

# Evaluation of incidental findings of whole body computed tomography in multiple trauma patients in emergency department

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## Abstract

**Aim:** The aim of this study was to investigate the frequency of incidental findings and the clinically significant ones in whole-body computed tomography (WBCT) scans in multiple trauma patients in the emergency department (ED).

**Material and Methods:** This study was designed as a single-centered retrospective cohort in a tertiary emergency room. Multiple trauma patients who were screened with WBCT in the ED in 2017 were analyzed. Incidental findings (IF) were categorized into 3 groups as group 1 (emergency treatment / need further examination), group 2 (need examination depending on the symptoms of patients) and group 3 (minor findings with no need for further examination).

**Results:** WBCT screening was performed in 206 of 3746 patients (5.4%) who were admitted to the trauma unit in ED due to multiple traumas. A total of 360 IFs were found in 138 (67%) of 206 patients. Of the patients, 13.3% were classified as group 1, 30.9% as group 2, 55.8% as group 3 and IF was detected, respectively (48, 111, 201). Cardiomegaly was the most common finding in group 1 (n = 11). In group 2, hepatomegaly (n = 18) and atherosclerosis (n = 13) were the most common ones observed. Brain calcifications (n = 42) and renal cysts (n = 17) were the most common findings in Group 3. The age distribution of patients with IF was statistically significantly higher compared to those without IF ( $43.54 \pm 18.78$ ,  $25.16 \pm 11.7$ ,  $p < 0.001$ , respectively).

**Conclusion:** WBCT is used in the ED with an increasing frequency in multiple trauma patients and causes incidental findings to occur significantly. Some of these findings may be vital and may require further clinical evaluation and follow-up.

**Keywords:** Multiple trauma; whole-body computed tomography; incidental finding; emergency.

## INTRODUCTION

Imaging techniques play an important role in the management of many patients and with the increase in the quality of imaging examinations, many new uses are emerging (1). In recent years, the use of whole-body computed tomography (WBCT) for diagnostic purposes in trauma patients is on increase. The most important advantage of this imaging technique is that it is fast, and that it reveals an overview of trauma patients from the head to the pelvis (2,3). One of its most important disadvantages is radiation exposure (4).

WBCT has a high sensitivity and specificity in the detection of trauma lesions and another interesting point is the observation of incidental findings (IF) with this

imaging method (5). Most of these IFs are benign, age-related degenerative changes. In addition, there may be findings that may be needed for evaluation and follow-up of emergency treatments (3). The rate of IF in trauma patients ranged from 30% to 50%. However, in these studies, imaging includes two or less body regions (6-8). On the other hand, in Van Vugt's et al's study conducted with 1047 patients with thoracic trauma was found to be 36% (9).

There are few studies in the literature evaluating the IFs of traumatic patients screened with WBCT screening as part of patient examination (10,11). We aim to evaluate the frequency of IFs in WBCT scans in adult trauma patients and the proportion of those who are potential and clinically significant.

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## MATERIAL and METHODS

### Patient Selection

Our study was designed as a retrospective cohort. Patients with multiple trauma, who were screened using WBCT and admitted to our ED between January-December 2017 were included in our study. The inclusion and exclusion criteria in our study are shown in Table 1.

**Table 1. All Whole-body computed tomography screening criteria**

Inclusion Criteria	Exclusion Criteria
Trauma patients with one of the following clinically suspicious diagnoses:	Patients with known pregnancy
-Change of consciousness due to head trauma	- <18 years old patients
-Deformity or external hemorrhage with suspicion/finding of fracture in at least in two long bones	-Patients with traumatic arrest
-Unstable pelvis/ pelvis fracture	-single region screened patients with CT(isolated torque / brain / abdomen)
-Open thorax injury / multiple rib fractures	-Patients with incomplete data
- Cervical distraction injuries	- Patients referred to the external center

### Whole Body Computed Tomography

All patients were examined using ECLOS 16-section computed tomography scanner (Hitachi Medical Systems, Tokyo, Japan) in the ED tomography room. WBCT was administered to the whole body from vertex to symphysis pubis and then intravenous contrast agent was applied and thorax, abdomen and pelvis were screened. This scanning was made at least 5 mm section thickness.

### Data Collection

The data of all trauma patients were retrospectively collected. All data were collected using electronic hospital database. A cohort was created from the patients that were screened with WBCT. Radiological images taken at the ED admission. WBCT radiological images were scanned retrospectively by radiologist and IFs were recorded. The clinical findings were evaluated by researchers.

### Incidental Findings and Categories

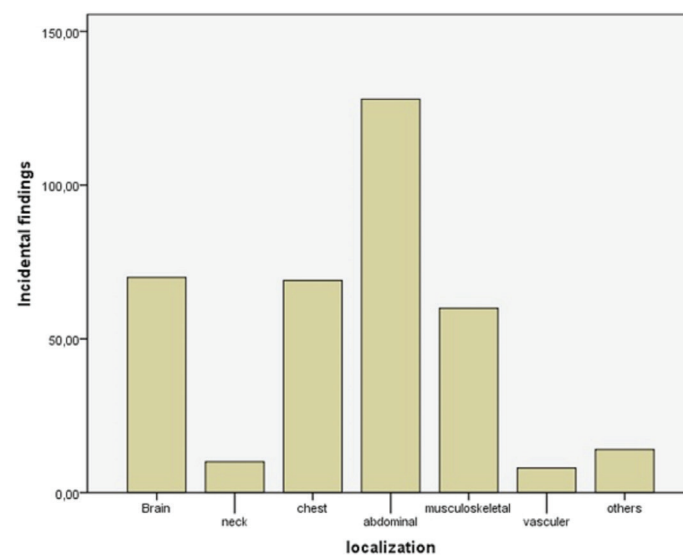
IFs were categorized into 3 groups as group 1 (emergency treatment / need for further examination), group 2 (need for examination depending on the symptoms of patients) and group 3 (minor findings with no need for further examination). Categorical groups were defined to be compared to previous studies (5,6,9).

### Statistical analysis

Standard deviation and mean values for continuous variables; and the median and interquartile range of non-parametric data were calculated. Each of the independent variables was compared with the chi-square test and the independent t test according to the suitability. Descriptive statistical analysis of all variables was evaluated using SPSS 18.0.

## RESULTS

In our study, in 2017, 206 (5.4%) of 3746 patients who were examined at our ED underwent WBCT screening for multiple trauma. Traffic accidents (82.5%) and falls (17.5%) were the main trauma mechanisms. The mean age of these 206 multiple trauma patients (78.2% male, 21.8% female) was  $37.4 \pm 18.8$  years. A total of 360 IFs were found in 138 (67%) of 206 patients. In other words, 2 IFs were found per patient. Only 68 (33%) patients had no IF. 32.8% of these IFs were observed in the abdominal region and 20% in the brain, thorax and musculoskeletal region. The rest were in the neck and vascular structures. The distribution of IF according to the body region is shown in Figure 1.



**Figure 1.** Localization of incidental findings of patients with histogram graph

IFs are divided into 3 groups according to their importance. 13.3% of all patients were classified as group 1 (n = 48; emergency treatment / advanced examination); 30.9% of the patients were classified in group 2 (n=111; Patients who need to be examined according to the symptoms); and 55.8% of the patients were classified as group 3 (n= 201; insignificant minor findings that do not require further examination). The number and nature of each IF is shown in Table 2-4 according to the groups.

Cardiomegaly was the most common finding in group 1 (n = 11). This is followed by findings of suspicious destabilization (n = 5) and brain tumors (n = 3) in vertebral body deformities. In group 2, hepatomegaly (n = 18) and atherosclerosis (n = 13) were the most common ones observed. Brain calcifications (n = 42) and renal cysts (n = 17) were the most common ones observed in Group 3.

The age distribution of patients with IF was statistically significantly higher compared to those without IF ( $43.54 \pm 18.78$ ,  $25.16 \pm 11.7$ ,  $p < 0.001$ , respectively). However, there was no significant difference between the sex distribution and the patients with or without IF ( $p = 0.317$ ). There was no significant difference between males and females in terms of the number and severity of IF ( $p = 0.192$ ).

**Table 2. Incidental findings of group 1 (emergency treatment /need for further examination)**

Brain tumors	(n=3)
Parietal meningioma	(n=1)
Aortic aneurysm	(n=1)
Thoracic aneurysm	(n=1)
Lymphadenopathy	(n=2)
Abdominal lymph node >1 cm	(n=2)
Indeterminate liver lesion >1 cm	(n=3)
Ovarian or adnexal cyst> 5cm	(n=3)
Vertebral body deformation suspected destruction	(n=5)
Indeterminate sclerotic bone lesion	(n=3)
Lytic bone lesion	(n=2)
Adrenal mass with indeterminate appearance	(n=2)
Indeterminate retroperitoneal masses	(n=1)
Bowel wall thickening	(n=3)
Terminal ileum mass or thickening	(n=3)
Cardiomegaly	(n=11)
Pulmonary mass	(n=2)

**Table 3. Incidental findings of group 2 (need for examination depending on the symptoms of patients)**

Thyroid incidentalomas	(n=10)
Circle of Willis calcifications	(n=2)
Atherosclerosis	(n=13)
Coronary artery calcification	(n=8)
Breast nodule	(n=2)
Prostate enlargement	(n=5)
Splenomegaly	(n=1)
Common bile duct dilatation	(n=1)
Gallstone	(n=3)
Indeterminate hepatic lesion	(n=11)
Indeterminate adrenal nodule	(n=2)
Hepatomegaly	(n=18)
Pancreatic calcifications	(n=2)
Pancreatic mass	(n=1)
Adrenal mass with benign appearance	(n=2)
Inguinal hernia or bowel-containing abdominal hernia	(n=4)
Pulmonary nodules	(n=8)
Pulmonary parenchymal opacity	(n=2)
Pulmonary emphysematous bullae	(n=11)
Abdominal aortic ectasia	(n=1)
Hydronephrosis	(n=4)

**Table 4. Incidental findings of group 3 ( minor findings with no need for further examination)**

Brain calcifications	(n=42)
Brain cyst	(n=11)
Large cisterna magna	(n=5)
Splenic cyst	(n=1)
Hepatic steatosis	(n=10)
Simple ovarian cyst	(n=2)
Spondylolisthesis	(n=8)
Diffuse osteopenia	(n=4)
Degenerative spine changes	(n=16)
Sclerotic bone lesion, likely bone island	(n=13)
Osteoarthritis	(n=1)
Bone cyst	(n=4)
Bone nodule	(n=4)
Renal atrophy	(n=2)
Renal cyst	(n=17)
Renal malrotation	(n=5)
Suspected renal or ureteric stones	(n=9)
Hiatal hernia	(n=6)
Calcified pulmonary nodules	(n=4)
Lung base subsegmental atelectasis	(n=5)
Diaphragmatic calcification	(n=1)
Thickening of mucosal lining in sinus	(n=14)
Lipoma	(n=1)
Jugular vein position anomaly	(n=4)
Distal esophageal wall thickening	(n=1)
Arterial stenosis	(n=3)
Inflammation of the external ear canal	(n=1)
Nasal septum deviation	(n=5)
Situs inversus	(n=2)

## DISCUSSION

IFs that may require high emergency in 13.3% of the 206 patients who underwent post-traumatic WBCT; and incidental findings that may require a follow-up in 30.9% of the patients were found. The majority of these IFs were in the abdominal region, followed by the brain and thorax. In addition, we found that the distribution of age of patients with IF was significantly higher than those without IF.

There are many studies in the literature dealing with IFs found in tomography scans. However, there are very few studies evaluating this issue on the WBCT screening. First of all, while comparing WBCT studies with other studies, there are difficulties with the studies involving design differences and different categorization schemes. However, the group category with urgent assessment is

available in all studies (5,12). The frequency of patients in this category varies between 5.4-8.4% (10,13,14). In our study, the rate of patients in this category was found to be 13.3%. The fact that our study was performed with lower number of patients and only patients with major trauma may explain the reason why of this high rate. In a study conducted by Barrett et al with a large patient population, they found the rate of patients requiring high urgency to be approximately 30%. However, all patients were included in the same category except the minor findings that were not required for further investigation. In our study, this rate is 42% (5).

In the study, we showed that with increasing age, the number of IFs increased in a similar way with the literature (14). In two recent studies, it was reported that the frequency of IF increased in women, but unlike these studies, in our study there was no relationship between male and female distribution and IF (5,6,15,16).

Studies have shown that medical follow-up is insufficient for many patients who require follow-up and treatment due to lack of medical documentation (6,17). In a study, it was reported that 23% of patients required follow-up and treatment within a short period of time.(14). In another recent study, it was stated that 45 of 143 patients were IF, which may require to be followed within a short period of time (10). In our study, we found this rate to be 30.9%. However, large population studies are needed for more accurate determinations due to the small number of patients. It should also be considered that there may be IF in young patients that require significant follow-up.

Unlike many other studies, we also analyzed the distribution of IF's in body parts. We found that IFs are most commonly seen in the abdominal region and then in the brain, thorax and musculoskeletal region, respectively. In a large-scale study of 2440 patients, it was also reported that IFs were most commonly found in the abdominal region, similar to our results. However, in this study, IFs were found to be more common in the thorax region than brain (14).

Studies have reported that IF monitoring is insufficient and that there is a need for specially equipped staff to monitor them (7,15). Considering the increasing use of WBCT during the primary examination of patients after severe trauma, we think that a system should be established to inform the primary care physician as soon as it is reported that the patient is required to be monitored.

Our study had some limitations. The first one is the fact that the study was conducted in a single-center tertiary ED retrospectively. These results may not apply to other hospitals with different patient populations. In addition, the fact that the follow-up of IFs was not investigated in this study is one of our most important limitations. Even if some of the findings may look quite like characteristic tomography, the final histopathological diagnosis may be different in some cases. This may have resulted in over-reporting of some findings, such as a tomography view image, malignancy, or cyst.

## CONCLUSION

In the evaluation of trauma patients, WBCT is used more frequently and this leads to the detection of many IFs. While many of these findings do not require follow-up or treatment, some may be life-threatening.

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