Is there a benefit of Whole Body Computed Tomography for patients with only high velocity Road Traffic Collision Vittel criteria?

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- Introduction
- Materials and Methods
- Results
- Discussion
- Conclusion

Introduction

Whole Body Computed Tomography (WBCT) for victims of severe trauma :

- Fast diagnosis of traumatic injuries
- Fiability, safety, sensitivity
- Reduction of time spent in the Emergency Departement (ED)
- **Lead to diagnose clinically unsuspected injuries** (4-60% depending on the population included)

Introduction

Indications to perform a WBCT or a targetted exploration are debated :

- No reduction of mortality with initial assessment by WBCT compared to standard exploration (X-rays, US, targetted scan)
- Greater irradiation than standard exploration
- Leads to perform a significant amount of normal CT (32- 44,2%)
- Mobilisation of material and human resources (mean time of interpretation : 20.48 min)

→**Define WBCT indications is a great medical and economical challenge :**

→**Not missing potentially severe injuries but limit the amount of normal WBCT performed**

Introduction
Vittel Criteria

WBCT indication in France : presence of at least one Vittel criteria of gravity

Evaluation	Severity criteria
Physiological variables	Glasgow score < 13
	Systolic blood pressure < 90 mmHg
	O_2 saturation < 90%
Kinetic elements	Ejection from a vehicle
	Other passenger died in the same accident
	Fall > 6 m
	Victim thrown or run over
	Global assessment (vehicle deformation, estimated speed, no helmet, no seat belt)
	Blast
Anatomical injuries	Penetrating trauma: head, neck, chest, abdomen, pelvis, arm, thigh
	Flail chest
	Severe burn, smoke inhalation
	Smashed pelvis
	Suspected spinal cord injury
	Amputation at the wrist, ankle, or above
	Acute ischemia of a limb
Resuscitation prior to admission	Assisted ventilation
	Colloid fluids > 1000 mL
	Catecholamines
	Inflated antishock trousers
Predisposition (to be determined)	Age > 65 years old
	Heart or coronary failure
	Respiratory failure
	Pregnancy (second or third trimester)
	Dyscrasia

Introduction
Vittel Criteria

- Kinetics elements with the item “Global assessment” are the elements leading to perform most of the WBCT
- Those items are subjective :
  - Evaluation of deformation of the vehicle
  - No limit of speed determined
- Necessity to precise those criteria

→**Interest of a specific study of victims of high kinetic Road Traffic Collision (RTC) only Vittel criteria**

Objectives

For victims of high velocity RTC, with no other Vittel criteria of gravity, normal clinical examination of the thorax, abdomen and pelvis and Glasgow Coma Scale (GCS) score of 15 :

- Study of clinically unsuspected injuries discovered on WBCT
  - Description
  - Predictive factors
  - Diagnostic performances of kinetic elements of Vittel criteria, and results of examinations realised at the ED.

Materials and Methods

Study design

- Retrospective and monocentric study

- **Inclusion criteria** :
  - Consecutives patients consulting the emergency department between August 1st 2016 and July 31th 2017
  - Older than 18 y.o.
  - WBCT performed,
  - Victim of a high velocity RTC as defined by the presence of at least one criteria of the kinetics elements of the Vittel Criteria
  - Normal physical exam of the chest, abdomen and pelvis,
  - GCS score of 15

- **Exclusion criteria** :
  - Patients presenting another Vittel criteria of gravity than kinetics elements

Materials and Methods
Collected data

- Circumstances of the RTC : kinetic elements of Vittel criteria, type of RTC
- Physical examination : vitals, symptoms
- Biological tests
- Radiological studies : WBCT, X-Rays
- Medical care

Materials and Methods
Technical elements

- WBCT realisation :
  - Acquisition exploring the head without contrast product injection
  - 2 protocols for the acquisitions with injection of iodinated contrast product (arterial and portal time or biphasic injection)

- WBCT interpretation :
  - First reading by a senior radiologist at the ED
  - Second reading for the study, blinded from the first one, by a junior and a senior radiologist
  - Third reading by both the senior and the junior radiologist who decided the final interpretation if discordance after confrontation of the first two readings

Results

Population included

- 93 patients included on 459 (20.3%) consulting the ED for a RTC with at least one Vittel Criteria in the one year period of inclusion

- **11 (11.8%) WBCT showed clinically unsuspected injuries**

- Male : 72 (77,4%); women : 21 (22,6%)
- Mean age : 30,8 +/- 12,0
- 75 patients (80.6%) presented symptoms (pain of the neck, head, face, or limb)

Results

Population included

- Most represented type of RTC :
  - Car : 69 (74.2%)
  - Motorbike accident : 17 (18.3%)

- Most represented kinetics elements :
  - High speed : average speed (km/h): 97.6 ± 16.9
  - Roll-over : 44 patients
  - Airbag triggering : 24 patients

Results

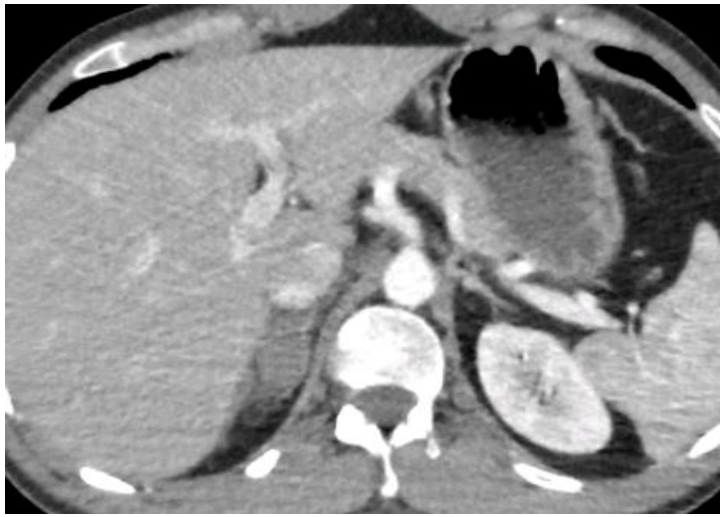
Population included

- Mean time spent at the ED (hours) : 7.5 ± 5.1
- Mean delay before WBCT realization (hours) : 3.1 ± 1.5
- Hospitalization : 38 (40.9%) patients
  - Orthopedic surgery : 18 (47.4%)
  - Post-emergency departement : 15 (39.5%)

Results

Clinically unsuspected injuries : description

- **1 abdominal injury : adrenal hematoma**
  - No specific medical care
  - Hospitalized for orthopedic treatment of cervical vertebra fracture

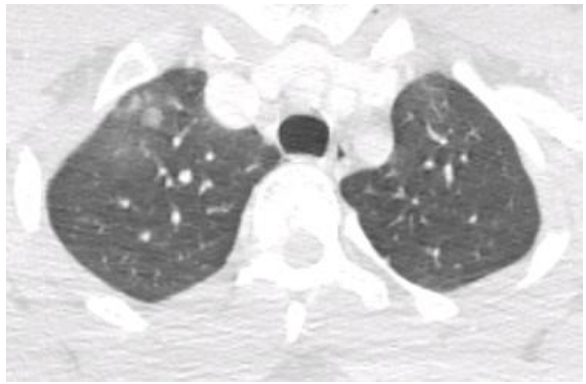


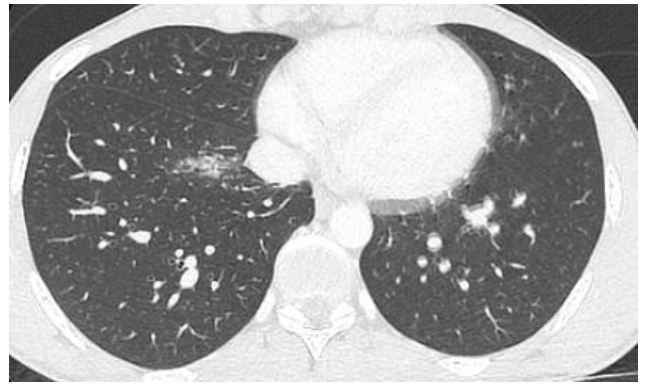
Results

Clinically unsuspected injuries : description

- **8 lung contusions**
  - 1 needed a clinical and radiological surveillance
    - Patient hospitalized for treatment of a wrist fracture

  - 4 patients were discharged from hospital after consultation at the ED

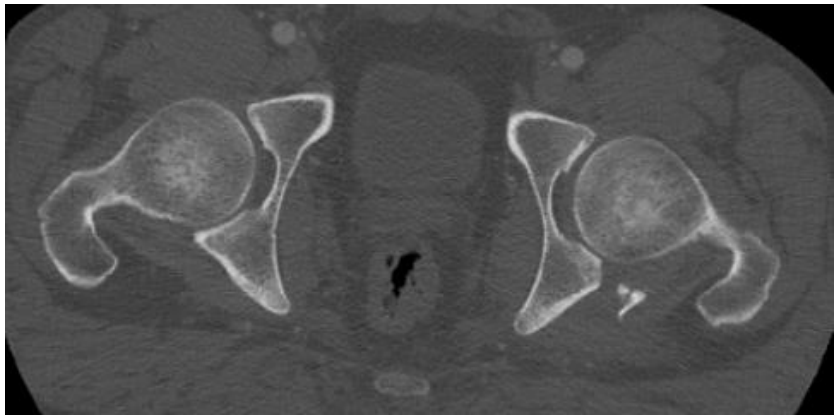


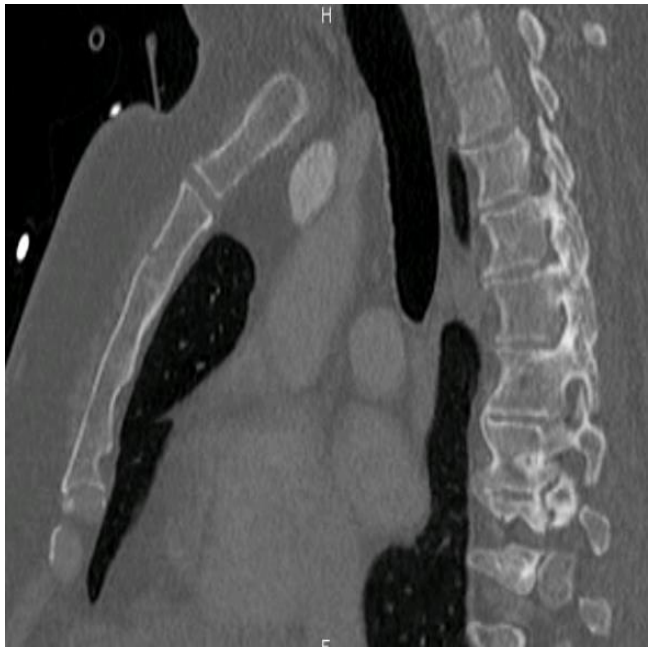


Results

Clinically unsuspected injuries : description

- **2 orthopaedic fractures :**
  - 1 acetabulum fracture
  - 1 sternal fracture
    - No specific medical care





Results

Population included

- Statistically significant differences between patients with and without clinically unsuspected injuries :
  - Diastolic blood pressure (mmHg) : 86.6 ± 11.0 vs 77.8 ± 11.8 (p = 0.0213)
  - Leukocyte count (G/L) : 16.1 ± 7.3 vs 11.8 ± 4.9 (p = 0.0127)
  - Troponin T Hs (UI/L) : 6.9 ± 10.6 vs 0.6 ± 2.7 (p = 0.0029)
  - Hematuria (RBC/mm^3) : 103.3 ± 128.6 vs 15.2 ± 53.2 (p = 0.0074)

Results

Clinically unsuspected injuries : predictive factors

- Multivariate logistic regression
- For all type of RTC :
  - Leukocytes > 15 G/L : OR = 6.64 [1.64 ; 26.88] (p=0.0080)
  - Elevation of 20 mmHg of mean arterial pressure : OR = 2.854 [1.037 ; 7.856] (p= 0.0424)

Results

Clinically unsuspected injuries : diagnostic performances

	Variable	Sensibility	Specificity	Positive predictive value	Negative predictive value
Clinical examination	**Facial pain or headache**	27.27% [1%;53.6%]	68.29% [58.2%;78.4%]	10.34% [-0.7%;21.4%]	87.5% [79.4%;95.6%]
	Pain of one or more limb	63.64% [35.2%;92.1%]	54.88% [44.1%;65.6%]	15.91% [5.1%;26.7%]	**91.84% [84.2%;99.5%]**
	Head trauma	**87.5% [64.6%;100%]**	47.06% [35.2%;58.9%]	16.28% [5.2%;27.3%]	**96.97% [91.1%;100%]**
	Loss of consciousness	28.57% [-4.9%;62%]	83.1% [74.4%;91.8%]	14.29% [-4%;32.6%]	**92.19% [85.6%;98.8%]**
	Mean blood pressure > 107 mmHg	36.36% [7.9%;64.8%]	81.48% [73%;89.9%]	21.05% [2.7%;39.4%]	**90.41% [83.7%;97.2%]**
Biological tests	**Leukocytes > 15 G/L**	54.55% [25.1%;84%]	82.72% [74.5%;91%]	30% [9.9%;50.1%]	**93.06% [87.2%;98.9%]**
Kinetics elements of Vittel criteria	**Speed > 90 km/h**	66.67% [28.9%;100%]	56.36% [43.3%;69.5%]	14.29% [1.3%;27.2%]	**93.94% [85.8%;100%]**
	No seatbelt	12.5% [-10.4%;35.4%]	**95% [88.2%;100%]**	33.33% [-20%;86.7%]	84.44% [73.9%;95%]
	Airbags triggering	60% [17.1%;100%]	52.38% [37.3%;67.5%]	13.04% [-0.7%;26.8%]	**91.67% [80.6%;100%]**
	Roll-over	50% [15.4%;84.6%]	20% [8.9%;31.1%]	9.09% [0.6%;17.6%]	71.43% [47.8%;95.1%]
	Thrown	50% [1%;99%]	33.33% [13.2%;53.5%]	12.5% [-3.7%;28.7%]	77.78% [50.6%;100%]
	No helmet	0% [0%;0%]	81.25% [62.1%;100%]	0% [0%;0%]	**92.86% [79.4%;100%]**
	Other passenger died	0% [0%;0%]	95.35% [89.1%;100%]	0% [0%;0%]	85.42% [75.4%;95.4%]
Radiological studies	**Presence of traumatic injuries, thorax and abdomen excluded**	45.45% [16%;74.9%]	73.17% [63.6%;82.8%]	18.52% [3.9%;33.2%]	**90.91% [84%;97.8%]**
	Limb(s) fracture(s)	27.27% [1%;53.6%]	80.49% [71.9%;89.1%]	15.79% [-0.6%;32.2%]	89.19% [82.1%;96.3%]

Discussion

- No immediate life-threatening injury discovered
- None of the unsuspected injury needed a specific treatment
- 1 abdominal injury : adrenal hematoma without active hemorrage, lead to no specific care
- 1 lung contusion needed a surveillance
  - Interest of chest X-ray to diagnose lung contusions that could benefit from a surveillance
- 1 sternal fracture : may have been clinically diagnosed
- 1 acetabulum fracture : may have been diagnose by clinical examination and radiography

Discussion

- 2 independent predictive factors of clinically unsuspected injuries :
  - Leukocytes > 15 G/L
  - Elevation of mean arterial pressure
    - Could reflect the violence of the RTC

- Analysed criteria (clinical, biological, kinetics) have a low specificity and sentibility but some have a good negative predictive value, that could be used to select patients that would not benefit from a WBCT

Discussion
Limits

- Retrospective study
- Monocentric
- Low number of patients regarded the frequency of RTC
- Lack of data :
  - No uniformization of tests performed at the ED → Could explain that troponemia and hematuria are not confirmed as predictive factors despite of the statistically significant difference between patients with and without clinically unsuspected injuries
  - Elements of kinetics were notified in the patient folder when present but not when absents → limitation of the research of predictive factors

Conclusion

For victims of high kinetic RTC with no other Vittel criteria of gravity, a normal clinical examination of the thorax, adomen and pelvis and a GCS >15

- A WBCT may not be performed if :
  - No head trauma, loss of consciousness, pain of a limb,
  - Mean blood pressure < 107 mmHg,
  - Leukocytes < 15 G/L,
  - Speed < 90 km/h, no airbag triggering, presence of a helmet, no other passenger dead,
  - Absence of traumatic injuries (excluded thorax and abdomen)
- Realization of a WBCT should be discussed if : leukocytes > 15 G/L or elevated mean blood pressure
- A chest X-Ray could be performed searching for lung contusion that could need a surveillance
- Those results need to be confirmed by a larger prospective study.

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