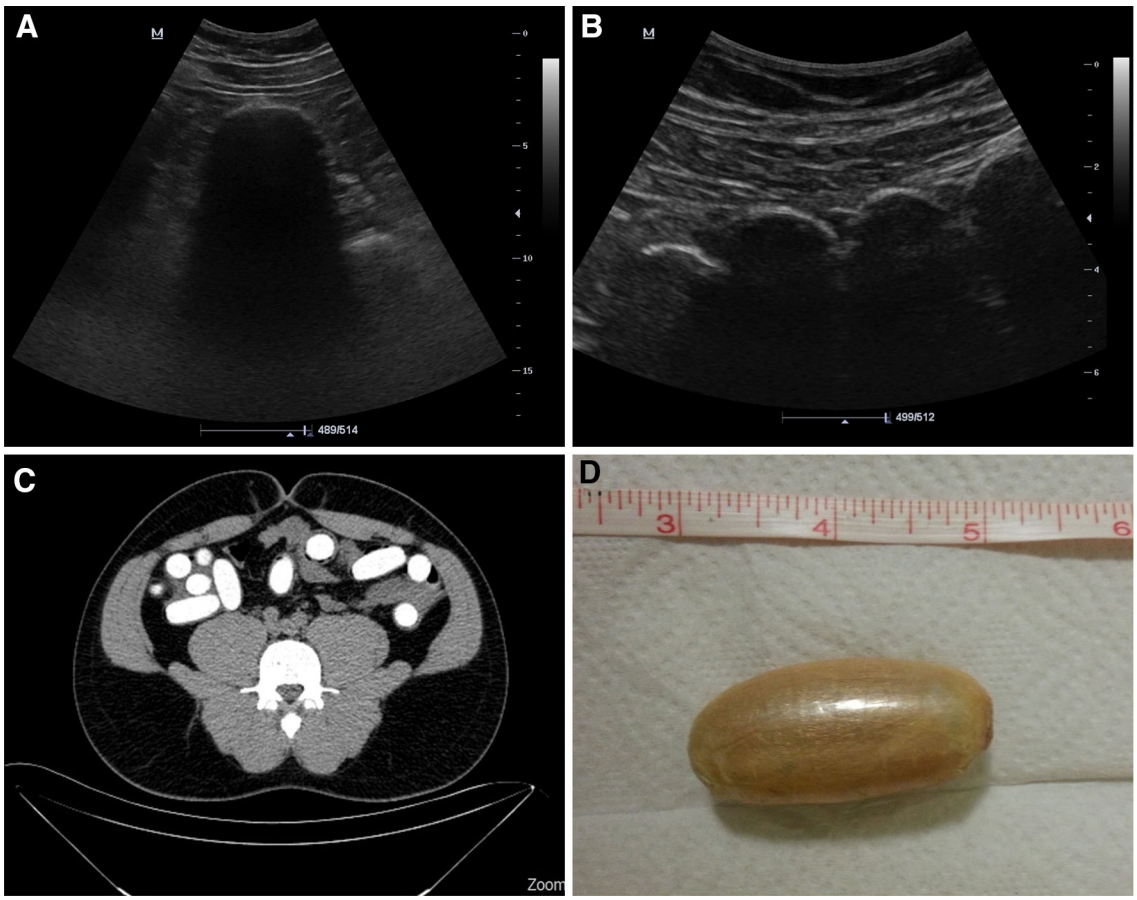


Fig. 4. A 39-year-old male. Smooth-contoured, multiple arcuate hyperechogenic packets with clean posterior acoustic shadowing in pericecal region (**A**, **B**). Their appearance on axial non-contrast CT (**C**). Some packets are also seen in descending colon and small intestinal lumen (**C**).

Table 1. Package localizations determined by CT data

	Stomach	Cecum	Rectosigmoid
Type 1 packet	14/28, 50%	21/28, 75%	27/28, 96%
Type 2 packet	1/7, 14%	6/7, 86%	7/7, 100%
Total	15/35, 43%	27/35, 77%	34/35, 97%

The packets observed in other intestinal segments were not taken into consideration

Table 2. Ultrasonography results in 45 suspected cases

	Positive CT	Negative CT	Total
Positive US	32	3	35
Negative US	3	7	10
Total	35	10	45

by US. US yielded a false negative result in 3 cases and a false-positive result in 3 cases. The sensitivity, specificity, PPV, and NPV of ultrasonography were found 91%, 70%, 91%, and 70%, respectively (Table 2). As a result, US provided a correct result in 39 (87%) of 45 suspected cases. Two of false negative cases were carrying type 2 packets and 1 was carrying type 1 packets. In these cases, packages could not be clearly differentiated from intestinal gas and content. In three false-positive cases, intestinal gas and contents were interpreted as liquid packets.

Positive cases were put under monitorization in emergency department after being administered oral enema. As a hospital policy, a predischarge CT is taken in this patient group after three packet-free defecations. The time to defecate all packets varied between 1 h and 9 days and was 45 h on average. It varied between 6 h and 9 days and was 54 h on average for type 1 packets, while it varied between 1 and 14 h and was 9 h on average for type 2 packets. Two cases carrying type 1 packets (two men with 38 and 41-year-old) were operated with gastrotomy to remove one packet failed to pass the antropyloric region on the 8th and 9th days, respectively (Fig. 6). Neither of our cases had intestinal obstruction or perforation nor did they have signs or symptoms of intoxication as a result of package rupture or leakage.

Discussion

Radiology assumes an important task in early diagnosis and follow-up of cases of body packing. Drug intoxica-

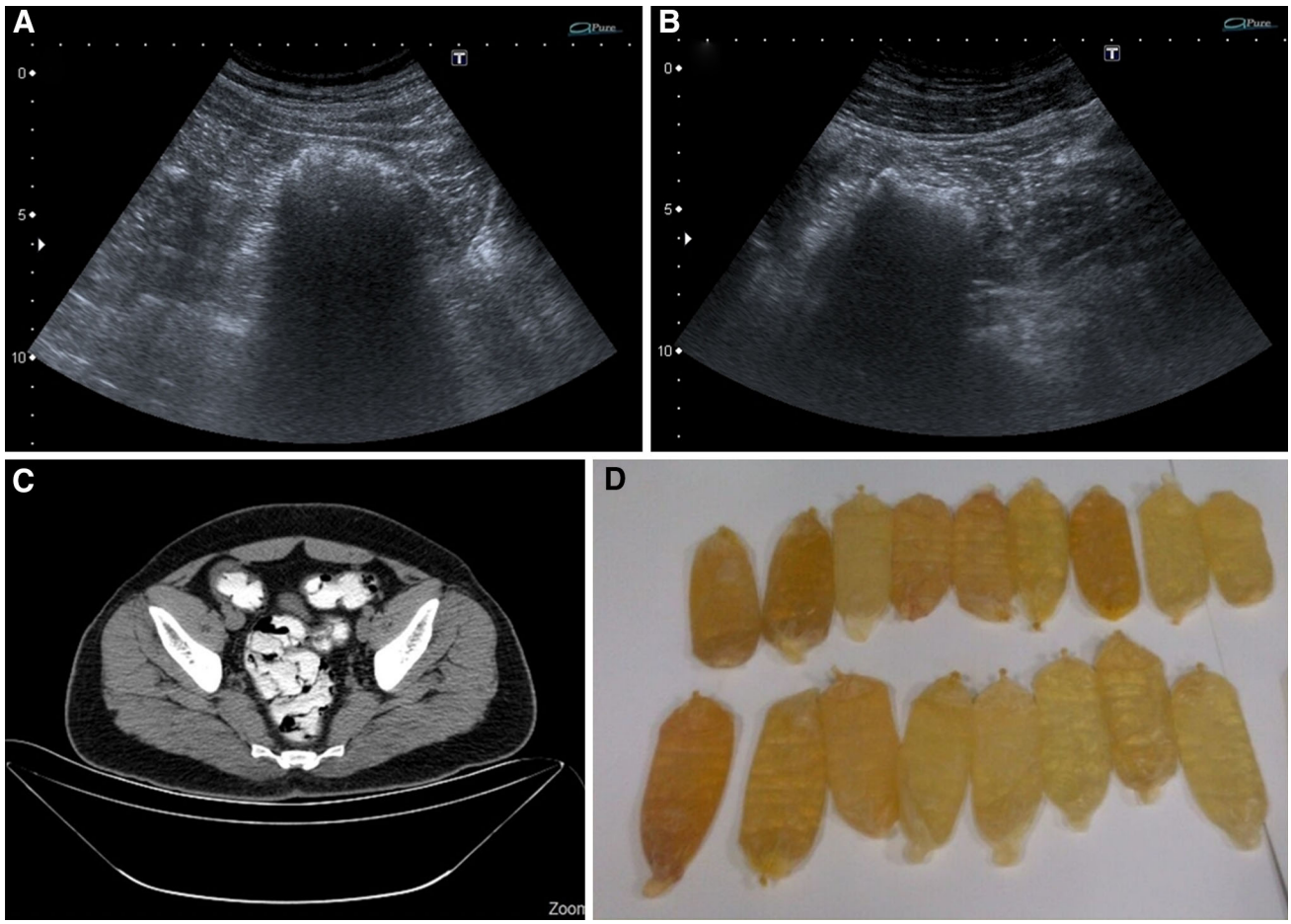


Fig. 5. A 48-year-old male. Hyperechogenic packets with irregular border and acoustic shadowing in pericecal region (**A**) and sigmoid colon (**B**). Their appearance on axial non-contrast CT (**C**).

tion may ensue as a result of leakage of package content (body packer syndrome). Gastric obstruction, ileus, and intestinal or colonic perforation have all been reported as the possible complications of body packing. Despite carrying risks that may even be fatal, however, body packing has been on the rise in recent years [3, 7].

In this group of patients, three important points should be addressed by radiologists. The first of them is to determine whether the suspect is indeed a body packer. Second is to ascertain if any imaging sign suggestive of possible complications exists, and third is to make it clear if any residual packets remain after multiple empty defecations [8, 11].

Many studies have evaluated the value of abdominal X-ray as the initial imaging modality and found that it had a sensitivity of 40% to 90% [3, 4, 9, 11, 12]. The sensitivity and specificity of CT for the diagnosis of body packing have been found so high that this test is accepted as the gold standard [3, 8, 9]. It has recently been reported that low-dose CT can be used as an alternative to X-ray in the initial diagnosis of body packers [9, 13]. Unfortunately, ionizing radiation is a significant limiting factor for both modalities. In our series, the mean effective radiation dose of non-contrast abdominal CT (standard dose protocol) in 45 patients was 8.77 mSv, that is, approximately 6 times higher than the mean effective radiation dose of a low-dose CT study [9]. Moreover, a predischarge CT may be needed when the actual number of packets cannot be reliably predicted because of an unreliable history given by body packers and the inability of initial CT to provide a clear count of packets. Rousset et al. [8] reported that X-ray proved inadequate to detect residual packets and recommended a pre-discharge evaluation CT in cases of body packing that are at risk of life-threatening complications of remaining packets.

Recently, a new but increasingly common form of smuggling carrying cocaine in liquid form using some resolvents has entered the medical literature [3, 7, 14, 15]. Despite having limited information on this subject, we know that detection of liquid cocaine-containing packets by abdominal X-ray is more difficult [3, 14, 15]. Many studies suggesting an important diagnostic role of abdominal X-ray in cases of body packing have excluded

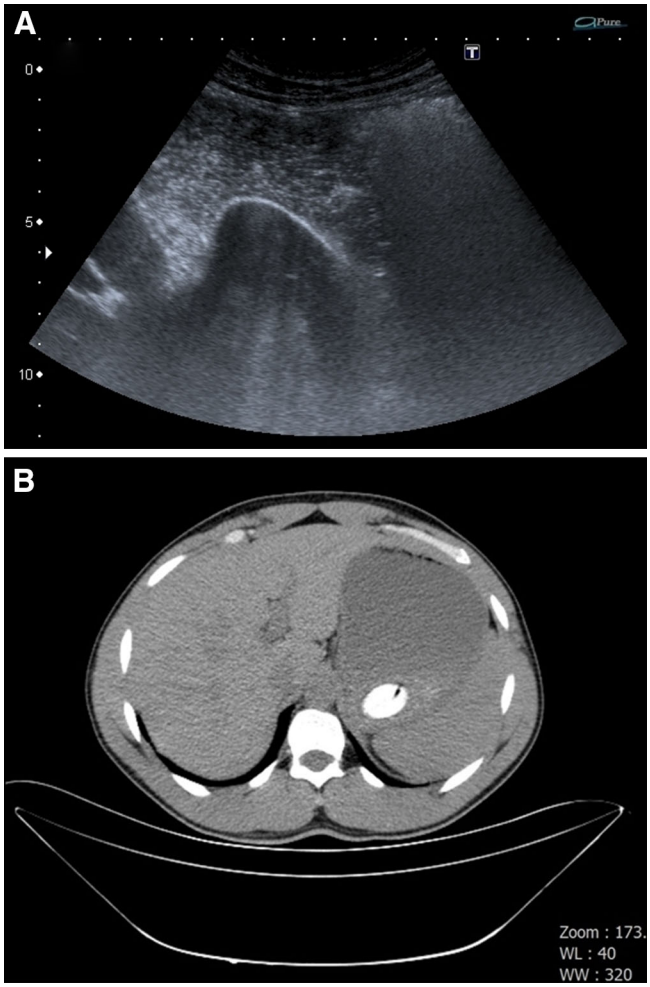


Fig. 6. A 41-year-old male. One packet is visible in water-filled gastric lumen on 9th day. Its appearance on axial non-contrast CT (**B**). The packet was removed by gastrotomy on 9th day.

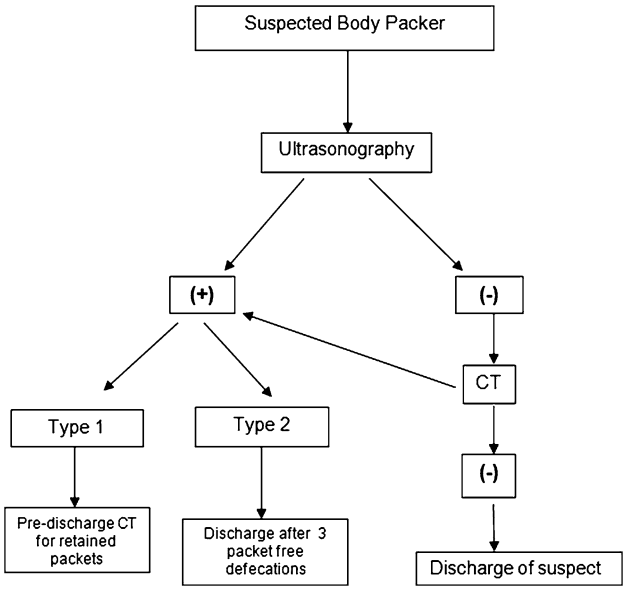


Fig. 7. The flow chart of the proposed radiological management of suspects.

such types of packets. Nevertheless, Bulakci et al. [3] found that plain X-ray films were significantly less sensitive and specific for liquid-containing packets.

There are limited number of studies in the literature about the use of US for this indication [11, 16]. Meijer and Bots diagnosed 42 of 50 suspected cases as body packers by US with a sensitivity of 95%, specificity of 87.5%, a PPV of 97.6%, and a NPV of 77.8%. In our study, on the other hand, 35 of 45 suspected cases were diagnosed as body packer, and despite a similar sensitivity, the presence of liquid packets reduced our specificity, positive, and negative predictive values. Hierholzer et al., in a comparative study using X-ray films, detected 7 of 12 body packers by US and X-ray although both modalities were unremarkable with respect to detection of drug packets. Both studies, however, do not contain any statement about differentiation between solid form packets and liquid form packets.

Narcotic packets (particularly type 1 packets) can be easily recognized by ultrasonographic examination, owing to their high echogenity, posterior acoustic shadowing, and multiple typical uniform foreign body appearances in GIS lumen [11, 16]. US has the advantages of being cheap, easy-to-use, radiation-free, and can be used for pediatric and pregnant cases. However, inexperienced radiologists may easily confuse intestinal contents and gas (pseudocondom) with drug packets [11]. Smooth contour, immobility, and clean posterior acoustic shadowing rather than dirty shadowing of drug packets may aid in differentiation of them from intestinal contents and gas [11, 16]. We observed that type 1 packets were sonographically more easily recognized, and these pitfalls were valid especially for type 2 liquid packets.

No clear criteria exist yet for clinical follow-up and management of body packers. The conservative approach in which a certain time is waited for packets being totally defecated is the norm in asymptomatic cases. Surgery is recommended in cases with intoxication or ileus or when packets are retained in body for more than 7 days [8, 17]. The results of our study and our clinical experiences suggest that the time to defecate type 2 liquid drug-containing packets usually does not exceed 24 h since this type of packets can assume the shape of intestinal lumen and pass anatomic narrowings more easily. The mean duration of defecation of liquid-containing packets was 9 h in our study. No remaining packages were visualized by radiological examinations after 3 empty defecations in this patient group. However, solid drug-containing type 1 packets can be stuck especially at the level of stomach, and despite multiple empty defecations, time to complete expulsion of all packets may well extend to 2 weeks. Previous series have reported extended defecation periods ranging from 24 h to

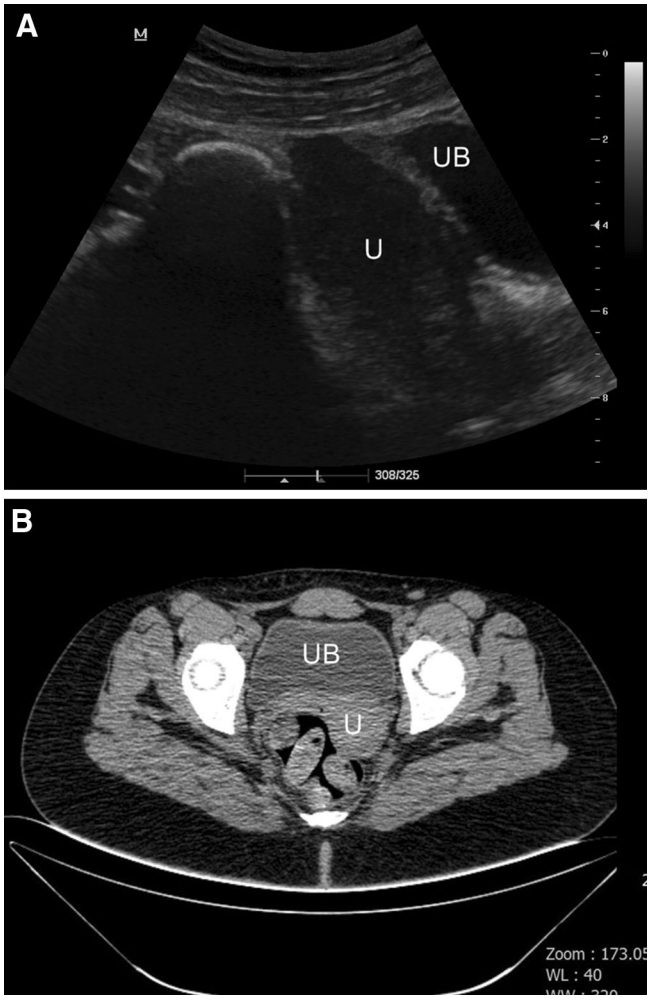


Fig. 8. A 26-year-old female. Drug packet is visible in rectal lumen. Multiple drug packets are seen in rectal lumen on axial non-contrast CT (*UB* urinary bladder, *U* uterus).

beyond 7 days [17]. As packets are usually stuck in stomach, package rupture by the action of gastric acidity may result in fatal consequences [8, 17]. In 2 cases in our study group, packets were retained in gastric lumen and removed by gastrotomy on 8th and 9th days. Packets in the gastric lumen were successfully demonstrated by US in these cases (Fig. 6). Based on these data, we are of the opinion that cases with type 2 liquid packets can be discharged after 3 empty defecations without a radiological control. With type 1 packets, on the other hand, a second radiological examination is required for excluding any remaining packets. Veyrie et al. [17] followed body packers with daily X-ray films. On the contrary, we believe that an ultrasonographic follow-up would be more suitable.

We propose radiological imaging to be started with US in suspected body packers. When US is positive for liquid cocaine, patient discharge is possible after 3 empty defecations. In the case when solid form packets exist, a control CT is needed following 3 empty defecations. If there is a suspicion for packet presence and US is negative, CT examination bypassing abdominal X-ray will be more appropriate (Fig. 7). If the US is positive and no packets are recovered after defecation (false-positive US cases), CT can be used for confirmation after the first empty stool.

Since drug packets are more easily visualized in fluid-filled stomach, examination of suspected cases at departure airport rather than at the airport of arrival when packets are still in stomach may improve the diagnostic power of US [16]. Making advantage of water's acoustic shadowing facilitates the detection of packets in GIS lumen. Making suspects drink water facilitates packets in stomach or intestinal loops, while a full urinary bladder aids in detection of packets in rectum and vagina (Fig. 8). We observed in the follow-up ultrasonographic examinations that diagnostic evaluation was hardened as the number of packets decreased.

There are some limitations of our study. First, ultrasonographic examination was performed by a single radiologist. Hence, inter-observer variability was not analyzed. Second, the study population did not include body stuffers carrying a low number of small drug packets. The study enrolled a specific patient group, with 78% of cases having had drug packets. Further studies with larger study and control groups are needed.

In conclusion, despite its some limitations, US is a cheap and easy-to-use imaging modality that is free of ionizing radiation and can be used for children and pregnant women. This study comparing US with the gold standard technique, CT, found a high sensitivity and PPV (both 91%) of US in the diagnosis of body packing. Although a negative sonography cannot reliably rule out the diagnosis of body packing, it can be selected as the initial imaging modality in suspected cases of body packing.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments.

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