WBCT: Split Bolus or Dual Phase

Ludo FM Beenen, MD PhD FASER FESER

Accident & Emergency Radiology
Amsterdam UMC
The Netherlands

Disclosures: None

Overview

- Technique
- Split Bolus vs dual Phase
- Body regions

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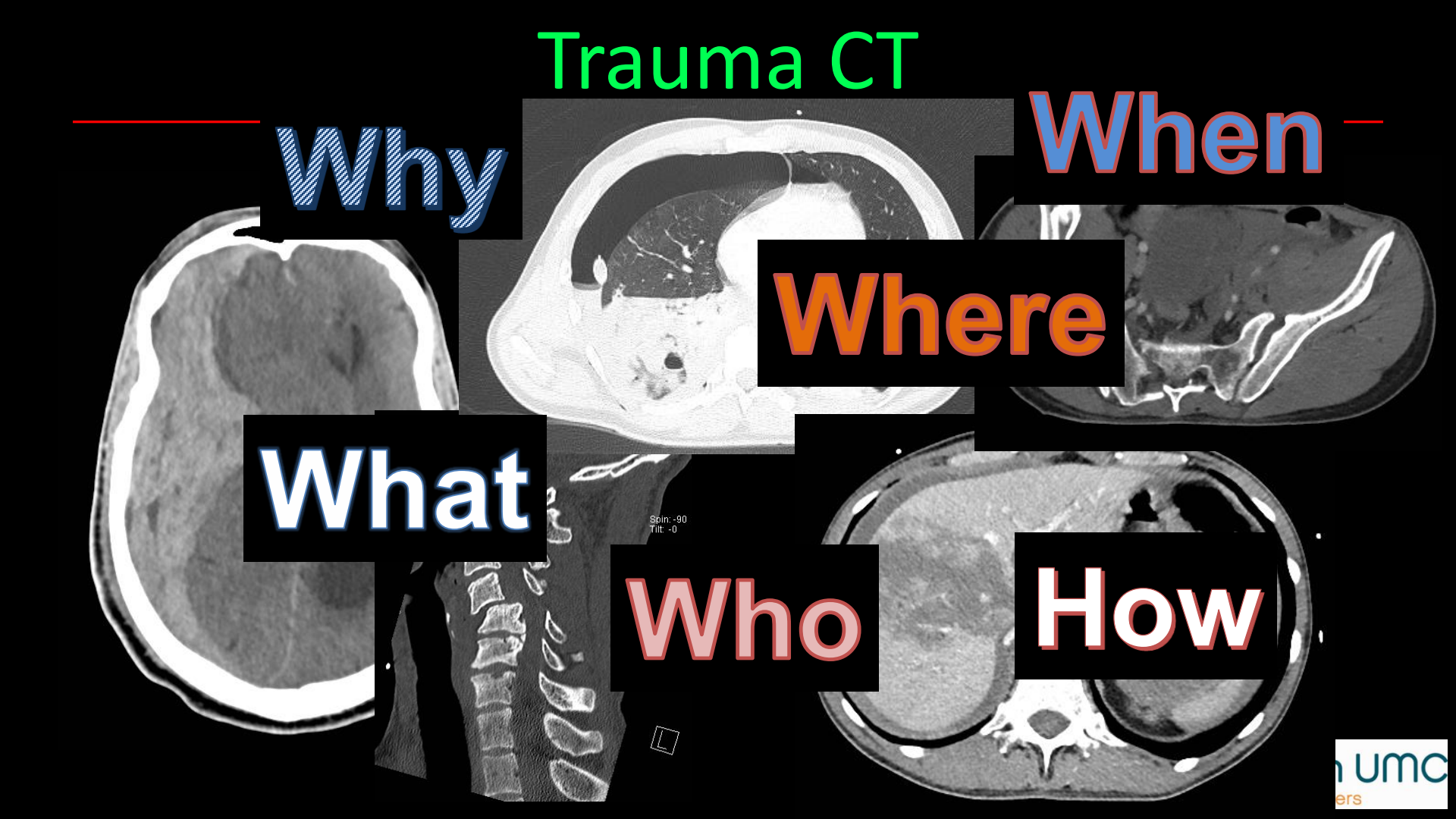
Trauma CT



Split Bolus vs Dual Phase

Contrast & CT Scan Timing

RSNA

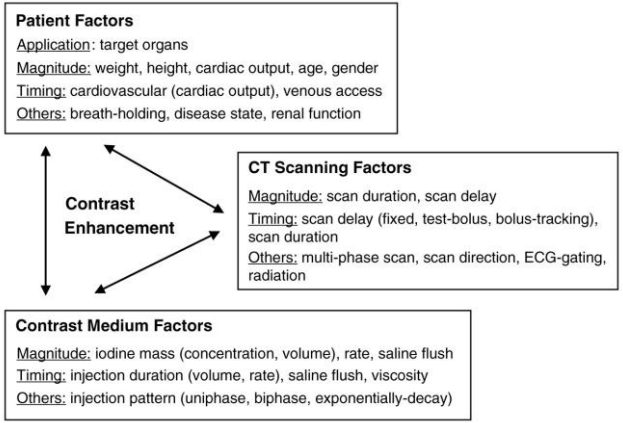


Figure 5: Factors involved in contrast medium enhancement. The factors can be divided into three categories: patient, contrast medium, and CT scan. In each category, the factors are further grouped according to affecting predominantly the magnitude or the timing of contrast enhancement. *ECG* = electrocardiographic.

Bae KT. Published Online: July 01, 2010
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Radiology

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Monitoring

- Fixed delay
- Bolus triggering
- Test bolus

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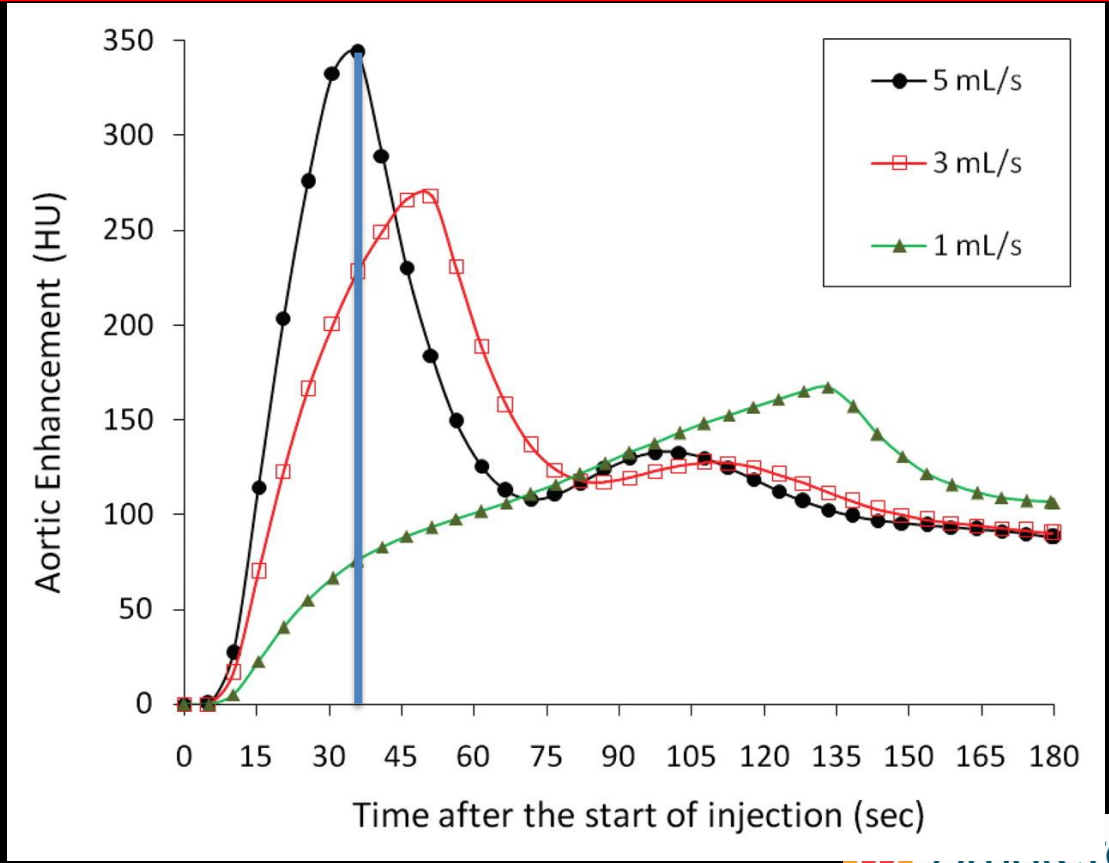
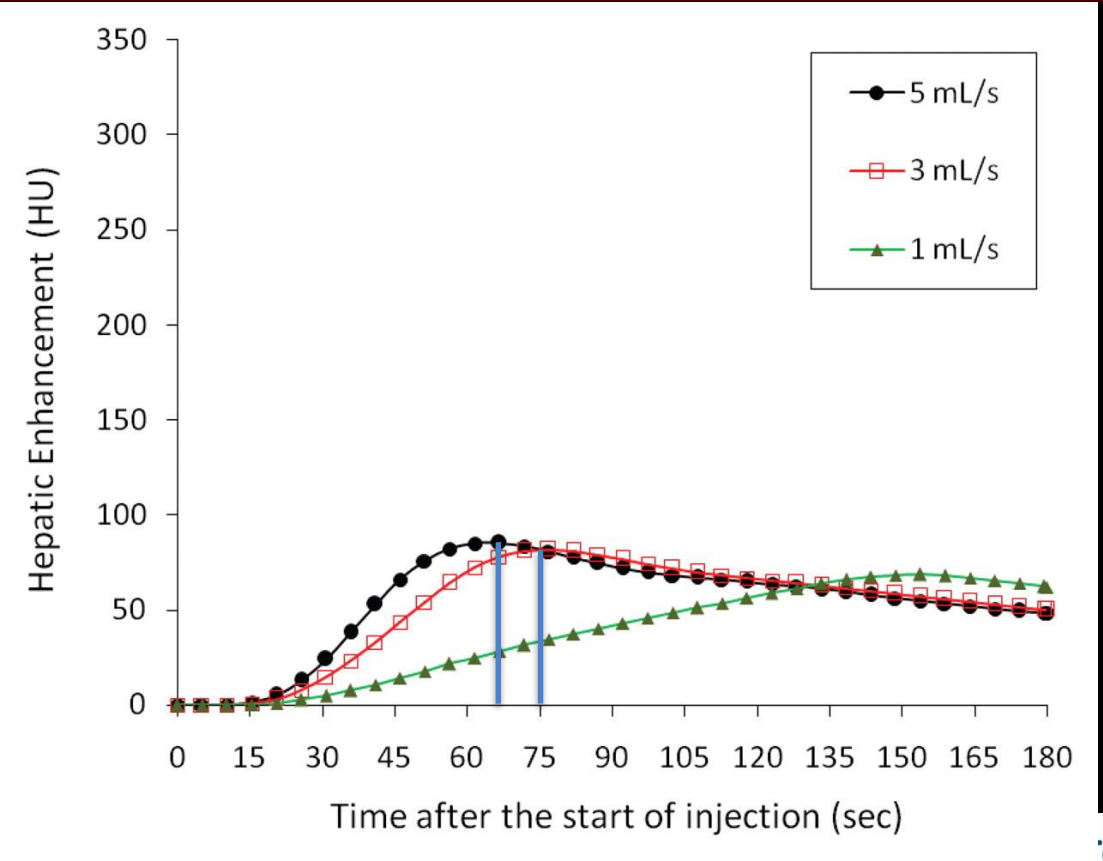
Single Bolus

- One contrast bolus
- Several scans in different phases
  - arterial
  - portovenous
  - delayed

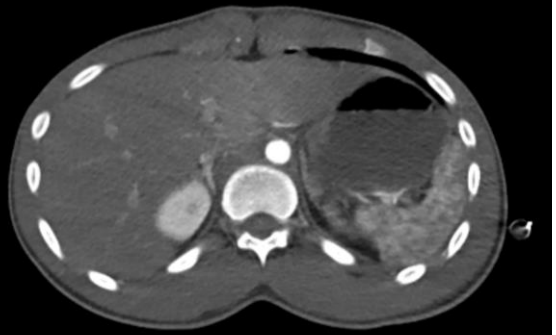
Contrast & CT scan Timing

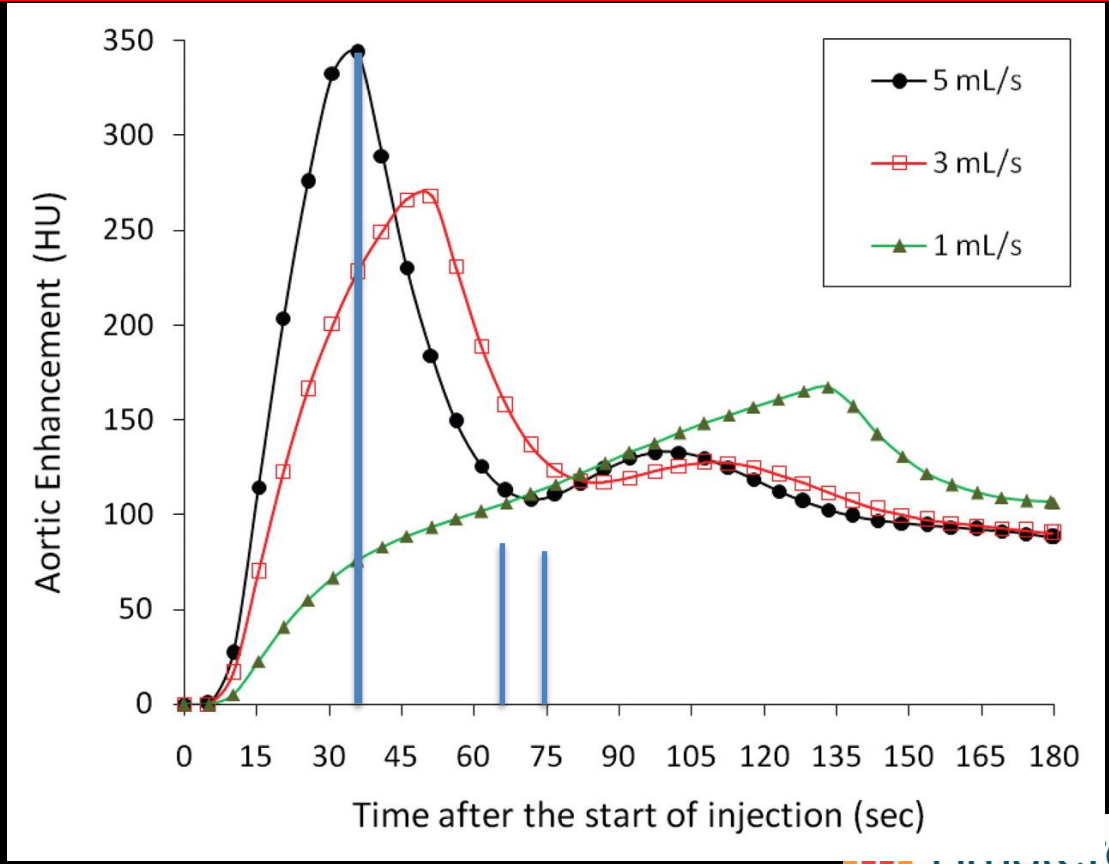


Contrast & CT scan Timing

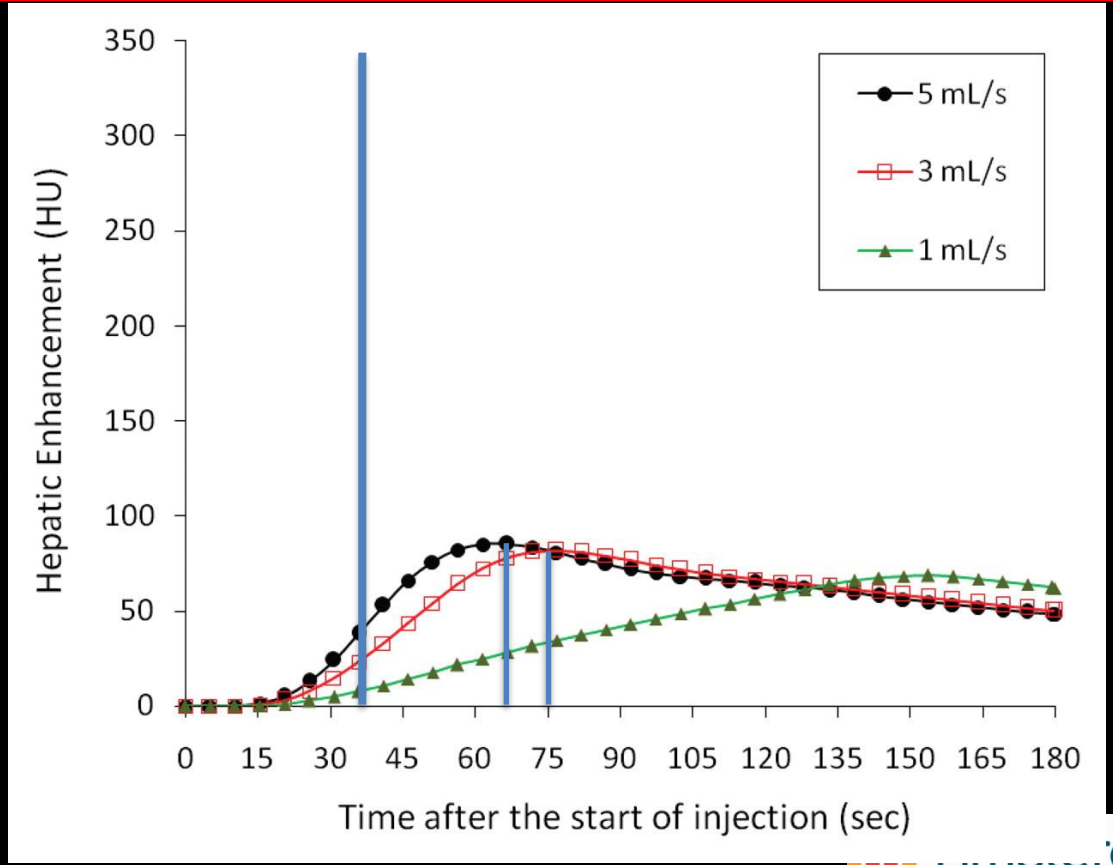


Contrast & CT scan Timing





Contrast & CT scan Timing



Single Bolus

Boscak Radiology 2013

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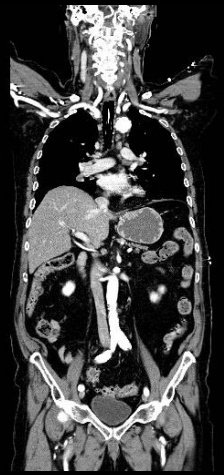
Split Bolus

- Combine arterial & portal venous information
- Bulk of contrast for PV phase
- Arterial boost just before the scan



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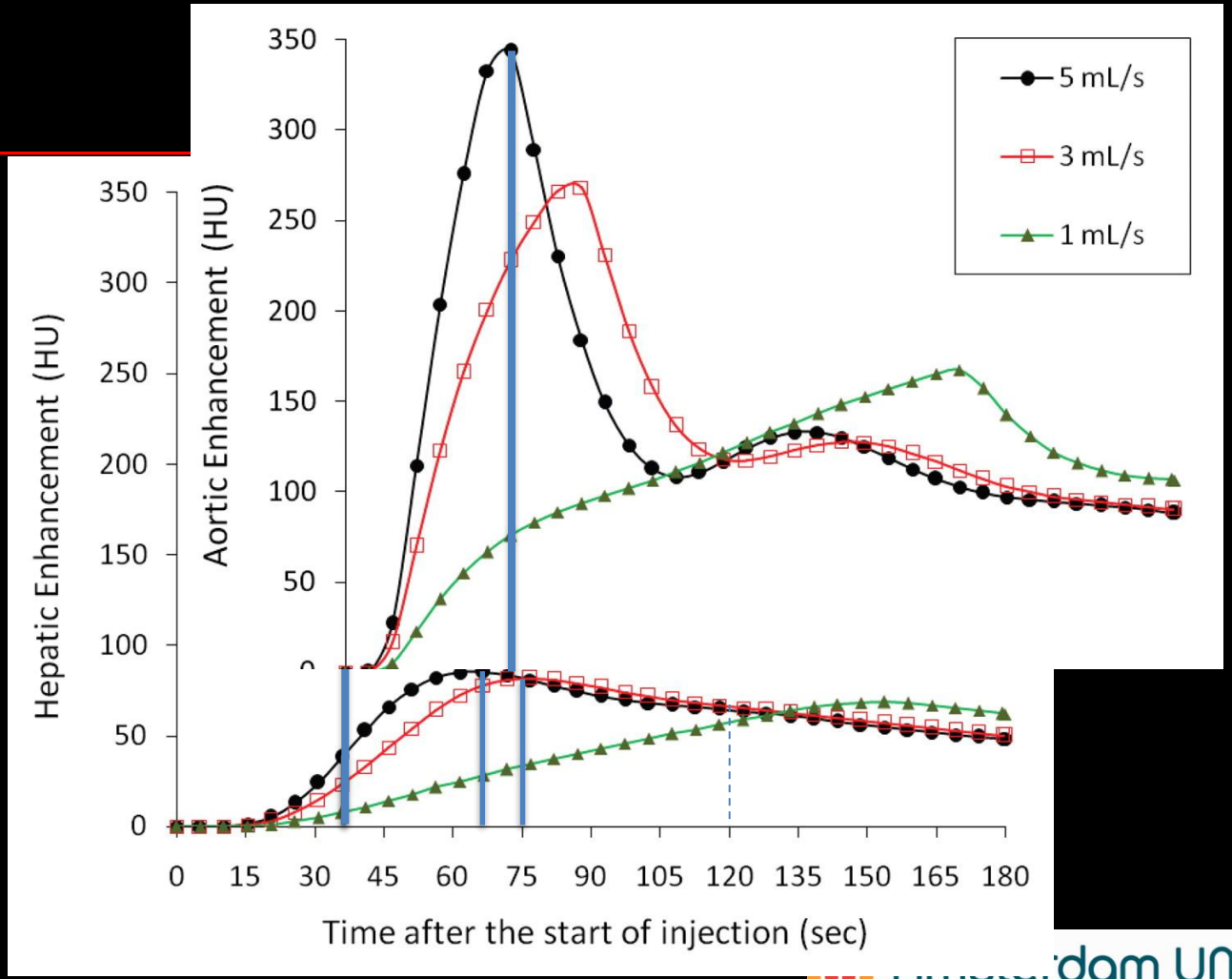

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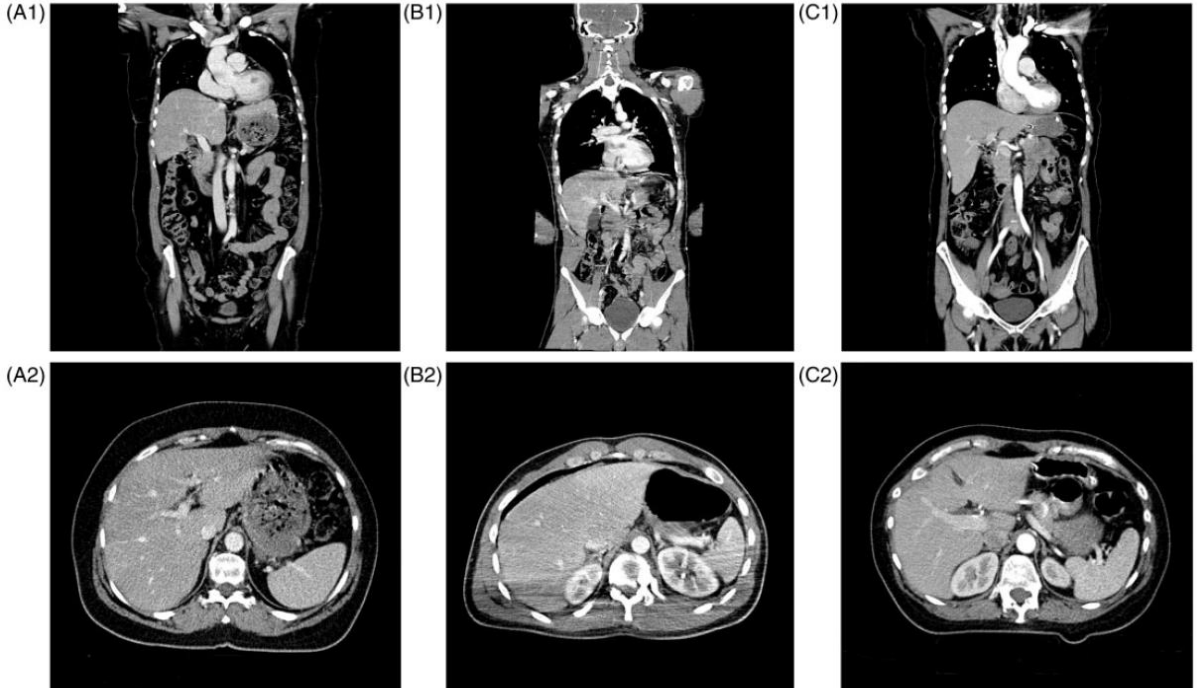
Split bolus technique in polytrauma: a prospective study on scan protocols for trauma analysis

Ludo FM Beenen[1], Joanne C Sierink[2], Saskia Kolkman[1], C Yung Nio[1], Teun Peter Saltzherr[2], Marcel GW Dijkgraaf[3] and J Carel Goslings[2]



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Splitbolus protocol AUMC

CT Whole Body Splitbolus Trauma

Siemens Somatom Force/AS+

NECT Head - S-spine
(arms alongside the patient, after which arms elevated)

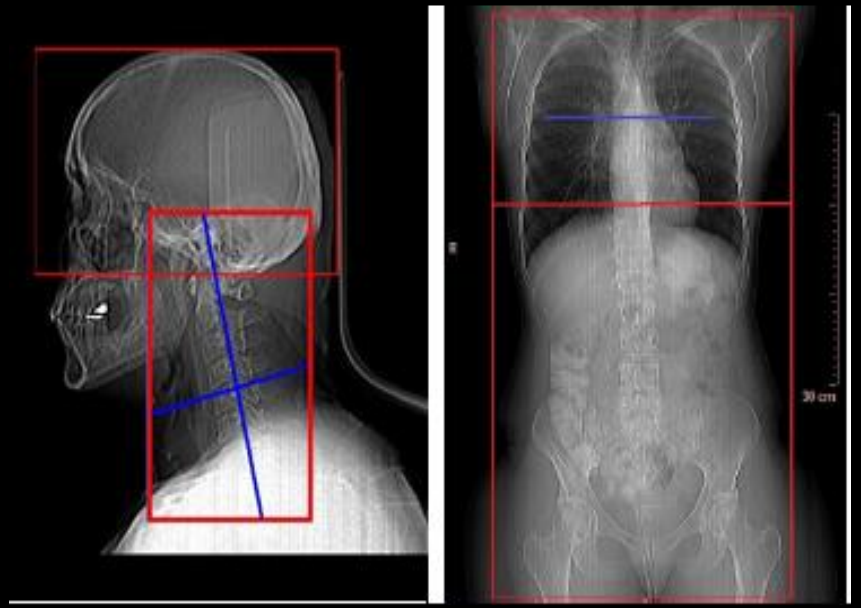
Split Bolus Premonitoring (carina)
Monitoring Aorta descendens
Delay 68 sec, Trigger 120HU

Body AV Normal: Torso
BCVI: frontal sinus - inguinal (radiologist)

Body Delayed Venous 45 sec torso (bleeding)
D600 (UG injury))

Xenetix 350mgI/ml

Contrast	70ml - 3.5ml/s
NaCl	60ml - 3ml/s
NaCl	40ml - 2ml/s
Contrast	40ml - 6ml/s
NaCl	30ml - 4ml/s



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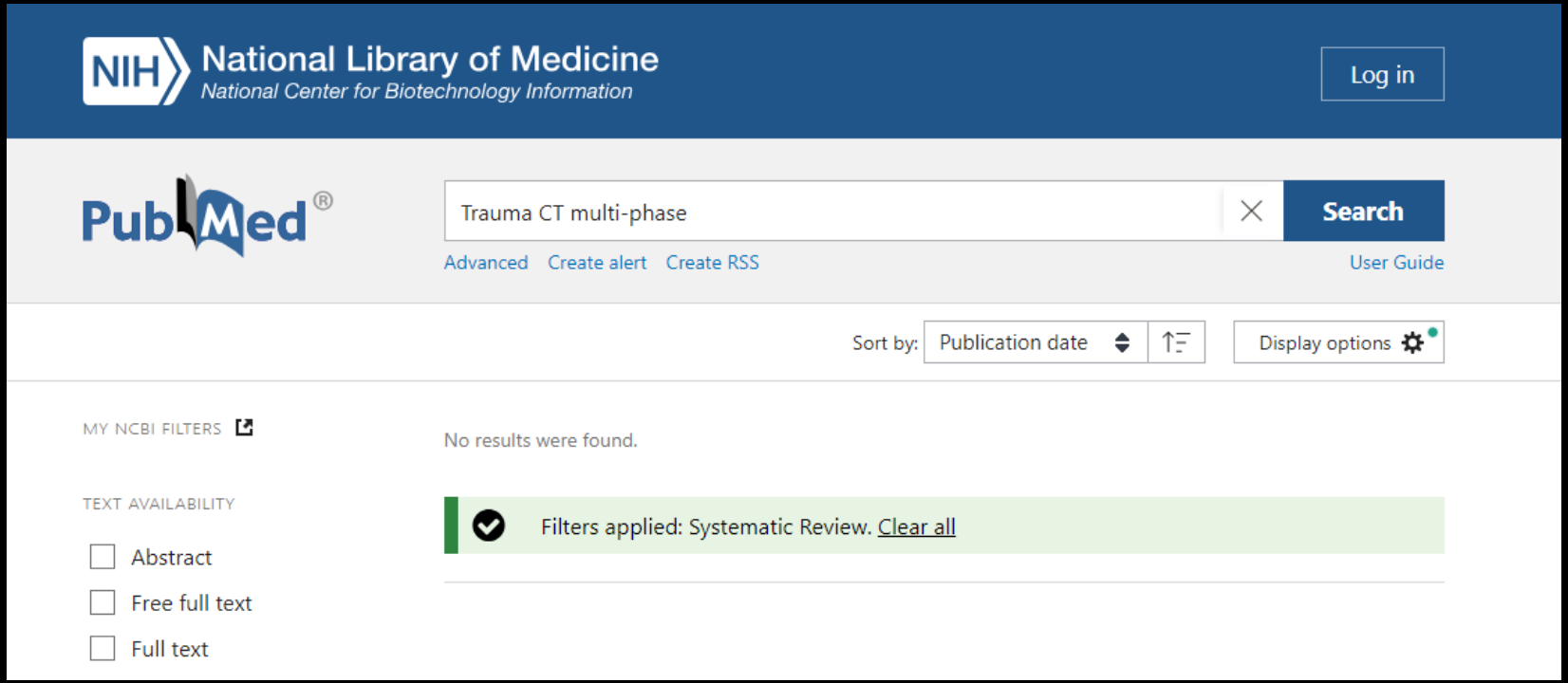
Split Bolus vs Dual Phase

- All contrast phases on one image
- Compartmentalisation of contrast phases

Evidence



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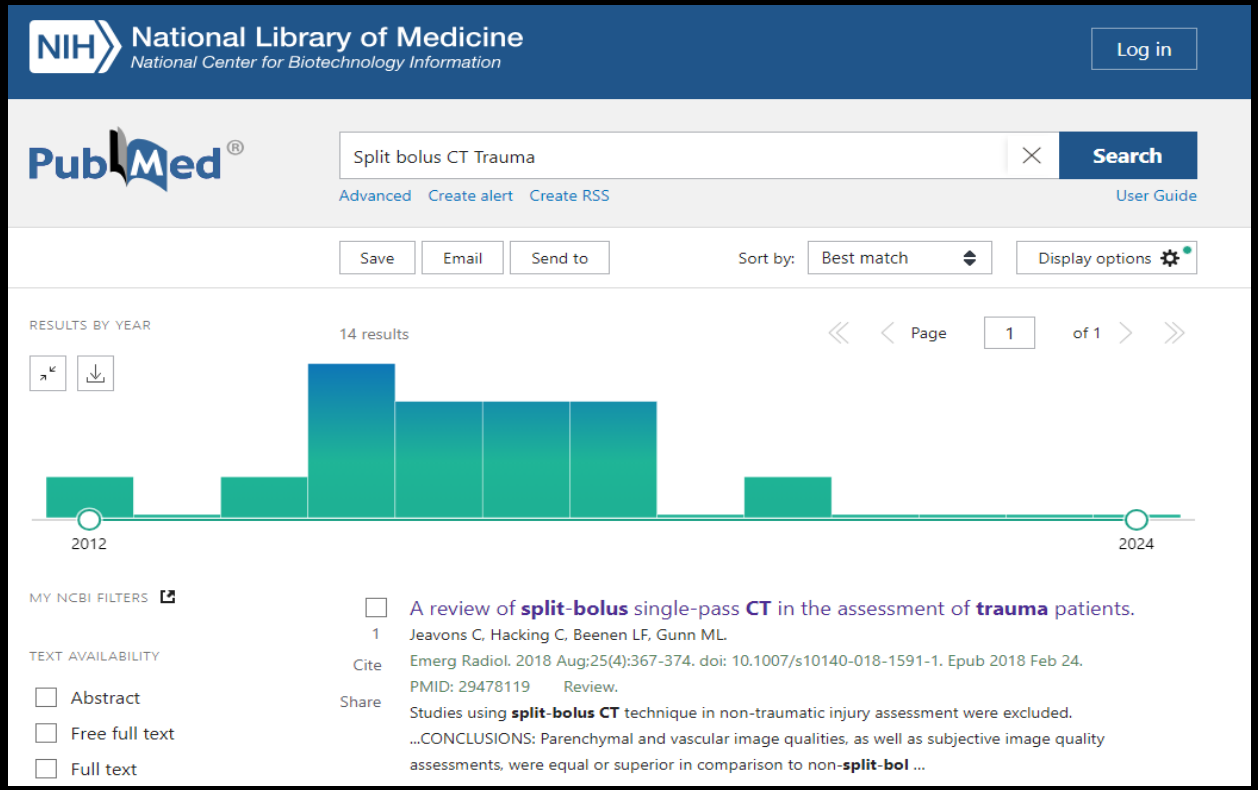
Evidence



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Emergency Radiology
https://doi.org/10.1007/s10140-018-1591-1

ORIGINAL ARTICLE

A review of split-bolus single-pass CT in the assessment of trauma patients

Cassandra Jeavons[1] · Craig Hacking[1] · Ludo F. Beenen[2] · Martin L. Gunn[3]

Received: 16 November 2017 / Accepted: 14 February 2018

Abstract

Purpose The purpose of this study was to review and compare the image quality and radiation dose of split-bolus single-pass computed tomography(CT) in the assessment of trauma patients in comparison to standard multi-phase CT techniques.

Methods An online electronic database was searched using the MESH terms "split-bolus," "dual phase," and "single pass." Inclusion criteria required the research article to compare a split contrast bolus protocol in a single-pass scan in the assessment of trauma patients. Studies using split-bolus CT technique in non-traumatic injury assessment were excluded. Six articles met the inclusion criteria.

Conclusions Parenchymal and vascular image qualities, as well as subjective image quality assessments, were equal or superior in comparison to non-split-bolus multi-phase trauma CT protocols. Split-bolus single-pass CT decreased radiation exposure in all studies. Further research is required to determine the superior split-bolus protocol and the specificity and sensitivity of detecting blunt cerebrovascular injury screening, splenic parenchymal vascular lesions, and characterization of pelvic vascular extravasation.

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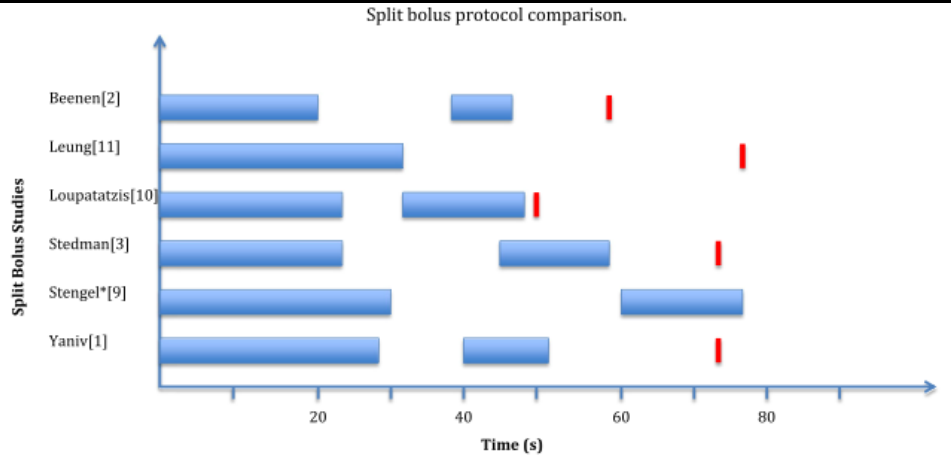


Fig. 1 Graph showing split-bolus protocol comparison, boluses with inter scan delay and fixed scan time (red line). No scan delay time was specified (asterisk)

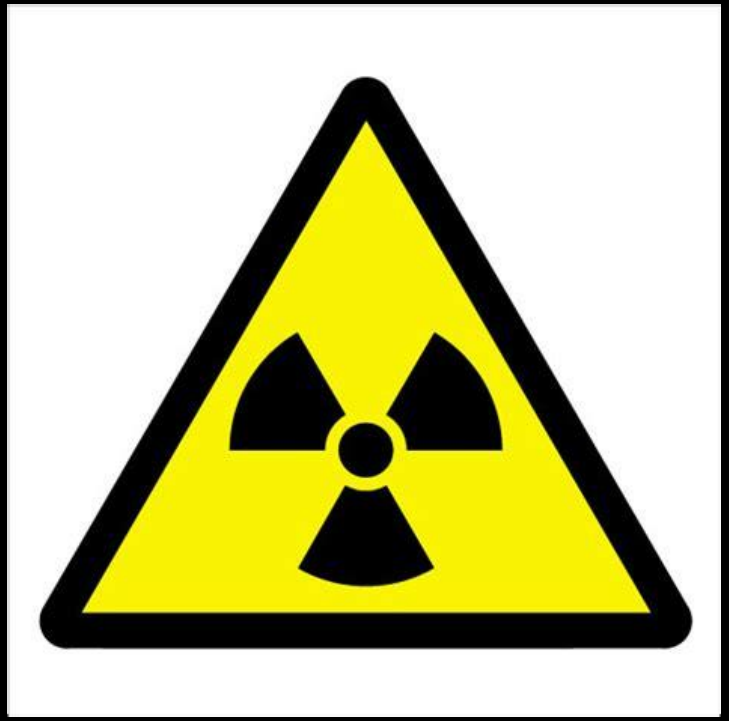
Table 1 Split-bolus protocol comparison

	CT head + cervical spine		Iodine concentrate (mg/mL)	Split-bolus volume and rate					Scan delay (s)	Saline flush
	Non-contrast	Contrast		1st bolus volume (mL)	Rate (mL/s)	Inter-bolus delay (s)	2nd bolus volume (mL)	Rate (mL/s)		
Beenen [12]	X		350	80	4	20	40	5	60	X
Leung [7]	X	X	340	65	2	10	85	3.5	77	X
Loupatatzis [13]	X		300	70	3	8	75	4	50	
Stedman [14]		NS	370	70	3	20	70	4	75	
Stengel [8]	X	X	300	80	2.7	30	70	4	NS	
Yaniv [15]	X		350	80	3	13	50	4	75	X

Split Bolus vs Dual Phase

Radiation:

- All 6 studies ↓
  - DLP reduction 32-68%



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Split Bolus vs Dual Phase

Length of stay

- All 6 studies ↓

MCI simulation study

- 1 patient/hr ↑

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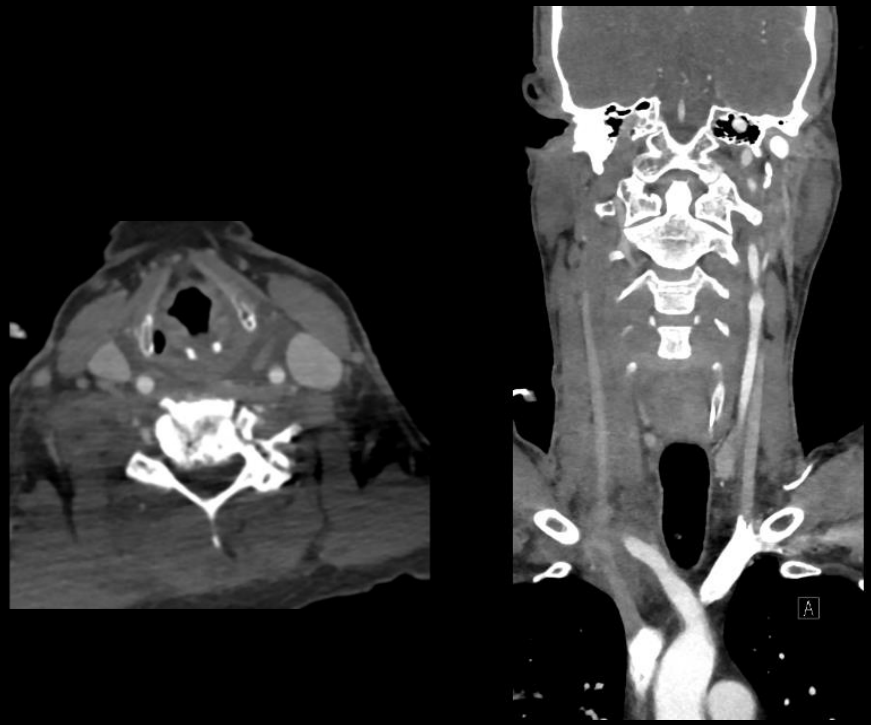
Split Bolus vs Dual Phase

Head & Neck

N=2

BCVI sens not assessed



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Split Bolus vs Dual Phase

Chest

Enhancement ++/-

Quality

aorta =

lung/mediastinum =

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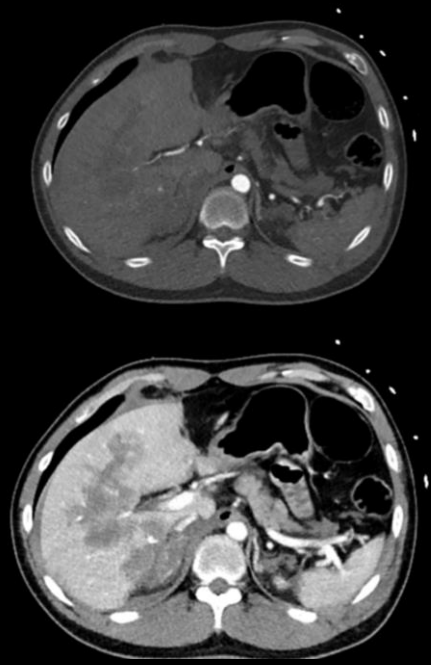
Split Bolus vs Dual Phase

Abdomen

Enhancement +++

Quality ++



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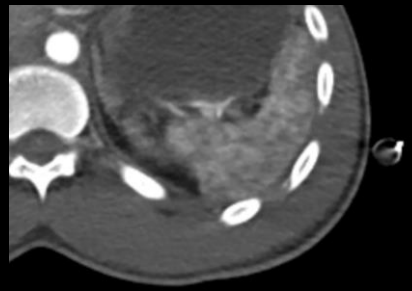
Split Bolus vs Dual Phase

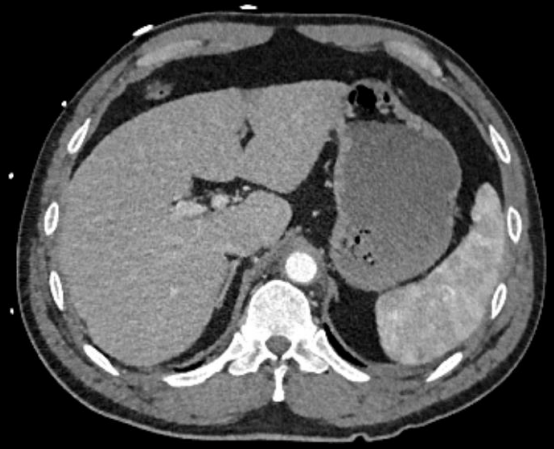
Spleen

Heterogenous enhancement

AAST grades

Sn/Sp Psan?





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Split Bolus vs Dual Phase

Pelvis

Stengel:

High Sn Sp

(no reported gold standard)

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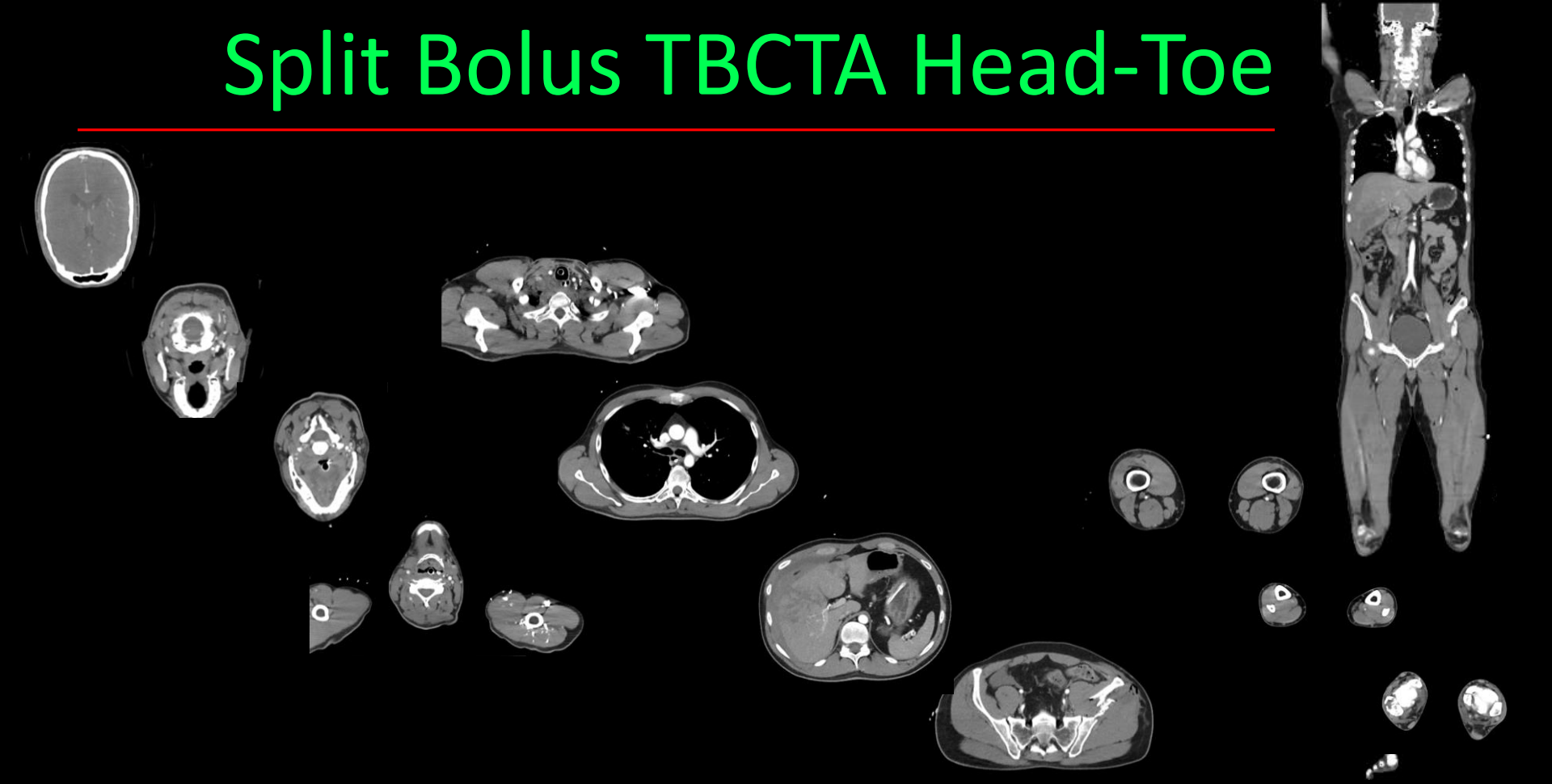
Split Bolus TBCTA Head-Toe



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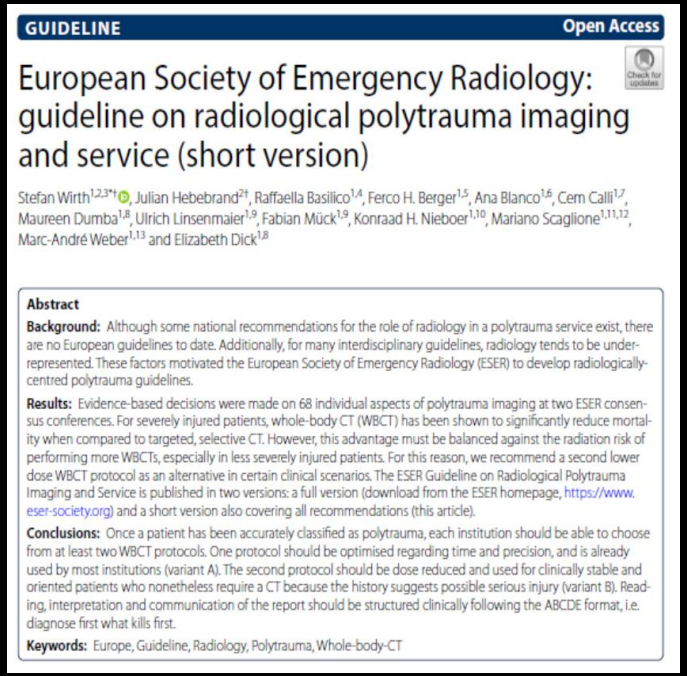
Split Bolus vs Dual Phase



GUIDELINE Open Access

European Society of Emergency Radiology: guideline on radiological polytrauma imaging and service (short version)

Stefan Wirth[1,2,3*†], Julian Hebebrand[21], Raffaella Basilico[1,4], Ferco H. Berger[1,5], Ana Blanco[1,6], Cem Calli[1,7], Maureen Dumba[1,8], Ulrich Linsenmaier[1,9], Fabian Mück[1,9], Konraad H. Nieboer[1,10], Mariano Scaglione[1,11,12], Marc-André Weber[1,13] and Elizabeth Dick[1,8]

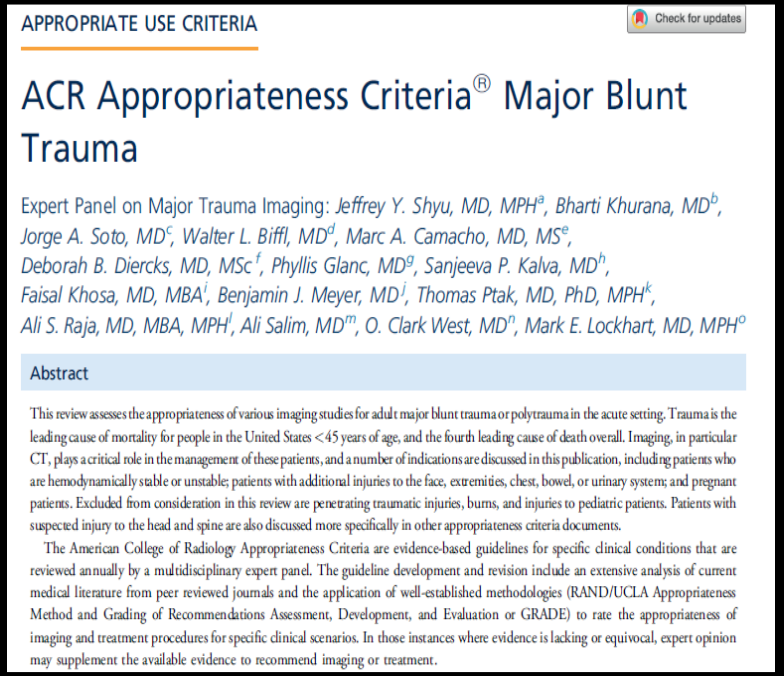
Abstract

Background: Although some national recommendations for the role of radiology in a polytrauma service exist, there are no European guidelines to date. Additionally, for many interdisciplinary guidelines, radiology tends to be under-represented. These factors motivated the European Society of Emergency Radiology (ESER) to develop radiologically-centred polytrauma guidelines.

Results: Evidence-based decisions were made on 68 individual aspects of polytrauma imaging at two ESER consensus conferences. For severely injured patients, whole-body CT (WBCT) has been shown to significantly reduce mortality when compared to targeted, selective CT. However, this advantage must be balanced against the radiation risk of performing more WBCTs, especially in less severely injured patients. For this reason, we recommend a second lower dose WBCT protocol as an alternative in certain clinical scenarios. The ESER Guideline on Radiological Polytrauma Imaging and Service is published in two versions: a full version (download from the ESER homepage, https://www.eser-society.org) and a short version also covering all recommendations (this article).

Conclusions: Once a patient has been accurately classified as polytrauma, each institution should be able to choose from at least two WBCT protocols. One protocol should be optimised regarding time and precision, and is already used by most institutions (variant A). The second protocol should be dose reduced and used for clinically stable and oriented patients who nonetheless require a CT because the history suggests possible serious injury (variant B). Reading, interpretation and communication of the report should be structured clinically following the ABCDE format, i.e. diagnose first what kills first.

Keywords: Europe, Guideline, Radiology, Polytrauma, Whole-body-CT



APPROPRIATE USE CRITERIA

Check for updates

ACR Appropriateness Criteria® Major Blunt Trauma

Expert Panel on Major Trauma Imaging: *Jeffrey Y. Shyu, MD, MPH[a], Bharti Khurana, MD[b], Jorge A. Soto, MD[c], Walter L. Biffl, MD[d], Marc A. Camacho, MD, MS[e], Deborah B. Diercks, MD, MSc[f], Phyllis Glanc, MD[g], Sanjeeva P. Kalva, MD[h], Faisal Khosa, MD, MBA[i], Benjamin J. Meyer, MD[j], Thomas Ptak, MD, PhD, MPH[k], Ali S. Raja, MD, MBA, MPH[l], Ali Salim, MD[m], O. Clark West, MD[n], Mark E. Lockhart, MD, MPH[o]*

Abstract

This review assesses the appropriateness of various imaging studies for adult major blunt trauma or polytrauma in the acute setting. Trauma is the leading cause of mortality for people in the United States <45 years of age, and the fourth leading cause of death overall. Imaging, in particular CT, plays a critical role in the management of these patients, and a number of indications are discussed in this publication, including patients who are hemodynamically stable or unstable; patients with additional injuries to the face, extremities, chest, bowel, or urinary system; and pregnant patients. Excluded from consideration in this review are penetrating traumatic injuries, burns, and injuries to pediatric patients. Patients with suspected injury to the head and spine are also discussed more specifically in other appropriateness criteria documents.

The American College of Radiology Appropriateness Criteria are evidence-based guidelines for specific clinical conditions that are reviewed annually by a multidisciplinary expert panel. The guideline development and revision include an extensive analysis of current medical literature from peer reviewed journals and the application of well-established methodologies (RAND/UCLA Appropriateness Method and Grading of Recommendations Assessment, Development, and Evaluation or GRADE) to rate the appropriateness of imaging and treatment procedures for specific clinical scenarios. In those instances where evidence is lacking or equivocal, expert opinion may supplement the available evidence to recommend imaging or treatment.

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Split Bolus vs Dual Phase

- Reduced radiation dose
- Fast
- Lower
  - Recon time
  - Transfer time
  - One image stack
- Faster reading
- Shorter examination time

- Increased radiation dose
- Time consuming
- Double
  - Recon time
  - Transfer time
  - More images

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Split Bolus vs Dual Phase

- More difficult to evaluate
- No pure arterial and venous phase; may hide vascular injuries
- Higher volume contrast

- Simpler to evaluate/compare
- Clear separation of phases, depiction of vascular injuries
- Lower contrast volume

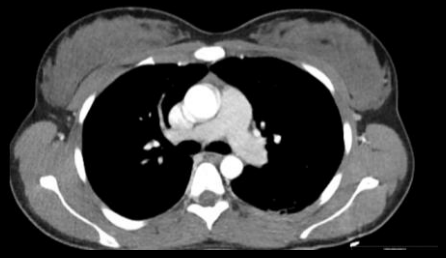
Special categories

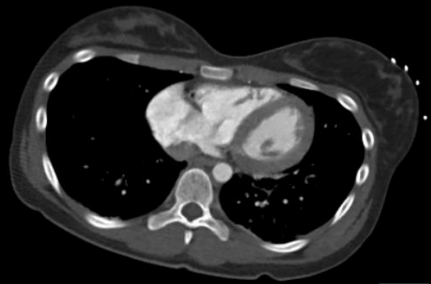
- Children
  - Split-bolus preference

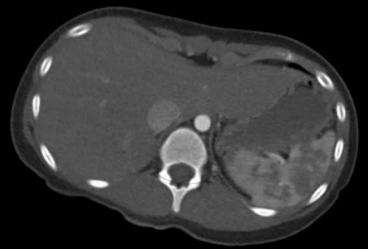
Early experience with a split-bolus single-pass CT protocol in paediatric trauma

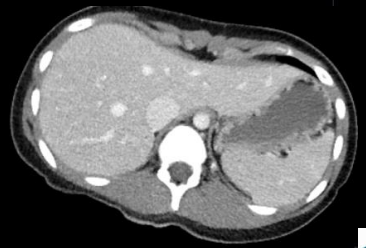
V.J. Leung*, M. Grima, N. Khan, H.R. Jones

Royal Stoke University Hospital, Newcastle Road, Stoke-on-Trent, ST4 6QG, UK









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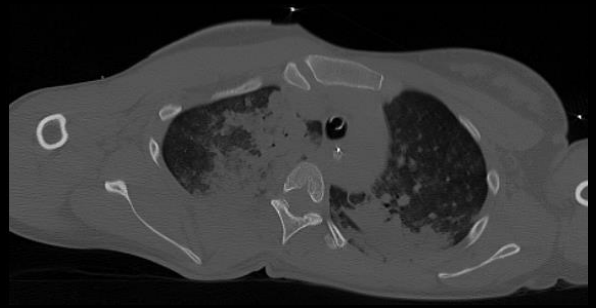
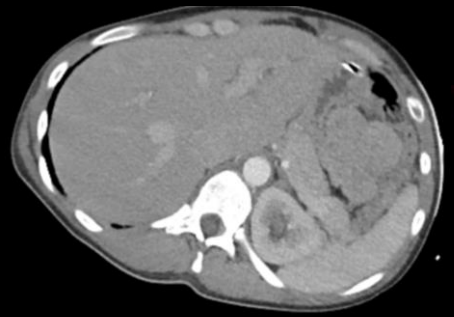
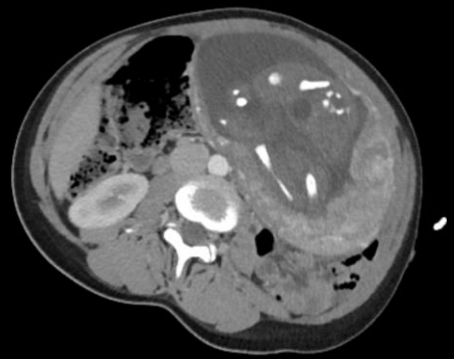
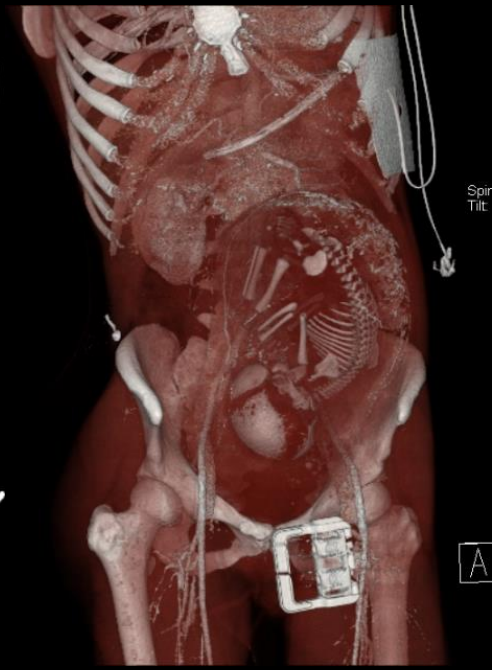
Special categories

- Pregnancy
  - Split-bolus preference









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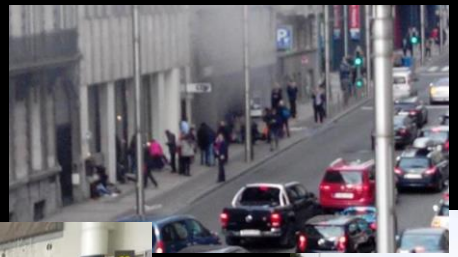
Special categories

- MCI
  - Bastion protocol (Afghanistan)



University Medical Centers

Split Bolus vs Dual Phase

- No consensus on superiority

- Lower radiation
- Less images

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WBCT: Split Bolus or Dual Phase

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Disclosures: None