Original Article

Outcome of selective CT *vs.* pan-CT scan in elderly trauma patients: A retrospective cohort study in a level 1 trauma center

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ABSTRACT

Purpose: There are currently no clear guidelines for use of pan- or selective CT in elderly trauma patients and this subject matter remains controversial. The aim of this study is to compare the outcome of elderly trauma patients in a level 1 trauma centre who required a pan- or selective CT scan on admission.
Methods: The Trauma Audit Research Network database was reviewed to identify eligible patients ($\geq$65 years) over a one-year period, from January 2018 to January 2019. Patients' demographics, mechanism of injury, injury severity score, length of hospital stay (LOS), mortality and type of CT scans done were recorded. The inclusion criteria were elderly patients $\geq$65 years involved in acute trauma setting (less than one day between incident and emergency department presentation and blunt mechanism of injury). Exclusion criteria were patients <65 years, perforating mechanism of injury and patients with delayed presentation more than one day after the incident, and patients who have not got any CT scan at presentation. Statistical analyses were undertaken on SPSS (version 25.0; IBM, New York, USA).
Results: In total, 481 patients with the mean age of 80.8 years were evaluated (48.6% male). Among them 232 cases were multiple injuries while 249 were single system injuries. And 235 patients (48.8%) underwent pan-CT in whom 66.8% were multiple injuries; 246 (51.1%) did selective CT scan in whom 69.5% were single system injuries. In multiple injury patients, performing a pan-CT scan on presentation was associated with shorter LOS compared to those who had a selective CT, in which 76.4% patients spent < 21 days in the pan-CT group compared to 16.0% for those investigated by selective CT scan ($p < 0.001$); and 2.5% spent > 60 days in pan-CT group compared to 64% in selective CT group ($p < 0.0001$). Performing pan-CT was also associated with lower need to repeat CT ($p < 0.01$). In patients with a single system injury, no differences were found in LOS or the need to repeat CT if either pan-CT or selective CT were requested.
Conclusion: We recommend doing pan-CT scan in all elderly patients with multiple system injuries as it decreases the LOS and the need for another CT during hospital stay. No difference in LOS or the need to repeat another CT if pan-CT or selective CT were requested initially in single system injuries. Although age and injury severity score are poor predictors for the need to do pan-CT, the mechanism of injury may be helpful.

Introduction

CT scan is one of the most effective investigations and is helpful in both the diagnosis and treatment of injuries in the shortest time possible.[1] CT scan machines are very expensive and have a high maintenance cost; therefore, there should be a fine balance between doing CT scans in trauma cases to avoid unnecessary costs and meanwhile to avoid missing injuries and complications. This becomes more important in emergency cases, where rapid decisions can save a patient's life especially in silver trauma patients where deranged physiology can mask signs and symptoms of a major pathology.[2,3]

The National Institute for Clinical Excellence guidelines in major trauma indicate the use of whole body CT (consisting of a vertex-to-toes scanogram followed by a CT from vertex to mid-thigh) in

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adults (≥16 years old) with blunt major trauma and suspected multiple injuries. Patients should not be repositioned during whole body CT. It also advises using of clinical findings and the scanogram to direct CT of the limbs in adults (16 years old or over) with limb trauma.[4]

The required CT scan may be either selective (scan from a pre-determined point) or non-selective (whole body scan from head to hip). Due to its more accurate diagnosis and detection of hidden injuries in asymptomatic cases, pan-CT scan is very interesting for many physicians especially emergency department (ED) doctors.[5] However, if the occult injuries detected in pan-CT scan are not clinically significant or do not make a difference in management of the patients, selective CT scan can be used instead so as to decrease costs and radiation received and its side effects.[6] Some studies do not believe that selective CT scan is capable of detecting all injuries caused by blunt trauma.[7,8]

The Trauma Audit Research Network (TARN) data highlights that major trauma patients in the England and Wales are becoming more elderly, and that low level falls can be a leading cause of severe injury.[9] Two-thirds of female and one-third of male injury-related deaths occur in those aged over 65 years.[10] Falls account for 73% of cases of major trauma in patients over 65 years old with road trauma constituting the majority of the remainder.[10] After adjusting for injury severity score (ISS), geriatric trauma victims have two times the mortality of younger patients and significantly longer intensive care unit and hospital stays.[10,11] Even minor elderly trauma that does not usually require hospital admission can be associated with functional decline and preventable re-presentations to the ED. Increasing age has been reported as one determinant of mortality and post-trauma functional recovery.[12]

In the field of trauma, it is well known that the first hour of presentation is the golden hour and that around 60% of patients lives can be saved if they are treated within that hour rather than later. Research has shown that aggressive treatment of the elderly with survivable injuries results in the majority of them returning home, and 85% of these patients return to functional independence.[13] Moreover, there are recommendations from the American College of Surgeons Committee on Trauma that all trauma patients older than 65 years should be considered for direct transport to a level 1/2 trauma center, regardless of injury severity.[13,14]

Our aims from this study are: (1) to compare the outcome and benefits of doing pan-CT scan in elderly multiple and single system injuries (more than 65 years old); (2) to highlight any difference in mortality, the length of hospital stay (LOS), or the need to repeat CT scan in cases who had been initially investigated by pan- or selective CT scan; (3) to find if there is any other predictor for the usefulness of doing pan-CT as age, ISS, and mechanism of injury.

Methods

We performed a retrospective study of trauma patients admitted to a major level 1 trauma center in the United Kingdom (UK) during a one year period between January 2018 to December 2018. The data obtained from the TARN involved 593 elderly trauma patients; from them we included 481 in our study regarding CT target analysis. The inclusion criteria were elderly patients above 65 years involved in acute trauma setting (less than one day between incident and ED presentation and blunt mechanism of injury). Exclusion criteria were ages less than 65 years, perforating mechanism of injury and patients with delayed presentation more than one day after the incident (two cases excluded), and patients who have not got any CT scan at presentation (105 cases). During review of the need to repeat CT scan after hospital admission, we excluded cases which required CT scan for follow-up of already diagnosed injury from the first CT scan done at

initial presentation. The age of patients varied from 65 to 103 years (median 80.8 years). From these cases, 233 (48.6%) were males and 248 (51.4%) were females.

The date and time of trauma, arrival to the ED and date and time of discharge were recorded. We classified the LOS into three categories, below 21 days, between 21 and 60 days and more than 60 days. All trauma injuries were recorded. These were classified by anatomical location into six groups (head, chest, abdomen, bones, pelvis, spine), and generally as single system injuries and multiple injuries. The decision whether to do a pan-CT scan or selective CT scan was put by the on charge ED consultant based on clinical presentation but without referring to any guidelines available.

The mechanism of injury was classified into falls (less than or greater than 2 m), road traffic accidents, blunt trauma, stabbings, shootings and burns. The outcome after 30 days, whether alive or dead, was also recorded. The ISS was classified into three groups (<8, 8−15, >15). Glasgow coma scale was recorded both at patient review by the health care team on the scene and at hospital arrival. CT date, time and region examined (whether selective CT scan or pan-CT scan) were recorded at initial presentation and in consecutive follow-ups during patient stay.

The demographic characteristics of the cohort were reported using descriptive statistics (mean and standard deviation). The distribution of the dataset was assessed using a Shapiro-Wilks test and histograms. This indicated a normally distributed dataset. Based on this, differences in continuous outcomes over time were assessed using an analysis of variance test whilst categorical data was analysed using a Chi-squared test. Statistical significance was determined as $p < 0.05$. Statistical analyses were undertaken on SPSS (version 25.0; IBM, New York, USA).

Results

General data

In our study, 481 elderly trauma patients met the inclusion criteria, in whom 232 were multiple system injuries, and 249 were single system injuries. Among the multiple system injury cases, 157 cases were investigated by pan-CT, 75 cases by selective CT scan at initial presentation at ED. In single system injury cases, 78 cases did a pan-CT scan, 171 did selective CT scan at ED presentation.

Trauma team was activated in 75.4% of multiple system injuries. In single system injuries, it was activated in 56.7% of chest injuries and in 52.5% of limb injuries and in 33% of head injuries.

Regarding LOS, generally, the most common LOS was <21 days in 80.7% of the cases. However, the most injury pattern with the longest LOS (>21 days) were spine injuries (26.6%), limb injuries (24.3%) and multiple injuries (19.6%).

Regarding ISS, most pelvic (79.4%) and spine (46.6%) injuries were <8. Most limb (92.3%) and chest (48.6%) injuries came in the 8−15 category. Respectively, 63% and 94.7% of multiple and single head injuries are of an ISS >15.

Looking at the mechanism of injury, the most common mechanism by far was the low energy falls (<2 m, 367 cases, 76.3%), followed by motor vehicle accidents (61 cases, 12.7%), high energy falls (>2 m, 47 cases, 9.7%), blow mechanism (4 cases, 0.8%), and other blunt mechanisms (2 cases, 0.4%). Interestingly, as the age progress, there is a gradual increase in the percentage of those affected by low energy falls and a gradual decrease in the percentage of those affected by vehicle accidents and high energy falls.

Comparing multiple and single system injuries

When we compared multiple injuries (232 cases) with single injuries (249 cases) included in our study, we found that 38 patients

Table 1
Comparison of the patients who did CT in multiple injury group and single injury group regarding mortality, LOS, ISS, and mechanism of injury.

Variables	Multiple injuries (n=232)	Single injuries (n=249)	p value
Mortality (n)	38	33	>1
LOS (days)			
<21	176 (75.9)	196 (78.7)	0.821
22-60	50 (21.5)	45 (18.1)	0.576
>61	5 (2.2)	8 (3.2)	0.634
ISS			
<8	29 (12.5)	49 (19.7)	0.211
8-15	54 (23.3)	76 (30.5)	0.320
>15	149 (64.2)	124 (49.8)	0.173
Mechanism of injury			
Fall <2 m	143 (61.6)	224 (90.0)	0.021
Fall >2 m	40 (17.2)	7 (2.8)	0.001
Motor vehicle accidents	46 (19.8)	15 (6.0)	0.005

LOS: length of hospital stay; ISS: injury severity score.
Data are presented as n (%) or p value.

(16.3%) died in the multiple system injury group while 33 (13.2%) died in the single system group (Table 1) with the mortality rate being highest in head injury (21.8%, compared to a medium of 5.2% in other system injuries, Table 2). Below 80 years of age, mortality is 7%–10%. After 81 years, it increases to 17%–20%. There is no difference with age progression as whether the injury is single system or multiple systems. Single system medium was 54.7%, while multiple injury medium was 45.2% (Table 3).

Analysis of the LOS revealed that most patients stayed less than 21 days (176 cases 75.9% in multiple injuries and 196 cases, 78.7% in single system injuries, p = 0.8218), followed by the group who stayed from 21 to 60 days (50 cases, 21.5% in multiple system injury group and 45 cases, 18% in single system injury group, p = 0.576) and finally the patients who stayed more than 60 days were 5 cases (2.1%) vs. 8 cases (3.2%) in multiple and single system injuries respectively (p = 0.634, Table 1).

Looking at the ISS, 149 cases, 64.2% were >15 and 124 cases, 49.7% > 15 in multiple and single system injuries respectively (p = 0.173, Table 1). Regarding the mechanism of injury, falls <2 m were the most common mechanism in both multiple (n = 143, 61.6%) and single system injuries (n = 224, 89.9%, p = 0.0218). The second common mechanism was motor vehicle accidents (n = 46 cases, 19.8% in multiple injuries vs. 15 cases, 6% in single system injuries, p = 0.005). Finally, falls >2 m was found in 40 cases (17.2%) of multiple system injuries compared to 7 cases (2.8%) of single system injuries (p = 0.001).

Pan-CT vs. single CT scan

From all the cases included in our study (481 patients), pan-CT scan was done in 235 cases (48.8%), single CT scan in 246 cases

(51.1%). Patients who were investigated by pan-CT scan were mostly multiple injuries (157 cases, 67.7%), while patients who were imaged by single CT scan were mostly single system injuries at the end (171 cases, 68.7%).

Mortality rate was the same in the two groups investigated by pan-CT or selective CT scans (9.5%). Trauma team call was activated in 206 cases (87.6%) of those who did pan-CT scan, and in 72 cases (29.2%) of those who did single CT scan.

In multiple system injury elderly trauma patients, we compared cases in which pan CT scan was done at ED presentation (157 cases, 67.7%) with those in whom single system CT scan was done at ED (75 cases). About 76.4% of cases who had pan-CT at presentation and spent <21 days in hospital compared to 16% who spent the same duration in the group of cases initially investigated by selective CT (p<0.0001). Thirty-three cases (21%) spent from 22 to 60 days in the pan-CT group compared to 15 cases (20%) in the selective CT group (p = 0.733). In the group who stayed more than 60 days, 4 cases were from the pan-CT group (2.5%) compared to 48 cases (64%) from the selective CT scan group (p < 0.0001, Table 4).

After exclusion of cases who were not initially investigated by any CT scan and those who did repeated CT scan for follow-up of already diagnosed injury, 63 cases did repeated CT scan during hospital stay out of 481 patients for suspected injuries missed at initial presentation and all revealed positive results. In 157 patients investigated by pan-CT scan from start, 50 patients had to do repeat CT scan, 30 of whom were head injuries and 20 were other suspicious lesions. However, in 75 patients investigated initially by selective CT scan, 34 patients needed repeated CT scan, 12 of whom were head or other system injuries already diagnosed from the initial CT, and 22 (29.33%) needed repeated CT scan for diagnosing other lesions missed from the initial selective CT scan (p<0.0001).

The mortality rate in the group investigated by pan-CT scan was 25 from 157 cases (15.9%), and in the group investigated by selective CT scan was 11 out of 75 cases (14.6%, p > 1). We compared these figures to the main mortality rates in all cases of our study (71 dead out of 481 cases, 14.7%, p = 0.7534), and to mortality in only multiple trauma elderly patients (38 dead out of 232 cases, 16.3%, p = 0.665).

In the same group of multiple trauma elderly patients, the mean age was 80.8 years, the mean age of those who did pan-CT from start and those who did selective CT was 80.8 and 80.7 years respectively (p > 1). ISS was commonly >15 (n = 101, 64.3%). Regarding the mechanism of injury, we found a preference to do pan-CT when the mechanism was motor vehicle accident (22.9% did pan-CT vs. 13.3% did selective CT, p = 0.0116), but no preference when the mechanism was a falling <2 m or >2 m (p = 0.16989, and 0.1743, respectively, Table 4).

In single system injury elderly patients, we compared patients who did pan-CT from start (first group, 78 cases) with those who did only single system CT (second group, 171 cases). It was found that the need to repeat CT scan was 19 cases (24.35%) in the group

Table 2
Comparison of patients' injury patterns at presentation regarding the number of cases, LOS, trauma team activation, mortality and ISS, n (%).

Injury pattern	Cases (n=582)	Mortality	Trauma team activation	LOS (days)			ISS		
				<21	22-60	>61	<8	8-15	>15
Single injuries	317 (54.5)	39 (12.3)	117 (36.9)	258 (81.4)	50 (15.8)	9 (2.8)	50 (15.8)	111 (35.0)	146 (46.1)
Head	133 (42.0)	29 (21.8)	44 (33.1)	112 (84.2)	15 (11.3)	6 (4.5)	0	7 (5.3)	126 (94.7)
Chest	37 (11.7)	1 (2.7)	21 (56.8)	34 (91.9)	3 (8.1)	0	9 (24.3)	18 (48.6)	10 (27.0)
Spine	30 (9.5)	2 (6.7)	5 (16.7)	21 (70.0)	8 (26.7)	1 (3.3)	14 (46.7)	14 (46.7)	2 (6.7)
Abdomen	0	0	0	0	0	0	0	0	0
Pelvis	39 (12.3)	2 (5.1)	6 (15.4)	34 (87.2)	5 (12.8)	0	31 (79.5)	0	8 (20.5)
Limb	78 (24.6)	5 (6.4)	41 (52.6)	57 (73.1)	19 (24.4)	2 (2.6)	6 (7.7)	72 (92.3)	0
Multiple injuries	265 (45.5)	41 (15.4)	200 (75.5)	208 (78.5)	52 (19.6)	5 (1.9)	34 (12.8)	64 (24.2)	167 (63.0)

LOS: length of hospital stay; ISS: injury severity score.

Table 3
Comparison of different elderly age groups ($n=593$) in trauma setting regarding ISS, trauma team activation, mechanism of injury, mortality, LOS, injury pattern, gender and CT scan requested, n (%).

Variables	Age group (years)				
	65-70 ($n=99$)	71-75 ($n=98$)	76-80 ($n=76$)	81-85 ($n=108$)	>86 ($n=212$)
ISS					
<8	15 (15.2)	20 (20.4)	16 (21.1)	18 (16.7)	28 (13.2)
8-15	25 (25.3)	26 (26.5)	30 (39.5)	31 (28.7)	93 (43.9)
>15	59 (59.6)	52 (53.1)	50 (65.8)	59 (54.6)	91 (42.9)
Trauma team activation					
Activated	61 (61.6)	49 (50.0)	60 (78.9)	55 (50.9)	117 (55.2)
Not activated	38 (38.4)	49 (50.0)	16 (21.0)	53 (49.1)	95 (44.8)
Mechanism of injury					
Fall<2 m	60 (60.6)	72 (73.5)	62 (81.6)	89 (82.4)	163 (76.9)
Fall >2m	16 (16.2)	12 (12.2)	3 (3.9)	7 (6.5)	39 (18.4)
Vehicle accidents	19 (19.2)	13 (13.3)	10 (13.2)	10 (9.2)	10 (4.7)
Blow	2 (2.0)	1 (1.0)	1 (1.3)	0	0
Stab	1 (1.0)	0	0	0	0
Other	1 (1.0)	0	0	0	0
Mortality	10 (10.1)	10 (10.2)	7 (9.2)	18 (16.7)	36 (17.0)
Injury					
Single system	50 (50.5)	53 (54.1)	57 (75.0)	63 (58.3)	114 (53.8)
Multiple system	49 (49.5)	45 (45.9)	19 (25.0)	45 (41.7)	98 (46.2)
LOS (days)					
<21	79 (79.8)	82 (83.7)	43 (56.6)	83 (76.9)	143 (67.5)
22-60	14 (14.1)	14 (14.3)	29 (38.2)	25 (23.1)	67 (31.6)
>61	6 (6.0)	2 (2.0)	4 (5.3)	0	2 (0.9)
Pan-CT scan	42 (42.4)	40 (40.8)	23 (30.3)	42 (38.9)	74 (34.9)
Single CT scan	38 (38.4)	42 (42.9)	38 (50.0)	45 (41.7)	80 (37.7)
No CT scan	19 (19.2)	16 (16.3)	15 (19.7)	21 (19.4)	58 (27.4)
Gender					
Female	35 (35.4)	42 (42.9)	46 (60.5)	65 (60.2)	113 (53.3)
Male	64 (64.6)	56 (57.1)	30 (39.5)	43 (39.8)	99 (46.7)

LOS: length of hospital stay; ISS: injury severity score.

investigated by pan-CT from start compared to 57 cases (33.3%) in the group for whom selective CT was initially done. After exclusion of CT scan for already diagnosed injuries, it was found that repeated CT scan was done in 7 cases (9%) *vs.* 14 cases (8.2%) in the first and second groups, respectively ($p = 0.077$). Mortality rate in the first group was 10.26% and in the second was 10.5% ($p > 1$). Regarding the ISS, we classified them into three categories (<8, 9–15, and >15). We found no difference between the three categories when we compared the first and second groups ($p = 0.67, 0.413$, and 0.717, Table 5).

We also compared three most common mechanisms of injury between the two groups and classified them to falls < 2 m, falls >2 m and motor vehicle accidents. We found a significant difference in preferring pan-CT when the mechanism of injury was a high energy fall (>2 m) or vehicle accident (p<0.0001 and 0.00027 respectively), but no difference in the preference to request the whole body or selective CT when the mechanism was low energy fall (<2 m, $p = 0.096$). No difference in LOS between both groups was found (Table 5).

Discussion

There are an increasing number of elderly populations in the UK with a median age of 40 years. The elderly populations are also living longer and birth rates are falling and the population exposed to injury is aging.[15–17] Elderly populations are at higher risk of low-energy trauma due to their poor physiological reserve, delirium and dementia,[16] urinary control issues, vision problems and drug interactions.[17] Poor bone quality in elderly populations than in young ones is a major concern as well, so the frequency and complexity of fractures in this elderly population are also increasing.[18,19]

The number of complications which follow injury is higher because pre-existing systemic disease is more common.[20,21] These major issues lead to higher mortality rates,[21–23] increased LOS and loss of independence with higher needs for enhanced social care.[24] Major trauma (ISS > 15) in the UK has been shown to be the most common by elderly patients > 50 years of age who have had a low-energy fall.[16] This is correlating with our results from this cohort, as we found that 56.7% of the injuries were of ISS > 15, and 76.3% of trauma were low energy falls <2 m.

Two-thirds of female and one-thirds of male injury-related deaths occur in elderly population more than 65 years of age.[3] Hospitalizations for injury-related issues continue to increase among them as well, prompting increasing focus on these scenarios.[2,25,26] Geriatric trauma patients have twice the mortality of younger patients and significantly longer LOS.[10] Increasing age is not the only determinant of survival and recovery because some ageing trauma victims will benefit from aggressive trauma resuscitation.[27]

Pan-CT scan has been used as a primary investigation in the management of patients with major trauma although the indications for its use are not evidence based. There are not universal guidelines across the UK for the use of pan-CT in major trauma. The Royal College of Radiologists and the National Institute for Clinical Excellence have proposed guidelines for pan-CT in trauma, but these have not been validated and are not used by all trauma-receiving hospitals.[28]

Whole-body CT is associated with greater radiation exposure than selective CT scan in which the radiation dose will be targeted to a particular organ and anatomical area. To estimate radiation exposure, an effective radiation dose is assumed to be 10–20 mSv for a whole-body CT, 5–16 mSv for a selective-organ CT, and 2 mSv for a conventional radiography series (chest, vertebral column, pelvis).[29] This effective radiation dose can accumulate and thereby potentially increase an individual's risk of cancer. The potentially harmful effects of increased radiation exposure have to be weighed

Table 4
Pan-CT or single system CT taken at presentation in elderly patients with multiple system injuries

Variables	CT taken		p value
	Pan-CT (n=157)	Single system CT (n=75)	
LOS (days)			
<21	120 (76.4)	12 (16.0)	<0.0001
22-60	33 (21.0)	15 (20.0)	0.733
>61	4 (2.5)	48 (64.0)	<0.0001
Mortality	25 (15.9)	11 (14.7)	> 1
Repeated CT scan for other suspicious injuries	20 (12.7)	22 (29.3)	<0.0001
Mean age (years)	80.8	80.7	>1
ISS			
1-8	17 (10.8)	12 (16.0)	>1
9-15	39 (24.8)	15 (20.0)	>1
>15	101 (64.3)	48 (64.0)	>1
Mechanism of injury			
Fall <2 m	89 (56.7)	54 (72.0)	0.16989
Fall >2 m	31 (19.7)	9 (12.0)	0.1743
Motor vehicle accidents	36 (22.9)	10 (13.3)	0.0116

LOS: length of hospital stay; ISS: injury severity score.
Data are presented as n (%) or p value.

against the better diagnostic accuracy of the whole-body technique which is mandatory in critically injured patients.[8]

Many studies showed the effectiveness of whole body CT over selective CT scan.[8,30] Salim and colleagues[8] showed that whole-body CT resulted in a change of treatment in 19% of 1000 patients without obvious external signs of injuries. Deunk and co-workers[30] reported that chest or abdominal CT resulted in a change of treatment in up to 34% of patients with blunt trauma.

In our study, although we were able to answer the main questions that we listed as our aims, some limitations need to be illustrated. The first is the difference in recording ISS depending on the recording medical personnel might bias our results. The study is retrospective and this was a reason why the results were not as accurate as needed; as we missed frailty which is expected from many research articles to affect the outcome. Moreover, no clinical

Table 5
Pan-CT or single system CT taken at presentation in elderly patients with single system injuries.

Variables	CT taken		p value
	Pan-CT (n=78)	Single system CT (n=171)	
LOS (days)			
<21	62 (79.5)	134 (78.4)	0.955
22-60	14 (17.9)	31 (18.1)	>1
>61	2 (2.5)	6 (3.5)	0.67
Mortality	8 (10.3)	18 (10.5)	> 1
Repeated CT scan for other suspicious injuries	7 (9.0)	14 (8.2)	0.077
GCS			
1-8	4 (5.1)	10 (5.8)	
9-11	5 (6.4)	6 (3.5)	
>12	69 (88.5)	155 (90.6)	
ISS			
1-8	14 (17.9)	35 (20.5)	0.67
9-15	27 (34.6)	49 (28.7)	0.413
>15	37 (47.4)	87 (50.9)	0.717
Mechanism of injury			
Fall <2 m	59 (75.6)	165 (96.5)	0.096
Fall >2 m	7 (9.0)	0	<0.0001
Motor vehicle accidents	11 (14.1)	4 (2.3)	0.00027

LOS: length of hospital stay; GCS: Glasgow coma score; ISS: injury severity score.
Data are presented as n (%) or p value.

examination results were recorded in TARN. The mechanism of fall was just recorded as fall A BLANK SPAE < 2 m; this can be a missed one step or fall from chair or bed and both are not similar. A fall <2 m in debilitated osteoporotic patient may be more dangerous than >2 m fall in healthy patient. Motor vehicle accidents were not reported with a speed which is essential for predicting the nature of injury.

The results of our study need to be confirmed in a randomized controlled trial in which the safety issues (radiation doses), treatments as a consequence of whole-body CT, and the costs and benefits are rigorously and prospectively assessed taking frailty into consideration. We are aware that our findings show associations rather than causalities. Despite these limitations, our results indicate that the benefits of doing pan-CT scan as an association with lower length of stay and lower needs for repeating the CT scan to detect suspicious injuries.

We recommend repeating this study in a prospective way taking into consideration the rule of frailty scores, ISS, new severity injury score, and cost effectiveness to the National Health System and the accumulative effect of CT radiation and its association with cancer. We collected our data from the TARN office, which do not document clinical examination and frailty scores. They only record the mechanism of injury, ISS, age, Glasgow coma scale and main site of injury (i.e., limbs, head, thorax, etc). The only way to address these is to conduct a prospective study and recommending recording all the above parameters for patients by ED physicians then compare that to our study results. We also recommend whole-body CT to be integrated into the early resuscitation phase of elderly injured patients as a standard and basic diagnostic method.

In elderly patients with multiple system injuries, we found that requesting pan-CT scan is associated with shorter LOS and lower need to repeat CT scan to diagnose missed or occult lesions. In single system injuries, no association was found between requesting pan-CT scans and decreasing the LOS or the need to repeat CT scan. No difference in mortality rates, ISS or mean age could be detected between the patients investigated by pan-CT and selective CT or between multiple and single system injury groups. There are no current clear guidelines about whether to investigate elderly trauma patients by pan-CT or selective CT; however, we recommend doing pan-CT for all silver trauma patients, as it is concluded from this cohort that it decreases both the radiation re-exposure risk and LOS which may decrease the National Health System costs especially in multiple trauma cases. The only factor we found for predicting multiple system or single system affection was related to the mechanism of injury.

Ethical statement

This study was approved by the TARN office in St. Georges University hospital in London.

Declaration of competing interest

All authors have completed the Unified Competing Interest form (available on request from the corresponding author) and no support from any organization for the submitted work; no financial relationships with any organizations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

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