

## Repeated CT scans in trauma transfers: An analysis of indications, radiation dose exposure, and costs



Ricarda Hinzpeter<sup>a,\*</sup>, Kai Sprengel<sup>b</sup>, Guido A. Wanner<sup>b,c</sup>, Peter Mildemberger<sup>d</sup>, Hatem Alkadhi<sup>a,\*</sup>

<sup>a</sup> Institute of Diagnostic and Interventional Radiology, University Hospital Zurich, University of Zurich, Raemistr. 100, Zurich CH-8091, Switzerland

<sup>b</sup> Division of Trauma Surgery, Department of Surgery, University Hospital Zurich, University of Zurich, Raemistr. 100, CH-8091 Zurich, Switzerland

<sup>c</sup> Department of General Surgery, Schwarzwald-Baar Klinikum, University of Freiburg, Klinikstr. 11, D-78052 Villingen-Schwenningen, Germany

<sup>d</sup> Department of Diagnostic and Interventional Radiology, University Hospital of Mainz, Langenbeckstr. 1, D-55131 Mainz, Germany

### ARTICLE INFO

#### Article history:

Received 7 July 2016

Received in revised form 1 January 2017

Accepted 5 January 2017

#### Keywords:

Imaging

Trauma

Radiation exposure

Health care costs

### ABSTRACT

**Objectives:** To identify the number of CT scans repeated in acute trauma patients receiving imaging before being referred to a trauma center, to define indications, and to assess radiation doses and costs of repeated CT.

**Methods:** This retrospective study included all adult trauma patients transferred from other hospitals to a Level-I trauma center during 2014. Indications for repeated CT scans were categorized into: inadequate CT image data transfer, poor image quality, repetition of head CT after head injury together with completion to whole-body CT (WBCT), and follow-up of injury known from previous CT. Radiation doses from repeated CT were determined; costs were calculated using a nation-wide fee schedule.

**Results:** Within one year, 85/298 (28.5%) trauma patients were transferred from another hospital because of severe head injury (n = 45; 53%) and major body trauma (n = 23; 27%) not manageable in the referring hospital, repatriation from a foreign country (n = 14; 16.5%), and no ICU-capacity (n = 3; 3.5%). Of these 85 patients, 74 (87%) had repeated CT in our center because of inadequate CT data transfer (n = 29; 39%), repetition of head CT with completion to WBCT (n = 24; 32.5%), and follow-up of known injury (n = 21; 28.5%). None occurred because of poor image quality. Cumulative dose length product (DLP) and annual costs of potential preventable, repeated CT (inadequate data transfer) was 631mSv (81'304mGy\*cm) and 35'233€, respectively.

**Conclusion:** A considerable number of transferred trauma patients undergo potentially preventable, repeated CT, adding radiation dose to patients and costs to the health care system.

© 2017 Elsevier B.V. All rights reserved.

### 1. Introduction

Computed tomography (CT) is the modality of choice for the early imaging work-up of severely injured trauma patients [1–4]. This is mainly due to fast image acquisition, robustness, accuracy and wide availability. Nevertheless, CT scans have the disadvantage of being associated with potentially harmful radiation exposure to the often relatively young trauma population [5–7].

The Swiss government announced in 2011 a total of 12 authorized centers for treatment of severely injured trauma patients, based on various criteria including the availability of 24/7 trauma patient care including radiology services. In addition, these trauma centers have to guarantee a standardized and structured data acquisition to a registry which records the quality of processes and results. While these trauma centers are intended to deliver the primary care of severely injured trauma patients, still many injured patients are admitted and often are radiologically evaluated in other, mostly regional hospitals and are then being transferred to a Level-I trauma center [8]. Reasons for transfers of these patients to a trauma center may be an initial underestimation of the true trauma load, patients who become hemodynamically unstable or had a trauma which is not manageable in the referring hospital [9,10].

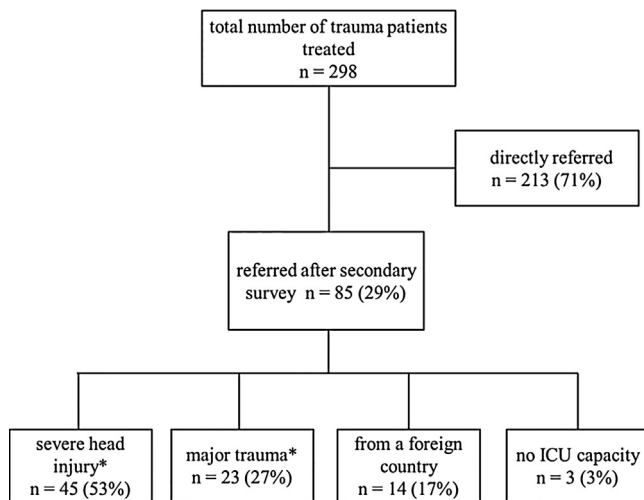
**Abbreviations:** WBCT, whole-body computed tomography; DLP, dose-length product.

\* Corresponding author.

**E-mail addresses:** [Ricarda.Hinzpeter@usz.ch](mailto:Ricarda.Hinzpeter@usz.ch) (R. Hinzpeter), [Kai.Sprengel@usz.ch](mailto:Kai.Sprengel@usz.ch) (K. Sprengel), [Guido.Wanner@sbk-vs.de](mailto:Guido.Wanner@sbk-vs.de) (G.A. Wanner), [peter.mildemberger@unimedizin-mainz.de](mailto:peter.mildemberger@unimedizin-mainz.de) (P. Mildemberger), [hatem.alkadhi@usz.ch](mailto:hatem.alkadhi@usz.ch) (H. Alkadhi).

<http://dx.doi.org/10.1016/j.ejrad.2017.01.007>

0720-048X/© 2017 Elsevier B.V. All rights reserved.



**Fig. 1.** Flowchart of the study. ICU: intensive care unit.  
\*not manageable in referring hospital.

It was observed that transferred trauma patients frequently had foregoing initial CT examinations performed at the referring institution, but many of them were rescanned based on indications of our trauma surgeons. This is in line with some recent literature from the U.S. indicating that repeated CT imaging in trauma patients occurs relatively often, and indications for duplicate CT imaging differ depending on the institution and referring networks [8–13]. Potentially unnecessary repeated CT scans, however, expose trauma patients to additional ionizing radiation and increase resource use [14].

It was sought to identify the number of CT scans repeated in trauma patients receiving a radiologic work-up before being referred to our trauma center, to define indications for repeated CT scans including imaging findings, and to assess associated radiation doses and costs.

## 2. Materials and methods

### 2.1. Study population

This study was performed at our Level-I trauma center in Switzerland between January and December 2014. During this one-year period 298 trauma patients were identified (mean age  $52 \pm 22$  years), being either directly admitted to our trauma center (213/298, 72%) or being transferred after secondary survey (85/298, 29%) (Fig. 1). Reasons for transfer to our trauma center were severe head injury ( $n = 45$ , 53%) and major body trauma ( $n = 23$ , 27%) being not manageable in the referring hospital, repatriation from a foreign country ( $n = 14$ , 17%), and lack of local intensive care unit (ICU) capacity ( $n = 3$ , 4%).

All patients included were recorded in the trauma registry hosted by the German Association for Trauma Surgery ([www.traumaregister-dgu.de](http://www.traumaregister-dgu.de)). According to this trauma registry only patients who are admitted through the emergency room and who are in need of intensive care are recorded in the database. In the present study only those adult trauma patients were included who got a CT evaluation at our hospital's emergency department. Repetition of CT was defined as CT examination in the referring hospital and at our trauma center within 24 h of trauma.

Patients who had been evaluated and underwent one or more CT examinations in the context of acute trauma and those who were directly referred and who had no foregoing CT were compared regarding age, sex, trauma mechanism, injury severity score (ISS) and time from trauma to our trauma center (Table 1) [15].

These data were taken from the electronic records of patients in all involved hospitals.

This retrospective study had local ethics committee approval; written informed consent requirement was waived.

### 2.2. Data collection and categorization

A thorough database search was made to identify the trauma mechanism, the severity of trauma indicated by the ISS and the indications for repeated CT examinations in our trauma center in patients who were transferred from a regional hospital. These indications were categorized as previously shown [11,12]: inadequate CT image data transfer, poor CT image quality, repetition of head CT after head injury together with completion to WBCT, and follow-up of trauma injury known from previous CT in the regional hospital. The four body regions comprising a whole-body CT were evaluated: head, neck/cervical spine, chest and abdomen.

Imaging data from referring hospitals were either sent electronically or were provided per data carrier (CD). For electronic transfer of imaging studies we used the MedicalConnector-network (H-Net AG, Zurich, Switzerland). This network ensures a flexible and encrypted transmission of medical data in the required data format.

### 2.3. Image quality of CT in referring hospitals

First, all CT examinations performed in the referring hospital (and which were repeated in our trauma center) were reviewed regarding image quality by one blinded radiologist (with 13 years of experience in imaging). Image quality was categorized in a dichotomous way: diagnostic or non-diagnostic because of inadequate image quality.

### 2.4. CT examination

All CT examinations in our center were performed using a 128-slice CT scanner (SOMATOM Definition Flash; Siemens Healthcare) located adjacent to the emergency room and included non-enhanced CT of the head, non-enhanced CT of the cervical spine and contrast-enhanced CT of the chest and abdomen. The contrast media protocol aimed at an arterio-venous phase for the chest and a portal-venous phase of the abdomen. For this, a total of 100 ml non-ionic iodinated contrast material (Iopromidum, Ultravist 300, 300 mg/ml, Bayer, Leverkusen, Germany) with a flow rate of 4 ml/sec was injected through an antecubital vein. Contrast agent application was controlled by bolus tracking in the descending aorta (attenuation threshold 120 HU at 120 kVp). Image acquisition started 5 s and 40 s after the signal density reached the predefined threshold.

All CT scans in our department were performed with our institutional standard protocol settings using a tube voltage of 120 kVp and with quality reference tube current-time products adjusted to the respective body region (head: 320 mAs, cervical spine: 200 mAs, chest and abdomen: 150 mAs). Images were reconstructed and reformatted with slice thicknesses ranging from 1 to 2 mm using sinogram-affirmed iterative reconstruction at a strength level of 3.

### 2.5. Imaging findings in repeated CT

All repeated CT examinations in our hospital were analyzed regarding their imaging findings and were compared to those from the previous CT examinations in the referring hospitals. Imaging findings were categorized by indications for repeated CT and by each body region (head, C-spine/neck, chest, and abdomen) as follows: no new imaging findings related to trauma, stable trauma injury known from previous CT, progression of trauma injury

Download English Version:

<https://daneshyari.com/en/article/5726224>

Download Persian Version:

<https://daneshyari.com/article/5726224>

[Daneshyari.com](https://daneshyari.com)