Tertiary Trauma Survey: Nurses' Performance and Poly-trauma Patients Outcome

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Abstract

Tertiary trauma Survey is an important tool for detection of missed injury and some trauma units have created their own protocol for tertiary trauma surveys to decrease the incidence of missed injuries in trauma patients. **Aim of the study**: This study aimed to assess nurses' performance regarding tertiary Survey and Poly-trauma patients outcome. **Research Design:** A descriptive exploratory design was utilized. **Subjects:** A convenient sample of all available nurses (50 nurses) who are working in intensive care unit at Emergency Hospital affiliated to Ain Shams University Hospitals. A purposeful sample composed of (50) adult patients from both gender diagnosed as poly-trauma patients was recruited from the same unit. **Methods:** Data were obtained through three tools; Self-administered questionnaire for nurses, Nurses practice observational checklist tool and clinical outcomes tool for patients. **Results:** Nurses under study had unsatisfactory level of knowledge and practice regarding tertiary trauma survey. There were high statistically significance positive correlation between total level of knowledge and practice**.** There was difference between injury severity score and laboratory investigations and hemodynamic status, physical assessment and radiological findings of poly trauma patients on admission and after 24 hours. **Conclusion:** Less than half and less than one-third of the nurses under study had an unsatisfactory level of knowledge and practice respectively, regarding tertiary trauma survey and there were high statistical significance positive correlation between total level of knowledge and total level of practice. Poly-trauma patients' outcome, there was difference between injury severity score and laboratory investigations and hemodynamic status, physical assessment and radiological findings of poly trauma patients on admission and after 24 hours **Recommendations:** In research**:** Research is needed to follow the patients' outcome and missed injury. Replication of the current study on larger probability sample is recommended to achieve generalization of the results.

Key words: Tertiary Trauma Survey, Poly-trauma, Patients Outcome, Nurses performance.

Introduction

Trauma remains the leading cause of death and disability in young adults. Poly trauma is a major cause of morbidity and mortality in both developed and developing countries. Poly trauma patients represent the ultimate challenge to trauma care team and the optimization of their care is a major focus of clinical research. The heaviest toll of traumatic deaths occurs within the first hour following trauma. Often defined as "golden hour of trauma" following the principle of "time is essence" management during the first hour of injury is essential (**Kunreuther, 2012**).

Poly trauma is generally used to describe trauma patients whose injuries involve multiple body regions, compromise the patient's physiology and potentially cause dysfunction of uninjured organs. The expected higher risk of mortality of poly trauma patients is based on the assumption that the underlying pathophysiological response of the injured person would aggravate the clinical outcome (**Paffrath, Lefering and Flohe, 2014**).

The World Health Organization defines an outcome measures as a "change in the health of an individual, group of people or population that is attributable to an intervention or series of interventions." Outcome measures (mortality, readmission, patient experience) are the quality and cost targets healthcare organizations are trying to improve (**Tinker, 2018**).

A common quality indicator in trauma care is missed injury. Missed injuries are the result of the prioritization that takes place during the initial assessment and management in the Emergency Department (ED) and emergency intervention. Because the focus in the ED is on making time-critical decisions, complete injury identification during resuscitation (including primary and secondary survey) is not always feasible (**Keijzers, Campbell, Hooper, Bost and Crilly, 2014).**

Missed Injuries (MIs) adversely affect patient outcome and damage physician/ institutional credibility. The primary and secondary surveys are designed to identify all of a patient's injuries and prioritize their management; however, MIs are prevalent in severely injured and multisystem trauma patients, especially when the patient's condition precludes completion of the secondary survey (**Pfeifer and Pape, 2014).**

Nursing care in cases of emergency trauma requires the health services and professionals to use a variety of practices, to meet the high complexity and seriousness presented by violence or accident victims, who need specific health actions/interventions. Tertiary trauma surveys (TTS) are proposed to reduce the rate of missed injuries in hospitalized trauma patients. TTS is performed by the trauma nurse practitioners on critical care admissions within 24 hours and repeated prior to discharge. It includes physical assessment of the trauma patients from head to toes, detailed history, all radiographic imaging and laboratory value trends are then reviewed interventions (**Aitken, Marshall and Chaoyer, 2015).**

Significance of the study

Trauma is a major cause of death and disability and places huge requirements, both social and economic, on health system resources. However, not all injuries are detected by primary and secondary surveys. In fact, between 2 to 50% of combined life-threatening and non-life-threatening injuries are missed. With the aim of minimizing the occurrences of these unnoticed injuries, tertiary trauma survey was introduced Studies have suggested that tertiary trauma survey protocol can identify life- threatening injuries and minimize the number and effect of missed injuries. There is little information on current practice of tertiary survey performance in hospitals. Therefore, the present study was conducted to assess the nurses' level of knowledge and practice regarding tertiary trauma survey and to assess poly-trauma patients' outcome.

Aim of the study:

This study aimed to assess nurses' performance regarding tertiary Survey and Poly-trauma patients outcome.

This aim will be achieved through the following:

1. Assess the nurses' level of knowledge regarding tertiary trauma Survey for patients with poly-trauma.

2. Assess the nurses' level of practice regarding tertiary trauma Survey for patients with poly-trauma.

3. Assess poly-trauma patients' outcome.

Research questions

To fulfill the aim of this study the following research questions were formulated:

1.What are the nurses' levels of knowledge regarding tertiary trauma survey?

2.What are the nurses' levels of practice regarding tertiary survey for patients with poly-trauma?

3.What is poly-trauma patients outcome?

Research questions:

To fulfill the aim of this study the following research questions were formulated:

4. What are the nurses' levels of knowledge regarding tertiary trauma survey?

5. What are the nurses' levels of practice regarding tertiary survey for patients with poly-trauma?

6. What is poly-trauma patients outcome?

Operational definition

Nurses' performance: It was assessed in terms of nurses' level knowledge and practice regarding tertiary trauma survey measured by self-administered questionnaire tool for nurses and nurses 'practice observational checklist.

Patients' outcome: outcome was measured in term of injury severity score, physical assessment, hemodynamic status, radiological findings and laboratory investigations for poly-trauma patients.

Subjects and Methods

The present study was carried out through the following four designs:

I. Technical design.
II. Operational design.
III. Administrative design.
IV. Statistical design.

I-Technical design

The technical design includes; research design, setting, subjects and tools for data collection.

Research Design

A descriptive exploratory design was utilized to meet the aim of the study.

Setting

The study was conducted in the intensive care unit at Emergency Hospital affiliated to Ain Shams University Hospitals.

Subjects

1- A convenient sample of all available nurses (50 nurses) who are working in the above-mentioned settings.

2- A purposeful sample composed of 50 adult patients diagnosed as poly-trauma patients were recruited from the above-mentioned settings.

Sample size

Study subjects include a purposeful sample of total patients who were hospitalized during the period 2016. Their total number is 130 patients

multiple injury patients in ICU. Based on sample size equation 50 patients will participate in the study.

So, the sample size was calculated by adjusting the power of the test to 80% and the confidence interval to 95% with a margin of error accepted adjusted to 5% and a known total population of 130 patients using the following equation:

$$X = Z(^{c/}_{100})^2 r(100-r)$$
$$N = Nx/((N-1)E^2+x)$$
$$E = Sqrt\ [^{(N-n)x}/_{n(N-1)}]$$

Where N is the population size, r is the fraction of responses that you are interested in, and Z(c/100) is the critical value for the confidence level *(Chow, Shao & Wanget, 2007).*

Patients were selected according to the following criteria:

Patients' Inclusion criteria:

• Adults, of both genders.

• Patients with poly-trauma (any traumatic injury which included multiple body regions).

Exclusion criteria:

• Burn, pregnant and geriatric patients.

Tools for data collection

The present study data were collected through the following three tools**:**

I)Self-administered questionnaire tool for nurses:

It was developed by the researcher based on a review of relevant literature and it was translated into Arabic and retranslated to English **(Urden, Stacy & Lough, 2014)**.

It included two parts as follows:

First part: It's concerned with nurses' characteristics such as age, gender, years of experience, educational level and training courses attended.

Second part: It was concerned with the assessment of nurses' level of knowledge regarding tertiary trauma survey. It consists of 61 multiple choice questions with one question including 15 points. It was related to nurses' knowledge regarding poly-trauma, definition and purpose of tertiary trauma survey, primary and secondary survey, trauma triage, injury severity score, diagnostic procedures and laboratory investigations.

Scoring system

The scoring system for this part was as follows:

One grade was given for the correct answer and zero for the incorrect answer. Sixty-one multiple choice questions equal 61 grade, the score of question number 49 equal 15 grades because it had 15 points, with total grade 76 grades, with total (62) questions.

The total level of nurses' knowledge score was categorized as follows:

- More than or equal 90% (55 marks) is considered the satisfactory level of knowledge.

- Less than 90% is considered the unsatisfactory level of knowledge.

II) Nurses' practice observational checklist

It was adapted from **Proehl & Allen (2009);** and modified by the investigator, it was used to assess nurses' level of practice regarding tertiary trauma survey of patients with poly-trauma. The checklist was composed of (141) steps. It was concerned

with nurses' level of practice regarding primary assessment, secondary assessment, neurological assessment, pain assessment, pulse oximetry, patient monitoring, reporting laboratory findings and radiological transfer.

• **Scoring system**

The scoring system for Nurses' practice observational checklist was as follows:

One grade for each step that done correctly and zero for the step that done incorrectly or not done, with total grade =141 grades

The total level of nurses' practice score was categorized as follows:

- More than or equal 90% (126.9 marks) is considered the satisfactory level of practice.

- Less than 90% is considered the unsatisfactory level of practice.

III) Clinical outcomes tool

This tool was adopted from **Grossman & Born, (2010)** and was used to assess poly-trauma patients' outcome on admission and after 24 hours. It involves two parts as follows:

First part: It was concerned with the patient's characteristics such as (age, gender, trauma activation type, history of present injury, comorbidity and past surgical history).

Second part: It was concerned with clinical outcomes of poly-trauma patients that involved injury severity score, hemo-dynamic status, physical assessment of poly-trauma patients, radiological findings review and laboratory investigations findings.

• **Scoring system**

1- Injury severity score

This score was adopted from **Chawda, Hildebrand, Pape & Giannoudis, (2014)** and was used to assess trauma severity. It was ranged from 1- 75 and categorized as follows:

- Minor injury (1-8)
- Moderate injury (9-15)
- Serious injury (16-24)
- Severe injury (25-49)
- Critical injury (50-74)
- Un survival & maximum 75

2-Glasgow coma scale

This scale was adopted from **Healey et al., (2014)** and was used to describe the general level of consciousness in patients with poly-trauma and to define broad categories of head injuries.

Scoring system: total score 15/15

- Minor brain injury (13-15)
- Moderate brain injury (9-12)
- Severe brain injury (3-8)

Tools validity and reliability

Testing validity: by using face and content validity. Face validity aimed at inspecting the tools for relevance comprehensiveness, accuracy, clarity, and applicability; no modi-fications were done. Testing content validity to ensure that an assessment tool produces stable result overtimes. The validity was done through seven panels of expertise from Faculty of Nursing, Ain Shams University (4 professors, 2 assistant professors, and one lecturer).

Reliability:

Tools were tested for its reliability by test-retest measurement. It was applied to 50 nurses with alpha Cronbach test. The

reliability was scaled as follows: < 0-0.25 weak reliability, 0.25-0.75 moderate reliability, 0.75< 1 strong reliability and 1 is optimum. The reliability of this tool is 0.85..

II-Operational design:

The operational design includes preparatory phase, ethical consideration ,pilot study and fieldwork.

A) Preparatory phase:

It was included reviewing of related national, international literature and theoretical knowledge of various aspects of the study using books, articles, and internet's periodicals and magazines to develop tools for data collection.

Ethical Considerations

The research approval was obtained from the Scientific Research Ethics Committee of the Faculty of Nursing, Ain Shams University, before initiating the study work. The researcher clarified the objectives and aim of the study on addition oral informed consent were obtained from each participant**.** The researcher assured maintaining anonymity and confidentiality of subjects' data. Nurses were informed that they are allowed to withdraw from the study at any time without any pressure.

C) Pilot study

A pilot study was carried out on 10 % of nurses (5 nurses) from the study subjects to test the clarity, applicability, feasibility, relevance of the tools, and to determine the needed time for the completion of the study tools. The nurses who were included in the pilot study were included in the sample because no modification was done after conducting a pilot study.

Fieldwork

The purpose of the study was simply explained to the nurses who agreed to participate in the study prior data collection. The actual work of this study started and completed within four months from March 2017 to June 2017, data were collected by the researcher 4 days (Thursday, Friday, Saturday, Sunday) per week at morning and afternoon shifts in the previously mentioned settings. The researcher started the assessment of nurses' practice using an observational checklist to assess nurses' practice regarding tertiary trauma survey. And then, the researcher delivers the self-administered questionnaire for nurses to assess nurses' knowledge. The questionnaire was filled in by the nurses. It took about 20 minutes for each nurse. Regarding clinical outcome sheet to assess poly-trauma patient' outcome, it was filled in by the researcher by using patients files and observation, It took about 2 hours to fill it for every patient on admission and 2 hours after 24 hours from admission.

Results

Table (1): Frequency and Percentage distribution of demographic characteristics of nurses under study (n=50).

Demographic characteristics	N	%
Age (years)		
<30 year	25	**50.0**
30-45 year	23	46.0
>45 years and more	2	4.0
Mean ±SD	30.52±3.82	
Gender		
Male	14	28.0
Female	36	**72.0**
Educational level		
Nursing diploma	12	24.0
Nursing technical institute	26	**52.0**
Nursing B.Sc.	10	20.0
Postgraduate study	2	4.0
Experience in years		
<10 years	31	**62.0**
≥10 years	19	38.0
Mean ±SD	9.28±2.32	
Training courses attended		
Yes	21	42.0
No	29	**58.0**

Table (1): Shows that 50% of the nurses under study were less than 30 years with a mean of age (30.52 ± 3.82). As regards to gender 72% of the studied nurses were females. As regards to the educational level 52% of the studied nurses were technical institute. In relation to experience, 62% of the nurses had experienced less than 10 years with a mean of 9.28 ± 2.32. Regarding attending training courses, 58% of the nurses did not attend any training courses.

Table (2): Frequency and Percentage distribution of nurses' level of knowledge regarding poly-trauma and Tertiary trauma survey (n=50).

Items	Satisfactory		Unsatisfactory	
	N	%	N	%
Poly-trauma	42	**84**	8	16
Tertiary trauma survey				
Definition of tertiary trauma survey	20	40.0	30	**60.0**
Purpose of tertiary trauma survey	22	44	28	**56**
Trauma triage	15	30	35	**70**
Primary survey	30	60	20	40
Injury severity score	10	20	40	**80**
Secondary survey	38	**76**	12	24
Diagnostic procedures and laboratory investigations	43	**86**	7	14
Total knowledge	28	56	22	**44**

Table (2): Shows that the nurses had an unsatisfactory level of knowledge regarding the definition of tertiary trauma survey, purpose of tertiary trauma survey, trauma triage and injury severity score (60%, 56%, 70%, 80%). respectively. The table also clarifies that the nurses under study had a satisfactory level of knowledge regarding poly-trauma, secondary survey, diagnostic procedures and laboratory investigations (84%, 76%, 86%) respectively. Additionally, table (2) shows that 22(44%) of the studied nurses had a total unsatisfactory level of knowledge.

Table (3): Frequency and Percentage distribution of nurses' level of practice regarding tertiary trauma survey (n=50).

Practices	Satisfactory		Unsatisfactory	
	N	**%**	**N**	**%**
Primary Assessment (ABCDE)				
Alertness / Airway	35	70.0	15	30.0
Breathing	45	90.0	5	10.0
Circulation	26	52.0	24	48.0
Disability	23	46.0	27	54.0
Exposure / environmental control	40	80.0	10	20.0
Total	**34**	**68.0**	**16**	**32.0**
Secondary Assessment				
History taking	30	60.0	20	**40.0**
Head and maxillofacial	28	56.0	22	**44.0**
Cervical spine and neck assessment	27	54.0	23	**46.0**
Chest	41	82.0	9	18.0
Abdomen / flanks	45	90.0	5	10.0
Back and Extremities	40	80.0	10	20.0
External genitalia	35	70.0	15	30.0
Total	**35**	**70.0**	**15**	**30.0**
Tertiary trauma survey Neurological assessment	38	64.0	12	24.0
Pain assessment	41	82.0	9	18.0
Pulse oxemetry	35	70.0	15	30.0
Connect Patient to monitor	39	78.0	11	22.0
Report laboratory findings	15	30.0	35	**70.0**
Check for radiological transfer	40	**80.0**	10	20.0
Total practice	34	68.0	16	**32.0**

Table (3): Shows that 68% of studied nurses had a satisfactory level of practice regarding the primary assessment. As regarding secondary assessment the table shows that the nurses had an unsatisfactory level of practice regarding history taking, head and maxillofacial assessment, cervical spine and neck assessment, and identifying and reporting laboratory findings (40%, 44%, 46%, 70%) respectively. In relation to nursing practice regarding checking of radiological transfer table (3) reveals that 80% of nurses had a satisfactory level of practice. Finally, the table shows that 32% of the nurses under study had a total unsatisfactory level of practice.

Table (4): Correlation between nurses' total level of knowledge and nurses' total level of practice regarding tertiary trauma survey (n=50).

Items	Total Practice	
	Correlation Coefficient	**p-value**
Total Knowledge	0.537	<0.001**

Table (4): Shows that there is a highly statistically significant positive correlation between nurses' total level knowledge and their total level of practice regarding tertiary trauma survey (r = 0.537 at p-value <0.001).

Table (5): Frequency and percentage distribution of patients' characteristics under study (n=50).

Characteristic data	N	%
Age (years)		
<30 year	11	22.0
30-45 year	22	**44.0**
>45 year and more	17	34.0
Mean± SD	30.5±2.82	
Gender		
Male	36	**72.0**
Female	14	28.0
Trauma activation type		
Type 1(unstable patient)	27	**54.0**
Type 2(stable patient)	23	46.0
History of present injury		
Penetrating trauma	15	30.0
Blunt trauma	35	**70.0**
Comorbidity		
Hypertension	10	20.0
Diabetes mellitus	6	12.0
Asthma	5	10.0
None	29	**58.0**
Past surgical history		
Appendectomy	7	14.0
Cholecystectomy	3	6.0
None	40	**80.0**

Table (5): Shows that 44% of the studied patients were within the age group 30-45 year with a mean of age 30.5±2.82. As regards gender 72% of the studied patients were males. As regards trauma activation type, it was observed that 54% of the studied patients were type 1. In relation to the history of present injury, table (5) clarifies that 70% of the studied patients had blunt trauma. As regards to past history, it was found that the studied patients did not have a medical and surgical history (58%, 80%) respectively.

Table (6): Injury severity score of poly-trauma patients on admission and after 24 hours (n=50).

Injury severity Score	On Admission		After 24hrs		Chi-square test	
	N	%	N	%	x2	p-value
Minor injury	10	20.0	10	20.0	0.000	1.000
Moderate injury	4	8.0	6	12.0	0.100	0.752
Serious injury	8	16.0	10	20.0	0.250	0.617
Severe injury	10	20.0	10	20.0	0.000	1.000
Critical injury	16	32.0	12	24.0	0.632	0.427
Un survival injury	2	4.0	2	4.0	0.000	1.000

Not significant >0.05 significant <0.05   * highly significant< 0.001**

Table (6): Shows that there was the difference but not statistically significant between patients' injury severity score on admission and after 24 hours. Regarding moderate injury, the results revealed that there was increased from 4 (8%) of the studied patients on admission to 6 (12%) after 24 hours. Whereas serious injury, there was an increase from 8 (16%) of the studied patients on admission to 10 (20%) after 24 hours and critical injury decreased from 16 (32%) of the studied patients on admission to 12 (24%) after 24 hours from admission.

Table (7): Hemodynamic status of poly-trauma patients on admission and after 24 hours (n=50).

Hemodynamic status	On Admission		After 24hrs		Chi-square test	
	N	%	N	%	x2	p-value
Vital signs						
Blood pressure						
Normal (90/60-120/80)mm Hg	15	30.0	13	26.0	0.036	0.850
Hypertension (above normal range)	5	10.0	3	6.0	0.125	0.724
Hypotension (below normal range)	30	**60.0**	34	**68.0**	0.141	0.708
Pulse rate						
Normal (60-100)beat/minute	20	40.0	22	44.0	0.024	0.877
Tachycardia (above normal range)	15	30.0	16	32.0	0.031	0.859
Bradycardia (below normal range)	15	30.0	12	24.0	0.148	0.700
Respiratory rate						
Normal (12-18) breath/minute	18	36.0	12	24.0	0.833	0.361
Tachypnea (above normal range)	25	50.0	20	40.0	0.356	0.551
Bradypnea (below normal range)	7	**14.0**	18	**36.0**	4.000	0.046*
Body temperature						
Normal(36,5-37,3) ċ	25	50.0	21	42.0	0.356	0.551
Hypothermia (below normal range	11	**22.0**	15	**30.0**	0.346	0.556
Hyperthermia (above normal range)	14	28.0	14	28.0	0.000	1.000

Not significant >0.05 significant <0.05*   highly significant< 0.001**

Table (7): Shows that there was a difference but not statistically significant between poly-trauma patients' hemodynamic status on admission and after 24 hours. Regarding blood pressure, the table shows there was an increased in the number of hypotensive patients 30 (60%) on admission to 34 (68%) after 24 hours. Regarding respiratory rate, the table also shows an

increase of the number of bradypnea patients from 7 (14%) on admission to 18 (36%) after 24 hours with a statistically significant difference (p < 0.05). In relation to body temperature 15 (30%) of the studied patients had hypothermia after 24 hours.

Table (8): Physical assessment of poly-trauma patients on admission and after 24 hours (n=50).

Physical Assessment	On Admission		After 24hrs		Chi-square test	
	N	%	N	%	x2	p-value
Body weight						
From 50- 70 kgms	5	10.0	10	20.0	1.067	0.302
>70-90 kgms	32	64.0	32	64.0	0.000	1.000
>90-120 kgms	13	26.0	8	16.0	0.762	0.383
Glasgow Coma Scale						
Minor brain injury	18	36.0	20	40.0	0.026	0.871
Moderate brain injury	22	44.0	22	44.0	0.000	1.000
Severe brain injury	10	20.0	8	16.0	0.056	0.814
Head injuries	33	66.0	44	88.0	5.647	0.018*
Eye injuries	17	34.0	17	34.0	0.000	1.000
Ear injuries	10	20.0	11	22.0	0.065	0.799
Nose injuries	15	30.0	15	30.0	0.000	1.000
Throat injuries	11	22.0	11	22.0	0.060	0.806
Neck injuries	15	30.0	17	34.0	0.047	0.829
Heart injuries	6	12.0	6	12.0	0.000	1.000
Chest injuries	32	64.0	45	90.0	8.131	0.004*
Lungs injuries	37	74.0	40	80.0	0.052	0.817
Abdominal injuries	25	50.0	36	72.0	4.203	0.040*
Back injuries	26	52.0	29	58.0	0.161	0.688
Rectal injuries	14	28.0	16	32.0	0.190	0.663
Extremities injuries	33	66.0	46	92.0	8.680	0.003*

Not significant >0.05 significant <0.05   * highly significant< 0.001**

Table (8): Shows that there was a statistically significant difference between patients' physical assessment on admission and after 24 hours regarding head injuries, chest injuries, abdominal injuries and extremities injuries (88%, 90%, 72%,92%) respectively at p <0.05.

Table (9): Radiological findings review of poly-trauma patients on admission and after 24 hours (n=50).

Radiological finding review	On Admission		After 24hrs		Chi-square test	
	N	%	N	%	x2	p-value
x-ray findings						
Chest x-ray						
Lung contusion	30	60	30	60	0.000	1.000
Pneumothorax	25	50	30	60	0.646	0.421
Hemothorax	29	58	29	58	0.000	1.000
Flail chest	18	36	31	62	6.760	0.009*
Fracture 2nd, 3rd rib	10	20	12	24	0.058	0.809
Fracture 4th,5th, $6^{th rib}$	8	16	8	16	0.000	1.000
Fracture sternum	5	10	7	14	0.095	0.758
Fracture 7th,8th,ribs	8	16	9	18	0.017	0.895
Pelvis						
Fracture acetabulum pelvis	6	12.0	24	48.0	9.633	0.002*
Open fracture	10	20	11	22	0.024	0.877
Closed fracture	6	12	6	12	0.000	1.000
C- spine						
Fracture C 1	7	14.0	16	32.0	3.614	0.057*
Fracture C2	8	16	10	20	0.068	0.795
Thorax/Lumbar/Sacral spine						
Fracture L1, L2	9	18.0	19	38.0	4.018	0.045*
Scapular fracture	0	0	2	4	0.510	0.475
Extremities Upper limbs						
Fracture humerus	1	2	1	2	0.000	1.000
Lower limbs						
Fracture open wound leg	1	2	1	2	0.000	1.000
Fracture tibia	0	0	2	4	0.510	0.475
Fracture femur	20	40.0	28	56.0	5.252	0.022*
Fracture fibula	0	0	2	4	0.510	0.475
Fracture HIP	5	10	6	12	0.045	0.831
Head CT						
Frontal hematoma	22	44.0	34	68.0	4.051	0.044*
Fracture base of skull	7	14	7	14	0.000	1.000
Cerebral contusion	8	16	9	18	0.017	0.895
Fracture depressed	2	4	2	4	0.000	1.000
Sub arachnoid hemorrhage	10	20	10	20	0.000	1.000
Subdural hematoma	6	12	6	12	0.000	1.000
Neck CT						
Tracheal deviation	0	0	1	2	0.169	0.681
Fracture mandible	2	4	7	14	1.954	0.162
Chest CT						
Diaphragm injury	2	4	5	10	0.614	0.433
Fracture clavicle	1	2	3	6	0.260	0.609
Abdomen/ Pelvis CT						
Liver tear	2	4	5	10	0.614	0.433
Spleen injury	0	0	2	4	0.510	0.475
Duodenal injury	0	0	2	4	0.510	0.475
Pancreatic injury	0	0	3	6	1.375	0.241
Retroperitoneal hematoma	27	54.0	39	78.0	5.392	0.020*
Vaginal tear	2	4	3	6	0.048	0.826

Not significant >0.05 significant <0.05   * highly significant< 0.001**

Table (9): Shows that there were statistically significance difference between patients' radiological findings of poly-trauma patients on admission and after 24 hours, whereas there was an increase in the percentage of injuries after 24 hours, regarding flail chest, fracture acetabulum pelvis, fractured C1, fracture L1, L2, fracture femur, frontal hematoma and retroperitoneal hematoma (62%, 48%, 32%, 38%, 56%, 68%, 78%) respectively.

Discussion

The current study was carried out aiming to assess nurses' performance regarding tertiary trauma survey and poly-trauma patients' outcome. Discussion of the findings of this study will cover the main parts of the results.

The discussion of the findings covered: the demographic characteristics of the studied nurses, represent an assessment of nurses' level of knowledge and practice. Represent the data related to poly-trauma patients' outcome.

Demographic Characteristics of the Studied Nurses

As regards the nurses' demographic characteristics, the present study revealed that half of the studied nurses their ages were below 30 years with a mean of age (30.52±3.82). This result might be due to the fact that nurses more than 30 years old leave the ICU work and transfer to another unit because of the workload of the work in such units. This finding was inconsistent with a study done by **Mohamed, (2015)** entitled "Impact of a designed head trauma nursing management protocol on critical care nurses' knowledge and practices at emergency hospital Mansoura university" who reported that two thirds of the studied nurses had 30 years old and more with the mean age of nurses 32.22± 5.29.

In relation to gender, the present study showed that less than three-quarters of the nurses under study were females. This might be due to that greater fraction of the nurse's task force in Egypt was female and might be also related to the studying of nursing in Egyptian universities were

exclusive for females till a few years ago. This finding agreed with a study done by **Taha, (2015)** entitled "Assessment of critical care nurses knowledge and practices regarding oxygen therapy at El Minia University hospital" who reported that more Regarding the educational level of nurses, results revealed that more than half of the nurses under study were holding nursing technical institute diploma. The investigator believed that, this might be due to that a large number of bedside nurses in governmental hospitals were graduated from the nursing technical institute diploma, because bachelor nurses in the governmental hospitals usually working as head nurses or supervisors. These findings are in the same line with a study done by **Loutfi, (2016)** entitled "Nurses' performance regarding nasogastric tube feeding among critically ill patients" who reported that near half of the nurses under study were having technical institute diploma. In contrast to the study, a study was done by **Mansour, Farhan, Othman and Yacoub (2010)** entitled "Knowledge and Nursing Practice of Critical Care Nurses Caring for Patients with Delirium in Intensive Care Units in Jordan" who reported that the majority of studied nurses had a bachelor degree of nursing science.

As regards years of experience, the result showed that less than two-thirds of studied nurses had less than 10 years of experience. This result may be due to that half of nurses under study were younger than 30 years old. This result was partly in agreement with in a study **Ghoneim, (2012)** entitled " Impact of implementing Nursing care protocol on moderate head injured patients' outcome" who reported that the majority of the studied nurses had years of experience ranged from 1-5 years.

As regards training courses attended by the studied nurses. The present result showed that, more than half of the nurses under study did not attend any training course. This might be due to that the majority of the nurses were female with family commitments, lack of time and workload in the intensive care unit may be also behind the reason. This finding is consistent with a study done by **Shahin, (2012)** entitled "Nurses' knowledge and practices regarding enteral nutrition at the critical care department" who reported that the majority of the nurses under study had no previous training courses. than half of nurses were female.

Assessment of nurses' level of knowledge and practice

Concerning the nurses' level of knowledge, the present result showed that most of the nurses under study had a satisfactory level of knowledge regarding polytrauma, diagnostic procedures and laboratory investigations. This result might be due to that more than half of the nurses under study were less than 30 years old and they are newly graduated from their schools and still retain some of the basic knowledge. This also might be due to that receiving a lot of heavy flow of polytrauma patients in the intensive care unit. This result is consistent with a study done by **Maarouf, (2012)** entitled "Nurses performance for patients with a traumatic head injury during golden hour" who reported that more than half of nurses had satisfactory knowledge regarding laboratory and diagnostic procedures.

The present result also showed that more than half of nurses under study had an unsatisfactory level of knowledge regarding the definition and purpose of a tertiary trauma survey. This result might be due to that they did not attend any training courses specific to a tertiary trauma survey.

One of the noticeable finding of this study that more than two-thirds of the nurses under study had an unsatisfactory level of knowledge regarding trauma triage. This might be due to that nurses under study did not attend any training courses to update their knowledge. This result is inconsistent with a study done by **Fathoni, Sangchan and Songwathana, (2013)** entitled **"**Relationships between triage knowledge, training, working experiences and triage skills among emergency nurses in East Java, Indonesia" who reported that nurses had satisfactory level regarding trauma patients' triage.

Concerning nurses' level of knowledge regarding injury severity score the results revealed that most of nurses had an unsatisfactory level of knowledge regarding injury severity score this result might be due to that nurses did not receive any courses specific to trauma and might be due to lack of standard documents to record it.

The present study revealed that more than half of studied nurses and more than three-quarters of them had a satisfactory level of knowledge regarding the primary and secondary survey respectively. This might be due to that the ICU admission form include a database of primary survey, history taking and head to toe assessment. This result is consistent with a study by **Considine and Currey, (2014)** entitled "Ensuring a proactive, evidence-based, patient safety approach to patient assessment" who reported that nurses had satisfactory knowledge regarding the primary and secondary survey.

Regarding nurses' total level of knowledge the result showed that less than half of the nurses under study had an unsatisfactory level of knowledge. This might be due to lack of nurses' time to update their knowledge, due to time constraints, lack of co-workers' support and work commitments, especially those who are working in the intensive care units for several years and overloaded by the increased number of patients for each nurse.

Concerning nurses' level of practice regarding tertiary trauma survey, it was clear that more than two-thirds of the studied nurses had a satisfactory level of practice regarding primary assessment. This result might be due to that some of the nurses attended training courses and the routine work of ICU admission allow the nurses to have hands on all the time. This finding is consistent with results of a study done by **Morad, (2010)** entitled "Developing a clinical pathway map for patients with traumatic spinal cord based on needs" who reported that the majority of nurses had a satisfactory level of practice regarding the primary assessment of the traumatized patient**.**

As regards secondary assessment the result revealed that more than two thirds of the nurses had satisfactory level of practice which is opposite to the study done by **Ahmed, (2011)** entitled "Developed of nursing standards for management of organophosphorus poisoned patients" who reported that the majority of nurses in the emergency unit had an unsatisfactory level of practice regarding secondary assessment of trauma patients**.**

The present study showed that less than half of nurses under study had an unsatisfactory level of practice regarding history taking, head and maxillofacial assessment, and cervical spine and neck assessment. This result might be due to lack of specific training sessions, lack of qualification as more than half of nurses had technical institute diploma. Also, the absence of continuous education and evaluation, workload, this could be attributed to the lack of knowledge which reflects on their performance. The present study also showed that more than two-thirds of nurses had an unsatisfactory level of practice regarding reporting laboratory findings. This result might be due to that nurses usually send labs requests and forgot to follow the results as well as lack of supervision and workload might play a role.

Interesting enough the present study showed that most of the nurses had a satisfactory level of practice regarding checking for radiological transfer and this results was supported by **Mansour, (2014)** in a study entitled "The effect of implementing triage training competencies on newly graduated nurses working in emergency department at emergency hospital" and by **Morad, (2010)** in study entitled "Developing a clinical pathway map for patients with traumatic spinal cord based o needs" both results showed that nurses under study had a satisfactory level of practice regarding checking of radiological transfer. From the researcher's point of view this might be due to that physicians usually the one who are following the results of the radiological study as its findings is extremely important in decision making for the trauma patient, so nurses are obliged to make sure it was done on a timely manner.

The result showed that less than one-third of the nurses under study had an unsatisfactory level of practice, although this percentage appears to be low, however in the researcher's point of view, this is unacceptable for nurses caring for critically ill patients.

The result showed that less than one-third of the nurses under study had an unsatisfactory level of practice, although this percentage appears to be low, however in the researcher's point of view, this unacceptable for nurses caring for critically ill patients.

By studying the correlation between participants' total level of knowledge and the total level of practice, the current study revealed that there was a highly statistically significant correlation between nurses' total level of knowledge and their total level of practice regarding tertiary trauma survey. This may be due to that nurses' knowledge increase with more practice and vice versa. This result is consistent with a study done by **Mohammed, (2014)** entitled "Critical

care nurses' knowledge and practice regarding administration of total parenteral nutrition at critical care areas in Egypt" Who stated that there is a highly statistically significant correlation between participants knowledge and practice.

The result showed that less than one-third of the nurses under study had an unsatisfactory level of practice, although this percentage appears to be low, however in the researcher's point of view, this is unacceptable for nurses caring for critically ill patients.

Clinical outcome data for polytrauma patients:

As regards the patients' characteristics, the present study revealed that less than half of the patients under study their age were at range 30-45 years with a mean of age (30.5±2.82). This result might be due to that under the age of 30 years who usually did not have cars as they started their career. This result is in contrary with a study done by **Payal, Sonu, Anil and Prachi, (2013)** entitled "Management of poly-trauma patients in emergency department: an experience of a tertiary care health institution of northern India" who reported that most of the trauma patients were in the age group between 15 -30 years.

In relation to gender, the current study showed that less than three-quarters of the patients under study were males. From the researcher's point of view female usually are very conservative in driving and usually follow the traffic rules and not engaged in public fighting or using a weapon that large portion of Egyptian males did not follow the traffic rules and largely engaged in public fighting. This result is in accordance with a study done by **Payal et al., (2013)** entitled "Management of poly-trauma patients in the emergency department: an experience of a tertiary care health institution of northern India" who found that majority of trauma patients were males.

As regards to trauma activation type the result clarified that more than half of the patients under study were type 1 (unstable patient) this might be due to that road traffic accidents are severe and fatal, lack of using the safety belt and using motorbike without head shelter or protector which usually results in head injuries. The arrival of an ambulance in Egypt might be a great factor in due to streets overcrowding. This result is consistent with a study done by **Davis et al., (2010)** entitled "Prospective evaluation of a two-tiered trauma activation protocol in an Australian major trauma referral hospital" who reported that the full trauma activation group had a significantly higher proportion of the major trauma outcome.

The current study revealed that more than two-thirds of the patient under study had blunt trauma. This might be due to that road traffic accidents are common in Egypt because of unregular roads, fight, sports injuries and fall from height. This result in accordance with a study done by **Thomson and Greaves, (2010)** entitled "Missed injury and the tertiary trauma survey" who reported that most of the trauma patient was blunt trauma.

The present study showed that more than half of patients under study did not have any comorbidity or past surgical history. This result might be due to twenty-two of them is young age under thirty years old is medically free. This result is in accordance with a study done by **Yuan et al., (2018)** entitled "Impact of comorbidities on the prognoses of trauma patients: Analysis of a hospital-based trauma registry database" who reported that most of the trauma patients were medically free and the severity of comorbidity was associated with higher hospital mortality among traumatized patients.

As regards injury severity score, The present study showed that, there is difference between patients' injury severity score on admission and after 24 hours of admission. This result might be due to that

reassessing patient with new detections may be missed injuries or deterioration and good prognosis, this result in accordance with a study done by **Copes, Champion, Sacco, Lawnick, Keast and Bain, (2010)** entitled "The Injury Severity Score revisited: trauma patients in the intensive care unit" who reported that injury severity score changed with discovering of missed injury.

In relation to injury severity score, As regards to a number of patients who had moderate and serious injury severity score, it is observed that there is an increasing number of patients who had serious injury after 24 hours of admission. This results might be due to either deterioration in patients conditions or detection of missed injury. This result in accordance with a study done **Mohamed, Ismail, Aziz and El-Laban (2013)** entitled "Relation between injury severity score and outcome of polytrauma patients" who reported that polytrauma patients who had injury severity score of more than 15 admitted to an intensive care unit increased related to mechanism of injury.

As regards injury severity score, the present study showed that, the number of patients who had critical injury decreased after 24 hours of admission. This may be due to improving patients' condition after surgical interventions.

As regards the hemodynamic status of studied patients on admission and after 24 hours. In relation to blood pressure and respiratory rate, the results revealed that there were an increases in the number of patients who suffer from hypotension and bradypnea respectively. Regarding blood pressure, the results revealed that more than half of patient had hypotension after 24 hours of their admission this may be due to detecting missed injuries or hidden bleeding. This results agreed with a results of a study done by **Holcomb, Salinas, McManus, Miller, Cooke and Convertino (2010)** entitled "The manual

vital signs reliably predict need for life-saving interventions in trauma patients all vital signs decreased during the measurement time frame" who reported that heart rate and respiratory rate dropped at the same time, the systolic and diastolic blood pressure decreased by 5 percent.

As regards respiratory rate and body temperature, there was difference but not statistically significant where less than half of patients under study had bradypnea and hypothermia after 24 hours from their admission this might be due to changes of hemodynamic status of patients and physical causes and some brain injuries. This result is consistent with a study done by **Quinten, Meurs, Maaten and Ligtenberg, (2016)** entitled "Trends in vital signs and routine biomarkers in patients with sepsis during resuscitation in the emergency department" who reported that changes of vital signs occur after trauma.

The current study revealed that there was a statistically significant difference between physical assessment of studied patients on admission and after 24 hours, whereas there was an increase of a number of patients who had injuries of chest, abdomen and extremities after 24 hours of admission. The result also revealed that there was a minor increase in a number of patients who had ear, neck, lung, back and rectal injuries after 24 hours of admission. This may be due to that missed injuries usually appeared after 24 hours with repeated examinations and repeated radiology survey.

Most of patients appeared to have head injuries after 24 hours of their admission with statistically significant difference, this result might be due to disturbed conscious level after 12 hours from admission and the patient's hair cover head injuries,. This result is consistent with a study done by **Smith, Findlay, Weyman and Freeth, (2013)** entitled "The management of trauma victims with head injury: a study by the national confidential inquiry into patient

outcome and death" who reported that majority of trauma patients had head injuries.

In the same line the results revealed that, the majority of patient discovered to have chest injuries after 24 hours from their admission with statistically significant difference. This might be due to suspected surgical emphysema and auscultations of wheezy sounds, this result is similar to the results of a study done by **Enderson, Lawson, Daley and Ormsby, (2011)** entitled "Missed injuries in the era of the trauma scan" who reported that there were a five thoracic injuries (23.33%) patients with chest trauma.

Regarding abdominal injuries, the results revealed that, less than three-quarters of the patient discovered to have abdominal injuries after 24 hours from their admission with statistically significant difference, this might be due to that palpation of the hard abdomen, absent bowel sound and large abdomen, usually appear in the second day. This result is similar with a study done by **Enderson et al., (2011)** entitled "Missed injuries in the era of the trauma scan" who reported that half of the patients had intraabdominal injuries.

The results revealed that, the majority of the patient discovered to have extremities injuries after 24 hours of their admission with statistically significant difference. From the investigator point of view, this might be due to that big attention usually are given to vital organs like brain, heart and lung, and any source of bleeding, penetrating trauma or major trauma with many casualties, with negligence to further assessment of all extremities and edema in lower limbs, this result is consistent with a study done by **Roche, McDonald and Liu, (2015)** entitled "Missed orthopedic injuries in adult trauma patients at a major trauma center" who reported that half of the patients had fractures or dislocations.

As regards radiological findings review for studied patients the results revealed that there was a statistically significant difference between patients finding on admission and after 24 hours, whereas after 24 hours of admission there was increase of number of patients who discovered with flail chest, fracture acetabulum, fracture C-1, fracture L- L-2, fracture femur, frontal hematoma and retroperitoneal hematoma. This might be due to that missed injuries usually appeared after 24 hours with repeated examinations and repeated radiology survey.

Similarly, the results revealed that there was a statistically significant difference, that more than half of patients discovered with flail chest post 24 hours, this result might be due to miss interpretation of ray films by physicians and x-ray done with the unprofessional practitioner and may be cardiopulmonary resuscitation to some patients led to fractured ribs. This result is consistent with a study done by **Brooks, Holroyd and Riley, (2011)** entitled "Missed injuries in major trauma patients". Who reported the majority of patients had missed multiple fractured ribs.

Likewise, the result showed that there was statistically significant difference which less than half of patients had fracture acetabulum pelvis, this result might be due to lack of orthopedic assessment on admission, instability of patients' hemodynamic status and that the attention given to vital organs and vital signs, and repeated trauma survey. This result is consistent with a study done by **Rizoli, (2012)** entitled "Injuries Missed during Initial Assessment of Blunt Trauma Patient" who reported that half of the patients had fractures pelvis.

Most importantly the results showed that there was statistically significant difference which less than one third of the studied patients and more than one third of them had fractures in Cervical 1, Lumbar 1, Lumbar 2, respectively, this result might be due to that upon admission patient usually admitted with disturbed level of

consciousness, and more attention is given to computed tomography (CT) brain finding, patient complains of pain might be misleading. This result is consistent with a study done by **Janjua, Sugrue and Deane, (2008)** entitled "Prospective Evaluation of Early Missed Injuries and the Role of Tertiary Trauma Survey" who reported that half of the patients had missed fracture cervical spine and tibia.

The result revealed that there was statistically significant difference which there was an increase in the number of patients who discovered with liver and spleen injuries, this result is consistent with a study done by **Sung and Kim, (2009)** entitled "Missed injuries in abdominal trauma" who reported that more than half of patients had missed injuries in spleen and liver.

In the same way the present study revealed that there was a statistically significant difference which that more than three-quarters of patients discovered with a retroperitoneal hematoma, this might be due to concerning on admission (CT) scan brain, chest, sometimes CT machine not working, delaying in writing reports of films and sending results of reports to the unit. Lack of coordination amongst the various specialists, lack of documentation, a workload with polytrauma patients as a result of clinical misinterpretation of the X-ray images by the trauma team in the resuscitation room. Radiological review as part of the tertiary survey would have led to earlier diagnosis in these cases .this result is consistent with a study done by **Tammelin, Handolin and Söderlund, (2016)** entitled "Missed Injuries in Polytrauma Patients after Trauma Tertiary Survey in Trauma Intensive Care Unit" who reported that half of the patients had abdominal hematoma

Conclusion

Based on the findings of the current study, it can be concluded that:

Less than half and less than one-third of the nurses under study had an unsatisfactory level of knowledge and practice respectively, and this is contrary to the level at which a nurse should be based on to care critically ill patients in life-threatening condition.

There was a statistically significant relation between the total level of knowledge regarding tertiary trauma survey and age, educational level and training courses attended. There was a statistically significant relation between the total level of practice and educational level and training courses attended. There was a statistically significant positive correlation between the total level of knowledge and total level practice.

After 24 hours from admission, there was a minor increased number of patients who were suffering from hypotension and bradypnea. Additionally, there was an increased number of patients with a below normal range of hemoglobin, hematocrit, red blood cells, white blood cells and platelet count. There was a statistically significant difference regarding physical assessment and radiological findings review of studied patients on admission and after 24 hours that indicate the presence of missed injury.

Recommendations

The results of the present study projected the following recommendations: In research:

- Research is needed to follow the patients' outcome and missed injury.

- Replication of the current study on larger probability sample is recommended to achieve generalization of the result.

In service:

- Tailored training courses are needed for nurses to improve unsatisfactory knowledge and practices regarding tertiary trauma survey.

- Disseminated findings with the emergency medical team to communicate patients' outcome research finding.

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