

# Optimisation of CT scanning protocols for polytrauma patients

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## Objective

The aim of this study was to evaluate the significance and validity of CT scanning protocols used for polytrauma patients (PP) in The Hospital of Lithuanian University of Health Sciences Kaunas clinic (HLUHS KC).

We distinguished multiple objectives:

1. To assess the most prevalent traumatic CT scan findings in PP.
2. To evaluate the efficacy and rationality of using three-sequential CT scans for PP.
3. To assess the CT scan determined iatrogenic radiation doses and changes in oncogenic risk for PP.
4. To assess the workload of the radiologist when evaluating CT scans of PP.

## Methods

This was a retrospective study that included PP (n = 103) admitted to the HLUHS KC between 2011 and 2016. For the evaluation of CT scan phase significance, we selected patients (n = 62) who had undergone **chest - abdomen - pelvis (C-A-P) three sequential CT scans**. Pathologic CT scan findings were separated into dichotomous groups (present / not present) and evaluated in each phase.

Radiation doses of WBCT, C-A-P CT scans and separate phases were determined using fixed technical parameters. **Effective dose (ED)** was calculated using standardised dose-length product (DLP) parameters and conversion coefficient k (k = 0.015 mSv/mGy x cm):  $ED (mSv) = DLP (mGy \times cm) \times k (mSv/mGy \times cm)$

**Changes in cancer risk** for PP who had undergone WBCT scans (n = 49) were also calculated.

To measure the workload of a radiologist, CT scan **image count** for all phases was documented and compared between different phases.

Patients with insufficient medical record data, poor quality or incomplete CT scans were excluded from the study.

We used related-samples non-parametric Qochran's Q and McNemar tests to evaluate the significance of differences between different phase findings and group homogeneity using  $\chi^2$ , one-way ANOVA and Kruskal-Wallis tests. Values of P < 0.05 were considered significant.

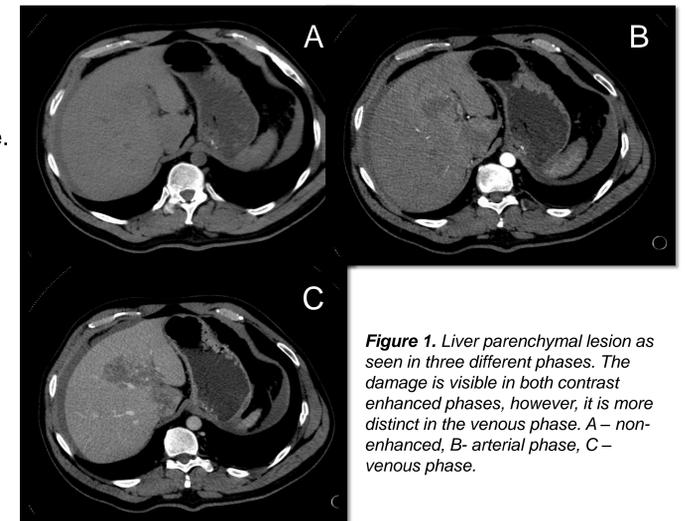


Figure 1. Liver parenchymal lesion as seen in three different phases. The damage is visible in both contrast enhanced phases, however, it is more distinct in the venous phase. A – non-enhanced, B- arterial phase, C – venous phase.

## Results

Age (years)	39.8 ± 15.8 (n = 103)
Gender	79% (n = 82) males 21% (n = 21) females
Injury severity score (ISS)	30.17 ± 15.05
Haemodynamics	Stable: 63.5% (n = 54) Unstable: 36.5% (n = 31)
Glasgow coma scale (GCS)	12.72 ± 3.8
Hospitalisation length (days)	19.10 (± 21.92)
Blunt/ penetrating trauma	92.6% (n = 87) / 7.4% (n = 7)
Trauma mechanism	Car accident: 31.2% (n = 29) Motorcycle accident: 10.8% (n = 10) Fall from a height of > 3 meters: 24.7% (n = 23) Fall from a height of < 3 meters: 8.6% (n = 8)

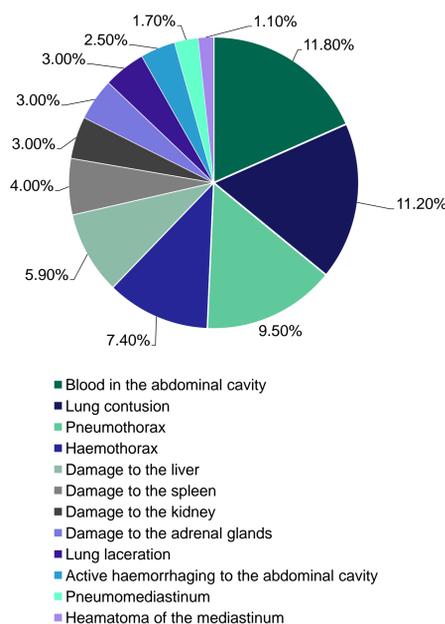


Table 1. Demographic parameters of the study population.

Figure 2. Most prevalent CT scan findings in polytrauma patients. Gastrointestinal, pancreatic, cardiac/pericardial, major thoracic blood vessel injuries, and pneumoperitoneum were observed in less than 1%.

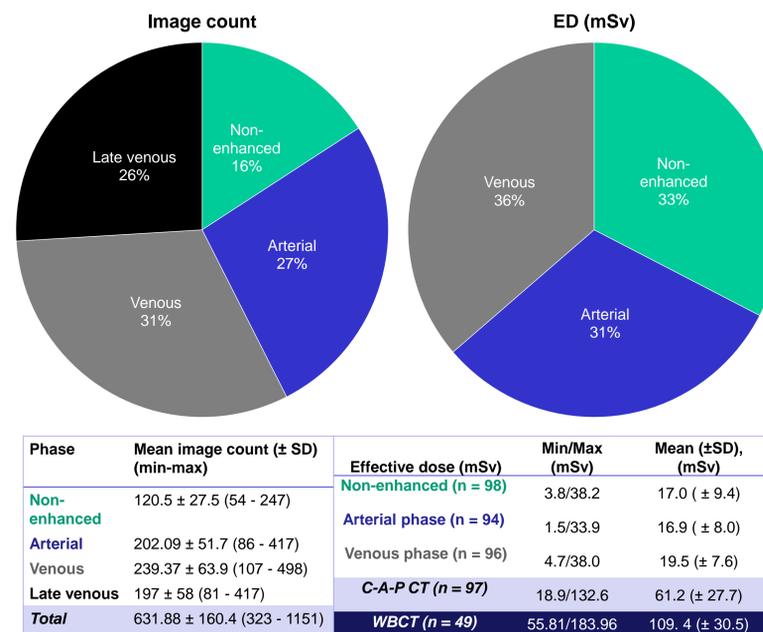


Figure 3. CT scan phase contribution to the workload (expressed as a number of images), and the radiation dose. Patients exposed to 109.4 (± 30.5) mSv had the cancer morbidity risk of 0.5% or 1/167.

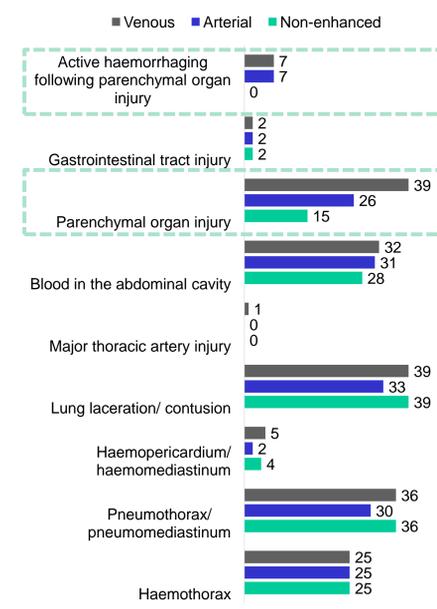


Figure 4. CT scan findings in polytrauma patients. Statistically significant superiority of arterial and venous phases compared to the non-enhanced was noted when diagnosing parenchymal organ injury with and without active haemorrhaging (P < 0.001).

## Conclusions

1. Most prevalent CT scan traumatic findings in PP were lung contusions, air or blood in the pleural cavity, hepatic/splenic/renal/adrenal gland injury.
2. Non-enhanced CT scan phases attribute to nearly a third of the ED and supply no significant additional information, making them unnecessary and detrimental.
3. WBCT scan ED is 109.4 mSv and it increases the risk of cancer to 0.5% (or 1/167).
4. The workload of a radiologist when evaluating PP' CT scans could be decreased by more than a half, were the scanning protocols to include only the venous phase, or by 32.6% if the arterial phase and 19.7% if the non-enhanced phase were to be discarded from imaging protocols.

## Key words

Polytrauma, radiation, emergency radiology, CT imaging