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Effect of Intra-Abdominal Hypertension & Abdominal Compartment Syndrome Guidelines on Critical Care Nurses' Performance and on Patients' Outcomes

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Abstract

Background: Literature review had cited that, Intra-Abdominal Pressure (IAP) monitoring helps in the early detection of patients who are susceptible for developing Intra-Abdominal Hypertension (IAH) and enabling prompt treatment to prevent the development of Abdominal Compartment Syndrome (ACS). **Purpose:** is to evaluate the effect of intra-abdominal hypertension & abdominal compartment syndrome guidelines on critical care nurses' performance, and on selected patients' outcomes among critically ill patients. **Methods**: a quasi- experimental study was conducted in intensive critical care medicine unit affiliated to Cairo university hospitals and Manial university specialized hospital (third unit), involving 100 male & female adult patients with IAH risk factors (50 matched subjects in each study and control groups).47 male and female critical care nurses were recruited within quasi-experimental (pre and post test one group) research design. Four tools were used to collect data pertinent to this study. Both patients groups (study and control) received the routine hospital care in addition to intervention guidelines for the study group. Follow-up assessments evaluated patient outcomes including length of ICU stay, duration of mechanical ventilation connection, frequency of abdominal compartment syndrome, mortality rate and organ failure . The study hypothesized that the implementation of the guidelines would result in improving outcomes for the study group patients as compared to the control group ones and critical care nurses performance. **Results:** The majority of both patients groups were females, their age was more than 60 years old. The most prominent comorbidities in both groups were Hypertension and Diabetes Mellitus and 80% of the both groups were none smoker**.** The majority of nurses group were females, their age were between 20-30 years old and most of them were technical nursing secondary school**.** The 1st hypothesis can be supported as a statistical difference was put into evidence between the pre and post intervention critical care nurses groups as regards IAH& ACS knowledge (t= 32.411, P value= 0.00). As well, the 2nd hypothesis can also be supported as a significant statistical difference was found between the pre and the post intervention critical care nurses groups regarding intra-abdominal pressure measuring (**F:** 388.538, P value: 0.00). However, the 3rd hypothesis regarding length of ICU stay and mechanical ventilator day connection can't be supported, as

there were no significant differences between patients group with the following χ^2 and p values (χ^2 =6.009, p = 0.422) and (χ^2 = 9.458, p = 0.124) respectively. Moreover, the frequency of abdominal compartment syndrome, mortality rate was lower in the study group with the following χ^2 and p values (χ2= 4.00, P value= 0.04), (χ^2 = 4.596, p = 0.03) respectively. which also can support the 4th and 5th hypotheses. Similarly, the 6th hypothesis related to organ failure can be supported as the study group showed lower mean of SOFA score than control group with the following t and p values (χ2= 11.34, P value= 0.01).**Conclusion:** Outcomes of IAH&ACS patients can be improved when applying IAH risk factors assessment algorithm and a designed nursing intervention protocol through reducing frequency of ACS, mortality rate and a mean SOFA score. Moreover, it increases nurses' knowledge and skills regarding intra-abdominal pressure measurement and nursing intervention for patients with IAH&ACS. **Recommendation:** Monitoring of IAP& early detection of IAH among critically ill patients need to be highly considered within the routine management protocol frameworks for IAH risk patients.

Keywords: intra-abdominal hypertension (IAH) & abdominal compartment syndrome (ACS), designed nursing intervention guidelines, Nurses' performance and patients' outcomes.

1. Introduction

Intra-abdominal hypertension (IAH) is frequently present in critically ill patients and is an independent predictor for mortality (Smit, Meurs& Zijlstra, 2022).Intra-abdominal pressure (IAP) monitoring helps in the early detection of patients who are susceptible for developing intra-abdominal hypertension and enabling prompt treatment to prevent the development of abdominal compartment syndrome (ACS), IAH is more prevalent and can occasionally progress into ACS (Ahmad, 2023). In spite of this, intra-abdominal pressure (IAP) measurements are not consistently carried out, even when data or expert opinion indicate that they can affect patient care and related outcomes (Qutob,et al,2022). Elevated pressure within the cavity of the abdomen is a serious complication that can threat the life of critically ill patients. Thus, there is an intense need to highlight the outcomes of intra-abdominal hypertension (IAH) that can face critical care nurses (Mahran, Abd El-Hafez& Abbas, 2018).

There is a pressure inside each cavity in the body, the pressure within the cavity of the abdomen is known as intra-abdominal pressure (IAP) which normally lies between 5 mmHg and 7 mmHg (Augustin, 2023). When the pressure is sustained or elevated due to pathological causes above 12 mmHg, developed to Intra-abdominal hypertension (IAH) (Depauw,et al,2019). New organ failure or dysfunction with sustained IAP greater than 20 mmHg (with or without abdominal perfusion pressure [APP] < 60 mmHg) is called abdominal compartment syndrome (ACS).This syndrome is responsible for the increase in prevalence of death from 90% to 100% if not immediately recognized and treated (Păduraru,et al,2021).

Abdominal Compartment Syndrome (ACS) represents a severe and life-threatening condition characterized by elevated intra-abdominal pressure (IAP) that can lead to catastrophic multisystem organ failure if not promptly recognized and managed. ACS is particularly prevalent in critically ill patients, where the condition often develops insidiously and remains underdiagnosed due to the nonspecific nature of its early signs and symptoms (Karunarathna,, De Alvis, Gunasena& Jayawardana, 2024).Intra-abdominal hypertension is a comorbid condition in critically ill, is an independent predictor of mortality, and has harmful effects on multiple organ systems through renal, pulmonary or hemodynamic damage (Li,Wang& Lu, 2023).

Increased intra-abdominal pressure (IAP) affects the functions of organs both within and outside of the abdominal cavity, resulting in various clinical problems. A continuous increase in IAP decreases the flow of blood supply to the nervous system, circulatory organs, respiratory organs, gastrointestinal system, liver, and kidneys, and induces long-term functional deterioration. Intra-

abdominal hypertension (IAH) and abdominal compartment syndrome (ACS), in which IAP increases, have been reported to increase patient mortality during ICU treatment, which may be related to severe organ damage (Ryu, et al,2019).Scholars believe that greater understanding of IAH among intensivists& nurses, standard and reasonable IAP monitoring of high-risk patients, and timely intervention with a goal-directed resuscitation strategy may improve short and long-term outcomes (Zhan, et al,2016).

Various methods are used for direct and indirect measurements of IAP. The gold standard of indirect measurement is measurement via a urinary bladder catheter. Either a transducer technique or a manometer technique can be used. The tools to measure IAP are readily available in any ICU (Moustafa, Mokhtar, Saleh & Moustafa, 2016). The significance of nurses' role among the health team has been established in all hospitals. Advancing the nursing care in ICU requires continuous in-service education. This education must be planned based on nurses' prerequisites of knowledge and skills (Geravandi,et al,2018).

Prevention is the most effective way to avoid the deleterious effects of IAH, therefore, identifying risk factors and clinical symptoms of IAH is particularly important to improve intensive care outcomes . Measurement of IAP is not a new concept, but only recently has its importance and therapeutic implications in the ICU become more apparent. However, measurements of IAP have rarely been used as a standard monitoring element, conversely, it is common to measure IAP only when a specific risk factor or the presence of IAH is identified. Many researchers strongly recommend conducting a simple IAP monitoring procedure on patients in the ICU to predict the development of ACS and provide better care (Li, et al,2024)

Critically Ill Patients rely heavily on critical care nurses to monitor Intra-abdominal pressure. Although critical care nurses are responsible for measuring and reporting IAP, there is limited information on their awareness of IAH and ACS. Despite best practice guidelines, recommendations are often not implemented. Critical care nurses may experience difficulties in adopting IAP monitoring due to a lack of resources, such as equipment and qualified personnel, which may impede their capacity to monitor it efficiently (Howthan, 2024).

Additionally, cultural differences may influence how patients and families react to IAP monitoring and care, despite these limitations, critical care nurses can assist minimize negative outcomes associated with IAH and ACS by recognizing early signs of IAH, delivering interventions, and educating patients and families on the need of IAP monitoring (Grealy, Johansson& Coyer, 2019) .All hospitals recognize the importance of nurses' roles as members of the health-care team. Continuous in-service education is essential for improving nursing care in the ICU, nurse education must align with their knowledge and skills. Research indicates a lack of awareness among nurses on recognizing high-risk patients and clinical indicators of IAH/ACS. (Geravandi,2018)

Therefore, the aim of the current study was to evaluate the effect of Intra-Abdominal Hypertension & Abdominal Compartment Syndrome guidelines on critical care nurses' performance, and on patients' outcomes. To achieve the aim of the study the following research hypotheses were formulated:

H1. The post mean assessment knowledge scores for critical care nurses who will receive intra-abdominal hypertension & abdominal compartment syndrome guidelines will be greater than their pre-assessment mean knowledge score.

H2. The post mean intra-abdominal pressure measurement assessment scores for critical care nurses who will receive intra-abdominal hypertension & abdominal compartment syndrome guidelines will be greater than their pre-assessment intra- abdominal pressure measurement mean score.

H3. The Average length of hospital stay & mechanical ventilator day connection for the study group subjects who received care by critical care nurses who are exposed to intra-abdominal hypertension & abdominal compartment syndrome guidelines would be lower than that among the control group subjects.

H4. The Frequency of abdominal compartment syndrome for the study group subjects who received

care by critical care nurses who are exposed to intra-abdominal hypertension & abdominal compartment syndrome guidelines would be lower than those among the control group subjects.

H5. The Frequency of mortality rate for the study group subjects who received care by critical care nurses who are exposed to intra-abdominal hypertension & abdominal compartment syndrome guidelines would be lower than those among the control group subjects.

H6. The mean SOFA scores for the study group who received care by critical care nurses who are exposed to intra-abdominal hypertension & abdominal compartment syndrome guidelines will be lower than those among the control group subjects.

Operational Definitions:

- The IAH & ACS guidelines: These guidelines are adopted from the World Society of Abdominal Compartment Syndrome (WSACS) guidelines (2013). Which are encompass Intra-abdominal Hypertension assessment algorithm which contains IAH risk factors, guidelines for measuring Intra-Abdominal Pressure and Intra-Abdominal Hypertension and Abdominal Compartment Syndrome management algorithm which I adopted nursing intervention for IAH/ACS patients from it. Nursing intervention for IAH/ACS include Nursing care related to improve abdominal wall compliance, Nursing care related to evacuation of intra-luminal content and Nursing care related to fluid balance correction.

Selected patient outcomes include several key metrics that were assessed in IAH patients comprised in the study involving:

- Average of ICU length of stay
- Frequency of developed Abdominal Compartment Syndrome
- Duration of mechanical ventilation
- Mortality rate.

All of these outcomes are measured by Intra-Abdominal Hypertension & Abdominal Compartment Syndrome critically ill patients' outcomes assessment sheet tool 1).

- Organ failure that is measured by (Sequential Organ Failure Assessment) (SOFA) tool 4.

Nurses performance: It includes; nurses' knowledge regarding IAH & ACS (measured by Pre-post critical care nurses' knowledge assessment questionnaire about intra-abdominal Hypertension & Abdominal Compartment Syndrome tool 2), Nurses' practice regarding measuring IAP and Nursing care for IAH & ACS patients (measured by Pre-post critical care nurses' intra-abdominal hypertension & abdominal compartment syndrome performance observation checklist tool 3).

Description of the Intra-Abdominal Hypertension (IAH), Abdominal Compartment Syndrome (ACS) guidelines: It is a set of different practical interventions directed toward IAP monitoring and early detection & management of IAH and ACS to minimize the frequency of possible complications and enhance the patient outcomes and nurses' performance. These guidelines include three main domains; detection for patients with IAH&ACS risk factors, IAP measurement, and Nursing management for patients with IAH. Regarding detection for patients with IAH&ACS risk factors it was done according to Intra-abdominal Hypertension assessment algorithm which contains IAH risk factors for patients on admission. For IAP measurement, close IAP levels monitoring with measuring IAP on daily base were done and recording it in patient's file according to guidelines for measuring Intra-Abdominal Pressure. In regards nursing management for patients with IAH, the guidelines encompass Nursing care related to improve abdominal wall compliance, Nursing care related to evacuation of intra-luminal content and Nursing care related to fluid balance correction.These nursing intervention was adopted from Intra-Abdominal Hypertension and Abdominal Compartment Syndrome management algorithm according to the world society of acute compartment syndrome (WSACS) guidelines (2013). Moreover, teaching these guidelines for

critical care nurses was done and following up their performance for measuring and monitoring of intra-abdominal pressure and applying nursing care management for patients with IAH&ACS.

2. Methods

2.1 Research design

A quasi experimental (study and control groups) & (pre & post-test) design was utilized in this study.

2.2 Setting and samples

The study was carried out at Critical care medicine unit affiliated to Cairo university hospitals and Manial university specialized hospital (third unit), on patients with IAH risk factors can be allocated. The critical care medicine units contain about 35 ICU beds equipped with all critical care equipment. The Manial university specialized hospital (third unit) contains 20 beds, all beds are equipped with advanced monitoring equipment, including continuous cardiac monitoring, blood pressure monitoring, and mechanical ventilator to closely monitor the patient's condition.The nurse-patient ratio was nearly; 1:2.

A purposive sample of adult male and female IAH risk factors patients were selected. They were matched according to these matching criteria; Age group, gender ,medical diagnosis, comorbidities, smoking habits, conscious level on admission and Body Mass Index(BMI) then, divided randomly and equitably to both study and control groups. Inclusion criteria: adult Patients with Age ≥ 18 years old, have an indwelling urinary catheter and have risk factors of abdominal hypertension & abdominal compartment syndrome, exclusion criteria: patients diagnosed with neurogenic bladder& abnormalities, pelvic trauma, and pelvic hematomas. Also, all the available nursing staff working at the critical care medicine department unit and Manial university specialized hospital (third unit), providing direct patient care, and are willing to participate in the study were included.

2.3 Measurement and data collection

Four tools were utilized to collect data pertinent to the current study. One tool adopted and three were developed by the researcher and reviewed by a panel of five critical care nursing and medical experts. These tools are as follow:

1. Intra- Abdominal Hypertension & Abdominal Compartment Syndrome critically ill patients' outcomes assessment sheet (tool I): it composed of two parts; first part includes; demographic data that comprised age and gender. Second part includes, medical data sheet that comprised history, medical data, comorbidities, chief complaints, BMI, GCS on admission, measurements of IAP, onset of IAH, ACS. The reliability value was 0.691.
2. Pre-post critical care nurses' knowledge assessment questionnaire about intra-abdominal Hypertension & Abdominal Compartment Syndrome: include Twenty-nine questions were designed to explore nurses' knowledge about IAH and ACS divided into (17 true & false questions), (10 multiple choice questions) and two completion question. A total score of 70 grades; each right answer has got one grade. The total scores are classified as follows; scores of less than 52 out of 70 scores (less than 75%) are considered as unsatisfactory knowledge level and scores equal to or more than 52 out of 70 (more than 75%) are considered satisfactory knowledge levels. It was reliable, utilizing Inter-rater reliability with kappa coefficient =0.699
3. Pre-post critical care nurses' intra-abdominal hypertension & abdominal compartment syndrome performance observation checklist: part 1:assess nurses' practices regarding skills in measuring IAP. Each practice step that checked as "done complete and correct" took 1 grade," done incompletely, done incorrect and not done" took zero. The total scores of the checklist were 18 grades. The scoring system was classified as follows; scores less than 11 (<60%) were considered as an unsatisfactory practice level, scores from 11 to 13 were considered fair (74-60 %) and scores equal or more than 14 (≥75%) were considered as satisfactory practice level and part2; assess nurses' practices regarding caring for patients with IAH &

ACS according to World Society of Abdominal Compartment Syndrome (WSACS) guidelines before and after the educational guidelines. Each practice step that checked as "done complete and correct" took 1 grade, Each practice step that checked as "done incompletely, incorrect and not done" took zero. The total scores were 11 grades. The scoring system was classified as follows; scores less than 7 (<60%) were considered as an unsatisfactory practice level, score 7 was considered fair (74-60 %) and scores equal or more than 8 (≥75%) were considered as satisfactory practice level. Concerning testing the reliability of nurses' practices checklist, tested for reliability by Test and retest with Pearson correlation = 0.741 for IAP measurement checklist and 0 .856 for IAH&ACS nursing intervention check list.

4. Sequential organ failure assessment sheet (SOFA score), developed by Vincent (1996). It is a scoring system used to determine the extent of a patient's organ function or rate of dysfunction during their stay in the intensive care unit (Lambden, Laterre, Levy & Francois, 2019)**.**It is completed through assessment of the function of six different body systems: a- Respiratory system: is mainly assessed based on obtaining the ratio of partial arterial oxygen pressure (PaO2)/fraction of inspired oxygen (FiO2). b- Cardiovascular system: is assessed through calculating the mean arterial blood pressure using equation of MAP= SBP + 2(DBP) / 3; and assessing the dose of vasoactive drugs. c- Renal system: is assessed based on monitoring serum creatinine level or diuresis (amount of daily urine output) d- Hepatic system: is assessed based on monitoring serum total bilirubin level.
e- Neurological system: is assessed through estimation of Glasgow Coma Scale (GCS) Score, to specify the level of consciousness. f- Hematological system: is assessed based on documenting the platelet count. It is a likert scale ranging from (0-24). Each organ is graded from 0 (normal) to 4 (the most abnormal), providing score of 0 to 24 points, the greater the score, the worse the condition. 0 – < 8 point = mild organ dysfunction
8 – < 16 point = moderate organ dysfunction 16 – 24 point = severe organ dysfunction. the SOFA core intra class correlation coefficient (ICC) rate = 0.889, Alpha Cronbach test. It was .921

2.4 Intervention

Two phases were included:

1. Preparatory phase: Involved preparation of the intervention guidelines of care, study tools and permission to conduct the study.
2. Implementation phase: Once permission are granted to proceed with the proposed study, the researcher approached the head nurse of critical care unit to obtain a list of patients and list of nurses then the researcher reviewed those patients against inclusion and exclusion criteria to select patients eligible for the study and reviewed those nurses. Head nurse was asked to contact the researcher for such new admission. All nursing staff was informed about the nature and purpose of the study. Frequency of admission was nearly three to four patients admitted per month eligible patients. The eligible first fifty patients were considered control group subjects. Then, patient or relatives and nurses who agreed to participate in the study were interviewed individually for a period of 10-15 minutes each, during morning/ afternoon shift by the researcher to explain the nature and purpose of the study and to establish rapport and cooperation. During which pre-questionnaire and pre checklists were completed for the nurses after written consents were obtained from patients/ relatives and nurses. Study group patients were exposed to the routine hospital in addition to the component of the designed nursing intervention guidelines on daily basis according to individualized condition during morning and afternoon shifts applying the component of the intervention protocol. First assessment was obtained as baseline information (pre-intervention phase) utilizing tools 1and 4 for patients and tool 2,3 for nurses. Researcher consumed nearly 30 to 45 minutes for each patient and about one hour for each nurse per day all through hospitalization period which was ranged between five to six days. Then the second assessment was done on daily basis for each study and control group patients and the mean observation

was calculated (post-intervention phase) utilizing tools 1and 4 for patients. Regarding nurses teaching guidelines were given to nurses in subgroups according to the availability of nurses, teaching guidelines were classified into theoretical part which was given through two session each session consuming about 20-30 minutes and practical part which was demonstrated in 10-15 minutes and critical care nurses re-demonstrated immediately in about 20-30 minutes then the second assessment was conducted using tool (2,3).Third and final assessment was done immediately before discharge. For nurses third assessment was conducted one month after teaching guidelines. Nursing and medical staff were cooperative. Patient' medical and nursing records were utilized in data collection.

Each of the study group subject was matched by a control group considering, predetermined matching criteria. Control group patients were exposed to the routine hospital care only and measuring of intra-abdominal pressure and assessed same as the study group patients. Thus, researcher visited control group subject on daily basis until discharge and consuming the same period exactly as study group subject except for intervention. Implementation of this study was fulfilled over a period of thirty months.

2.5 Data analysis

Data obtained from the study tools were categorized, tabulated, analyzed and data entry was performed using the SPSS software (statistical package for social sciences version 21.0). Descriptive statistics were applied (e.g. mean, standard deviation, frequency and percentage). Test of significance was performed to test the study hypothesis (i.e. independent t- test , chi square test and ANOVA test). Pearson's correlation coefficient was applied between quantitative variables. Probability (p- value) of 0.05 or less was considered significant and less than 0.001 considered as highly significant.

2.6 Ethical considerations

An official permission to conduct the proposed study was obtained from the ethical committee faculty of nursing and hospital directors. Participation in this study was voluntary; each potential subject was informed about the purpose, procedure, benefits, and nature of the study and that he/she had the right to withdraw from the study at any time without any rationale, then written consent obtained from them. Subjects were informed that obtained data will not be included in any further researches without second consent. Confidentiality and anonymity of each subject were assured through coding of all data and all information has taken was protected and didn't affect their annual appraisal.

3. Results

3.1 Finding related to nurses' demographic characteristic data:

Figure1 shows that, about two-thirds of the studied sample (70%) (33 nurse) were females.

Figure1: Percentage distribution of critical care nurses in regards to gender (n=47).

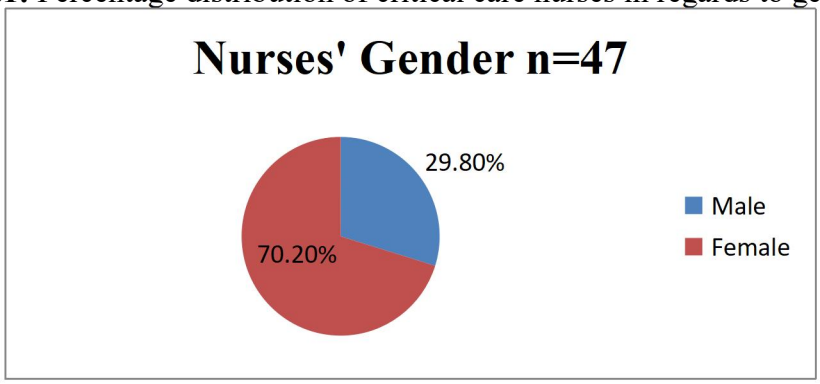


Table1 presents that, 53.2% of the critical care nurses' age was 20-30 years, with a mean age of (33.94±10.7). As regards educational level, (34%) (16) of the nurses included in the study were Technical Nursing Secondary school.

Table (1): Percentage Distribution of the critical care nurses *as* regards to age and educational level (n=47).

Variables	Study sample n=47	
	No	%
Age Category in Year		
20-30	25	53.2
31-40	7	14.9
41-50	10	21.3
51-60	5	10.6
Mean± SD (33.94±10.7)		
Educational level		
Technical Nursing Secondary school	16	34
Technical Nursing Institute	12	25.5
Bachelor's Nursing	12	25.5
post graduate studies	7	15
Total	47	100

3.2 - Finding related to testing the research hypotheses:

H1. States that: The post mean assessment knowledge scores for critical care nurses who will receive intra-abdominal hypertension & abdominal compartment syndrome guidelines will be greater than their pre-assessment mean knowledge score. (Table 2, Figure 2 are related to this hypothesis)

Table 2 shows that, there was a highly significant statistical difference existed between total and all Subtotal Knowledge Scores in relation to pre & post educational guidelines regarding intra-abdominal hypertension& abdominal compartment syndrome questionnaire. (Test value 32.411, P .000) Therefore, the 1st hypothesis can be supported.

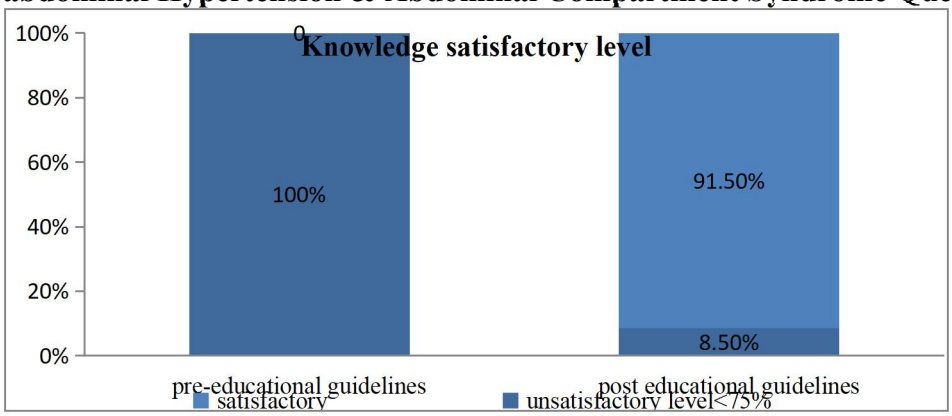
Table 2: Total and Subtotal Mean Knowledge Scores pre & post educational guidelines of the critical care nurses in relation to intra-abdominal Hypertension & Abdominal Compartment Syndrome Questionnaire. (n=47)

Items	Total score	Pre-educational guidelines	Post-educational guidelines	t	P value
		Mean± SD	Mean± SD		
Maximum Knowledge score.	70	12.61 ± 6.76	52.72 ± 7.50	32.411	.000

IAH Risk Factors	6	2.3617 ± 1.509	4.76 ±1.08	-9.610	.000
Clinical Signs of ACS	6	2.617 ± 1.894	4.80 ±1.034	-7.044	.000
Barriers of monitoring IAP	5	2.57 ±1.49	3.80 ± 1.27	-4.710	.000
Knowledge about IAP &Measurement steps	6	2. 957 ± 1.178	5.53 ± .717	-13. 96	.000
Care of patient with IAH	4	1.31± 1.105	3.55± .618	-12.206	.000
IAH Risk Factors algorithm	24	.851± 4.10	20.04± 3.20	-29.27	.000
IAH&ACS management algorithm	19	.000± ,000	9.87± 5.35	-12.64	.000

Figure 2 demonstrates that all of the critical care nurses (100 %) (47) Have got an unsatisfactory knowledge level pre-educational guidelines regarding intra-abdominal Hypertension & Abdominal Compartment Syndrome Questionnaire. While critical care nurses' knowledge level post-educational guidelines showed, most of them (91.5%) (43) Have a satisfactory knowledge level.

Figure 2: Critical Care Nurses' Knowledge Level pre & post educational guidelines in relation to intra-abdominal Hypertension & Abdominal Compartment Syndrome Questionnaire (n=47).



H2. States that: The post mean intra-abdominal pressure measurement assessment scores for critical care nurses who will receive intra-abdominal hypertension & abdominal compartment syndrome guidelines will be greater than their pre-assessment intra- abdominal pressure measurement mean score. (Table 3,4 and Figure 3are related to this hypothesis).

Table 3 shows that, there was a significant statistical differences between the studied critical nurses' sample in relation to pre educational practice, post educational practice1, and post educational practice 2 (Test value 388.538, P .000) regarding measuring intra-abdominal pressure skills.

Table3: Difference between critical care nurses pre & post-practice score in relation to different means regarding intra-abdominal pressure measurement. (N=47)

	N	Mean	Std. Deviation	Minimum	Maximum	F	P value
Pre	47	7.829	1.564	5.00	11.00	388.538	.000*
Post 1	47	15.574	1.394	13.00	18.00		

Post 2	47	16.00	1.628	11.00	18.00		

Table 4 shows that, a significant statistical association between the studied critical care nurses' sample between pre-educational guidelines practice & means of all two post educational guidelines practices. It also clarifies no significant statistical relation among the nurses' sample between practice 1 and practice 2.Therefore, the 2nd hypothesis can be supported based on finding of table 3 and 4.

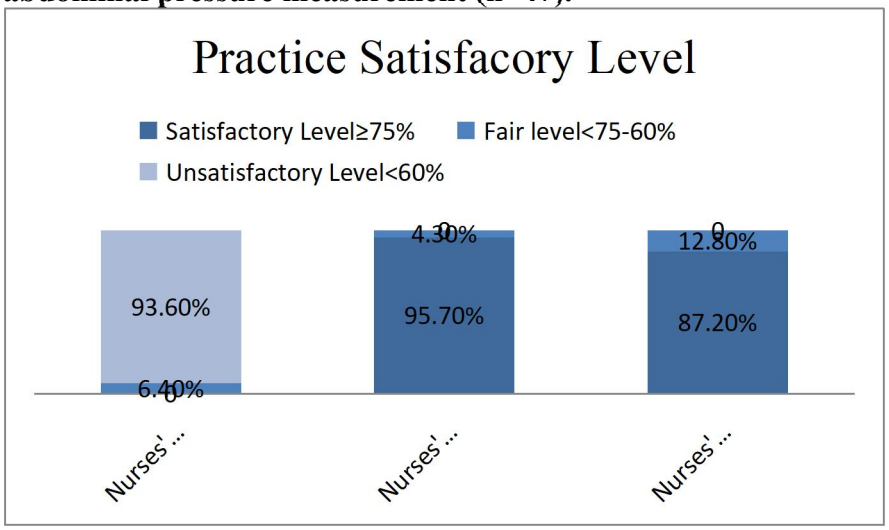
Table4: Difference between critical care nurses pre & post-practice score in relation to different means regarding intra-abdominal pressure measurement. (N=47)

Pairwise Comparisons

Bonferroni		Mean Difference	Std. Error	P value	95% Confidence Interval	
					Lower Bound	Upper Bound
Pre	post 1	-7.745*	.324	.000	-8.550	-6.940
	post 2	-8.170*	.317	.000	-8.957	-7.384
Post 1	Post 2	-.426	.299	.485	-1.169	.318

Figure 3 shows that (93.6%) (44) of critical care nurses has got an unsatisfactory practice level pre educational guidelines regarding intra-abdominal pressure measurement . While post educational practice 1; showed that (95.7 %) (45) of nurses have a satisfactory practice level and 4.3%(2) have fair level .and post educational practice 2; showed that 87.2%(41) has satisfactory level and 12.8%(6) have fair level.

Figure 3: **Critical Care Nurses' Practice Level pre & post educational guidelines regarding intra-abdominal pressure measurement (n=47).**



3.2 Finding related to patients' demographic characteristic data and medical data:

Table 5 details that homogeneity between the study and control groups, with no statistically significant differences observed in age group, gender, IAH, or Body Mass Index (all p-values > 0.05). This baseline equivalence strengthens the validity of subsequent comparisons between the groups, about 70% of study and 66% of control subject had age >60 years with no significant

statistical difference. Concerning IAH occurrence, majority of both study and control group subjects had IAH incidence (74%, 76% respectively) with no significant statistical difference. As well, majority of both study and control group subjects (52%, 50% respectively) had a normal body mass index with no significant statistical difference.

Table (5): Percentage Distribution of Patients' Data Related to Patient Characteristics (Age, Gender, IAH incidence and body mass index (BMI)) in both Study & Control Groups (n=100).

Variable	Variable category	Groups				χ2/ p value	
		Study		Control		Chi Square Test	
		No.	%	No.	%	χ2	p value
Age	20-30	2	4	2	4	.569	0.989
	31-40	1	2	2	4		
	41-50	4	8	5	10		
	51-60	8	16	8	16		
	>60	35	70	33	66		
Gender	Male	19	38	19	38	0.00	1.00
	Female	31	62	31	62		
IAH incidence	Normal IAP	13	26	12	24	2.000	0.500
	IAH	37	74	38	76		
Body Mass Index (BMI)	Under weight	6	12	7	14	.097	0.992
	Normal	26	52	25	50		
	Over weight	16	32	16	32		
	Obese	2	4	2	4		

Table 6 presents the distribution of comorbidities among the study participants, with no statistically significant differences observed between the control and Study groups (all p-values > 0.05). This comparability in pre-existing conditions strengthens the internal validity of the study. Diabetes and Hypertension were the most prevalent comorbidity, affecting 62% of the total sample. Diabetes mellitus, Hypertension and Cardiac problems were present in 40% of participants. Concerning habits i.e. smoking, about three fourths of the both groups subjects were none smokers with a percentage (80%) with no significant statistical difference.

Table (6): Percentage Distribution of Patients' Data Related to the Comorbidities and Smoking habits in both Study and Control groups. (n=100)

Variable	Variable category	Groups				χ2/ p value	
		Study		Control		Chi Square Test	
		No.	%	No.	%	χ2	p value
Comorbidities	DM	3	6	3	6	.898	0.989
	HTN	8	16	7	14		
	DM+ HTN	17	34	14	28		
	DM+HTN+ Cardiac	9	18	11	22		
	HTN+ Cardiac+ CVS	1	2	1	2		
	HTN+ Cardiac	5	10	7	14		

	None	7	14	7	14		
Habits	Smoker	10	20	10	20	1.00	0.598
	None Smoker	40	80	40	80		

3.4 Finding related to testing the patients' research hypotheses:

H3. States that:

The Average length of hospital stay & mechanical ventilator day connection for the study group subjects who received care by critical care nurses who are exposed to intra-abdominal hypertension & abdominal compartment syndrome guidelines would be lower than that among the control group subjects. (Table 7 and 8are related to this hypothesis).

Table 7 demonstrates a comparison between the study and control groups in regards to the length of ICU stay, which highlights that ICU days were fewer in the study group with mean length of stay 12.500±8.229 compared with 14.720 ±11.208 in the control group, however with no statistically significant difference between both groups ($\chi 2$= 6.009 & p= 0.422).

Table 7: Comparison between Study and Control group as regards to Length of ICU Stay (N=100)

Patient's group / $\chi 2$/ p value / Length of ICU stay	Patients' group				Total		(X^2)	P value
	study n= 50		Control n= 50		No	%		
	No.	%	No.	%				
< 5 days	6	12	5	10	11	22	6.009	0.422 NS
5 - 10 days	22	44	14	28	36	70		
11 - 15 days	7	14	14	28	21	42		
16- 20 days	5	10	4	8	9	18		
21-25 days	6	12	7	14	13	26		
26-30days	2	4	1	2	3	6		
> 30 days	2	4	5	10	7	14		
Total	50	100	50	100	100	100		

Table 8 clarifies that: 18% (9) of the study group their length of mechanical ventilator days connection were (< 5) days and 2% (1) their length of mechanical ventilator days were >30days with an overall mean of (3.180±6.82). While less than one fourth of the control group 18% (9) their length of mechanical ventilator days connection were (< 5) days and 4% (2) their length of mechanical ventilator were >30days with an overall mean of (5.86±9.85). However, no significant statistical differences regarding mechanical ventilator day connections for both group subjects. ($\chi 2$: 9.458, p value: 0.124). Therefore, the 3rd can't be supported based on finding of table 7 and 8.

Table 8: Comparison between study and control group as regards mechanical ventilator days among the studied sample, (n= 45).

Patient's group / χ2/ p value / MV days Connection	Patients' group				Total		(X^2)	P value
	Study n= 19		Control n= 26		No.	%		
	No.	%	No.	%				
5 days <	9	47.4	9	34.6	18	40	9.458	0.124 NS
5 - 10 days	6	31.5	4	15.8	10	22.2		
11 - 15 days	1	5.3	7	26.9	8	17.8		
16- 20 days	0	0	3	11.5	3	6.7		
21-25 days	2	10.5	1	3.5	3	6.7		
26-30 days	0	0	0	0	0	0		
> 30 days	1	5.3	2	7.7	3	6.7		
Total	19	100	26	100	45	100		

H4. States that:
The Frequency of abdominal compartment syndrome for the study group subjects who received care by critical care nurses who are exposed to intra-abdominal hypertension & abdominal compartment syndrome guidelines would be lower than those among the control group subjects. (Table 9 is related to this hypothesis).

Table 9 illustrates that, Regarding Abdominal Compartment Syndrome (ACS) frequency outcome, It was developed in 16% of control group verses 4% in intervention group. Overall there is a statistically significant difference between Patients' groups and ACS frequency among the studied sample (χ2: 4.00, p value: 0.04).Therefore, the 4th hypothesis can be supported.

Table 9: Comparison between study and control group as regards to Abdominal Compartment Syndrome (ACS) Frequency among the Studied Sample.

Patients' group / χ2/ p value / ACS Frequency	Patients' group				Total		(X^2)	P value
	Study N=50		Control N=50		No.	%		
	No.	%	No.	%				
ACS occurred	2	4	8	16	10	10	4.000	0.046* S
ACS not occurred	48	96	42	84	90	90		
Total	50	100	50	100	100	100		

H5. States that:
The Frequency of mortality rate for the study group subjects who received care by critical care nurses who are exposed to intra-abdominal hypertension & abdominal compartment syndrome guidelines would

be lower than those among the control group subjects. (Table 10 is related to this hypothesis).

Table 10 shows that, regarding mortality rate outcome; there is (42%) mortality rate in control group compared with (22%) in the study group. Therefore there is a statistically significant difference regarding Mortality rate in both groups. (χ2: 4.596, p value: 0.03). Therefore, the 5th hypothesis can be supported.

Table (10): Comparison between Study and Control group as regards to Mortality Rate among the Studied Sample, (n= 100).

Patients' group(χ2/ p value) / Patient's outcome	Patients groups				Total		(X^2)	P value
	Study N=50		Control N=50		No.	%		
	No.	%	No.	%				
Died	11	22	21	42	32	32	4.596	0.03* S
Discharged	39	78	29	58	68	68		
Total	50	100	50	100	100	100		

H6. States that:

The mean SOFA scores for the study group who received care by critical care nurses who are exposed to intra-abdominal hypertension & abdominal compartment syndrome guidelines would be lower than those among the control group subjects. (Table 11 is related to this hypothesis)

Table 11 demonstrates that, both study and control group subjects were in a mild organ failure (68% and 76 % respectively) with mean SOFA score (4.800 ± 3.043 and 5.340 ± 3.583) for the study and control group respectively during the pre-intervention assessment phase (on admission) with no significant statistical difference between the two groups. However, during the second assessment, (mean post intervention) 42%, 14% of the control groups were in moderate organ failure and severe organ failure respectively. As compared to 30%, 4% of the study group ones. With a significant statistical difference between them (χ2: 5.978, p value: 0.05), with mean SOFA score (5.100±4.404 and 7.440±5.135) for the study and control group respectively. As well, during the third assessment, (immediately pre-discharge) 32% of the control groups were in sever organ failure as compared to 10% of the study group ones with mean (4.760± 5.871) and 7.180±7.009 for the study and control group respectively. With a significant statistical difference between them (χ2: 11.34, p value: 0.01). Therefore, the 6th hypothesis can be supported.

Table11: Comparison between Study and Control group as Regards to Severity of Organ Failure all through the Hospitalization Period (N=100)

Assessment phases	Category of SOFA scores	Groups				χ2/ p value	
		Study Group		Control Group		Chi Square Test	
	SOFA category	No.	%	No.	%	χ2	P
Pre-intervention	Mild	34	68	38	76	.889	0.641
	Moderate	14	28	10	20		
	Severe	2	4	2	4		

Mean Post Intervention	Mild	33	66	22	44	5.978	0.050
	Moderate	15	30	21	42		
	Severe	2	4	7	14		
Pre-Discharge	Mild	36	72	28	56	11.34	0.01
	Moderate	9	18	6	12		
	Severe	5	10	16	32		

Table 12 donates that, a negative correlation was put into evidence between IAH incidence and body mass index (BMI) among study sample subjects (r: -0.210/ p value: 0.036). As well, a positive correlation was put into evidence between IAH incidence and Glascow Coma Scale (GCS) study sample subjects (r: 0.280/ p value: 0.005). However, no relation was found between IAH incidence regarding age, gender, comorbidities and smoking among sample subjects.

Table (12): Correlation between IAH frequency in relation to age, gender, comorbidities, BMI, GCS, and smoking for study sample subjects (N=100)

IAH Frequency r/P value / Variable	Groups	
	r	P value
Age	-.033	.733
Gender	.575	.057
Comorbidities	.149	.138
BMI	-.210	.036*
GCS	0.280	0.005*
Smoking	,047	.641

4- Discussion

The present study delineated that, two thirds of the study nurses sample were female. In accordance with these results, Reyad, Mahmoud& Eldriny, (2022) in a study titled "Assessment of Nurses' Knowledge and Practice Regarding Intra-Abdominal Pressure Measurement and Abdominal Compartment Syndrome Prevention" reported that about two thirds of the studied nurses were female. Moreover, Li,et al.(2024) reported that **;**The majority of the study sample were females in study titled"Knowledge, attitudes, and practices (KAP) regarding intra-abdominal pressure monitoring among pediatric intensive care nurses: A cross sectional study". but in disagreement with Kadhim &Hamza,(2020). who revealed that about half of the studied sample were male in a study tilted as "Effectiveness of an Educational Program on Nurses' Knowledge toward Burn Management". These findings explained by the investigator's experience that most of nursing students in Egyptian universities, institution and diploma nursing school are females.

The present study delineated that, about half of the study sample's age was ranged between ages 20 to 30 years old. In accordance with these results, Chipu, Kearns& Nel (2017), in a study titled "Experiences of registered nurses caring for patients with an open abdomen in an intensive care unit in Gauteng" reported that about half of nurses studied sample their age were ranged from 20-30 years old. In the same line with these results Reyad, Mahmoud& Eldriny (2022) reported that approximately three-quarters of nurses studied sample within the age group (20-30 years). In addition, Jing, Qian& Yi,(2021) in a study titled "The effect of education on the quality of nursing

care in ICU patients under mechanical ventilation" reported that half of the nurses studied sample their age were about 25-35 years old.

Based on the investigator point of view, these findings may be interpreted by the dynamic nature of ICUs and CCUs require younger age nurses to cope with that, as well as the older nurses in the upper age categories fulfill administrative roles in the department.

The current study showed that, more than one third of nurses were bachelor's nursing. (bachelor's nursing and post graduate studies). The result of the current study is supported to some degree by the findings of a study done by Musa, Mohamed& Selim,(2020). Who found that more than half were bachelor's nursing, in a study titled as "Assessment of Nurses' Practice and Potential Barriers Regarding the Medical Waste Management at Hamad Medical Corporation in Qatar". In a contradictory study, Li, et al. (2024) found that all participants were registered nurses in study titled as"Knowledge, attitudes, and practices (KAP) regarding intra-abdominal pressure monitoring among pediatric intensive care nurses: A cross sectional study"

As regarding to distribution of the nurses according to their level of knowledge regarding intra-abdominal hypertension and abdominal compartment syndrome, the results of the current study revealed that; all of the studied nurses had unsatisfactory level pre-teaching educational guidelines. This result is in harmony with a study done by Mahran *et al*.(2018), who implicated that the answer of nurses regarding definitions, values and grades of IAP, IAH and ACS were poor pre-teaching program in study tilted as" Effect of Teaching Program on Nurses' Knowledge and Skills And Development Of Abdominal Compartment Syndrome Among Intensive Care Patients".

In the same line, Qutob, et al.,(2022), approved that ;The study participants (physicians) showed a weak level of knowledge of IAH and ACS, In study titled as"Physicians' Knowledge of Abdominal Compartment Syndrome and Intra-Abdominal Hypertension in Saudi Arabia: An Online Cross-Sectional Survey Study". In contrast, Wise *et al.* (2019) indicated that more than half of respondents were aware of the consensus definitions and normal range of IAP, cut-off levels for IAH and ACS for adult patients and related organ dysfunctions in study titled as"Awareness and knowledge of intra-abdominal hypertension and abdominal compartment syndrome: results of a repeat, international, cross-sectional survey".

Regarding post educational guidelines satisfactory level this study showed that the majority of the studied sample had satisfactory level. This result is in harmony with a study done by Mahran et al, 2018, who implicated that the majority had satisfactory knowledge level post-teaching program in study tilted as" Effect of Teaching Program on Nurses' Knowledge and Skills And Development Of Abdominal Compartment Syndrome Among Intensive Care Patients" These findings explained by the investigator's experience may be due to lack of education and information about IAP, IAH and ACS at under graduate curriculum.

Regarding the total level of nurses' practice it was determined that the majority of the studied nurses had an unsatisfactory level of total practice regarding all items related to intra-abdominal pressure measurement pre-teaching. This result is congruence with study done by Reyad, Mahmoud& Eldriny (2022)in a study titled "Assessment of Nurses' Knowledge and Practice Regarding Intra-Abdominal Pressure Measurement and Abdominal Compartment Syndrome Prevention" revealed that more than two thirds of the studied nurses had an incompetent level of practice regarding measuring intra-abdominal pressure, On the other hand, contradictory a study done by Newcombe, et al.(2012), who found that most CCNs were performing IAP measurements correctly. In study titles as "Pediatric critical care nurses' experience with abdominal compartment syndrome".

This can be explained by the investigator's experience may be due to no previous training or work shop about intra-abdominal pressure measurement and the nurses were eager to learn. Another cause is that; the nurses' fatigue brought on by the increased ICU workload, which may prevent them from reading and maintaining their knowledge. There is no policy in the units belonging intra-abdominal pressure measurement and monitoring.

Also, this study showed that, the majority of the studied sample had satisfactory level of practice and minority had fair level post teaching. This result is in harmony with a study done by Mahran *et al.*,(2018)who implicated that the majority of the studied sample and minority of nurses had good practice, moderate practice respectively regarding measuring intra-abdominal pressure post-teaching program in study tilted as "Effect of Teaching Program on Nurses' Knowledge and Skills And Development Of Abdominal Compartment Syndrome Among Intensive Care Patients".

The present study delineated that, two thirds of the study patients' sample's age was> 60 years old and the mean age of the control group was (64.10 ±14.29) versus (65.18±12.82) in the study group with no statistically significant differences were found between both groups regards age. Also this study reveals there is no statistically significant correlation in IAH incidence in relation to age. In accordance with these results, Mahran, et al, (2018) in a study titled "Effect of Teaching Program on Nurses' Knowledge and Skills And Development Of Abdominal Compartment Syndrome Among Intensive Care Patients" revealed that mean age of control and study groups were (54.80±12.31) and (54.08±11.84) respectively. Moreover, no statistical significant differences were found between both groups regards age.

In the same line Blaser, et al.(2019) reported that median (IQR) were 61(18-94) with no statistical significant difference between IAH and age in study titled" Incidence, Risk Factors, and Outcomes of Intra-Abdominal Hypertension in Critically Ill Patients—A Prospective Multicenter Study (IROI Study)". Moreover, Anusha, (2022) reported that approximately one third 36% of the patients in 61-80 years of age group in study titled "intra-abdominal pressure monitoring in critically ill patients admitted in intensive care unit (ICU) as a predictor of acute kidney injury"

In a contradictory study , Ahmed (2023) reported that; about one fourth of patients were 51-60 years age group and one fivth were >60 years, there is a positive correlation between age and IAH (P value 0.02) in study titled" Effect of head of bed elevation on intra-abdominal pressure measurement among mechanically ventilated critically ill patients" **.** In addition, Moustafa, et al.,(2016) in study titled"Intra-abdominal pressure as a criterion for abdominal re-exploration: a prospective study" The study comprised 90 patients with mean age of 45.15 ±11.9, range 22–75 years. From the researcher point of view, Intra-Abdominal Hypertension incidence increase with elderly patients as with increase in age may develop risk factors that increase incidence of IAH like hypotension, decrease urine output and obesity in comparison with young age that have low incidence to have those risk factors.

The present study showed that, more than half of both groups were female with no significant difference among gender regarding incidence IAH. This finding agreed with Samimian, Khaleghdoost, Ashraf, Hakimi, (2021) in a study titled "Effect of body mass index on intra-abdominal pressure" showed that, two thirds of the studied sample were male and there was no difference by sex in increasing intra-abdominal pressure. Moreover, Luo, et al, (2022) in a study titled "Risk Factors for Mortality in Abdominal Infection Patients in ICU:A Retrospective Study From 2011 to 2018" that showed, more than half were male. Disagreed with Anusha, (2022) in a study titled "intra-abdominal pressure monitoring in critically ill patients admitted in intensive care unit (ICU) as a predictor of acute kidney injury" that showed, 66% were male and the incidence of IAH was higher in men than that in women.

From the researcher point of view, opinions vary regarding gender difference and incidence of intra-abdominal hypertension. Future research is needed to determine whether the pathophysiology of IAH actually differs between men and women to develop a better understanding of gender differences in IAH incidence, presentation, prevention, and treatment effectiveness.

The current study showed that, about half of patients have a normal body mass index and one third% were over weight with significant difference regarding incidence of IAH. Agreed with Mohan,Lim, Chan,& Shelat, (2023) found that, overweight and obesity were associated with a higher incidence of intra-abdominal pressure. Obesity was associated with raised IAP, IAH, or both. In study titled as "Impact of Obesity on Clinical Outcomes of Patients with Intra-Abdominal Hypertension and Abdominal Compartment Syndrome" systemic review. For instance, Kim, Prowle, Baldwin& Bellomo,(2012) reported that patients who were obese (BMI >30) were more likely to have IAH) compared to patients who were not obese. In study titled "Incidence, risk factors and outcome associations of intra-abdominal hypertension in critically ill patients."
In the same line Blaser,et al.(2019) reported that there is a significant difference regarding intra-abdominal hypertension(IAH) incidence after one day of admission and overweight; body mass index's median (IQR) were 25(23-29) for patients didn't develop IAH versus 28(24-32) who developed IAH in study titled" Incidence, Risk Factors, and Outcomes of Intra-Abdominal Hypertension in Critically Ill Patients—A Prospective Multicenter Study (IROI Study)".Moreover, Ahmed (2023) reported that; about more than half of patients were obese, there is a positive correlation between BMI and IAP (P value <0.001) in study titled" Effect of head of bed elevation on intra-abdominal pressure measurement among mechanically ventilated critically ill patients"

In the other hand, Zhang, et al, (2016) in a study titled "Study of intra-abdominal hypertension prevalence and awareness level among experienced ICU medical staff" reported that, the IAH wasn't correlated with BMI. In the same line, Kanlerd, Nakornchai, Auksornchart& Watkwaw,(2020) reported that; there is no difference in IAH incidence regards BMI in study titled "Incidence, Outcomes, and Factors Associated with Intra-Abdominal Hypertension and Primary Abdominal Compartment Syndrome in Abdomino pelvic Injury Patients"

From the researcher point of view, the current study showed that about half of study group have a normal body mass index and more than one third have overweight with significant relation with incidence of IAH. This finding is positively supported with many researches as morbid obesity considering risk factor related to increasing incidence IAH. This is because higher fat content around the abdominal cavity (central obesity) in people with higher body mass index results in increased intra-abdominal pressure by indirect impact on abdominal cavity and pelvis.

Also this study showed that more than one third of study group and less than one third of the control group had Diabetes mellitus and hypertension comorbidities respectively, 16%,14% of the study and control had hypertension respectively with no significant relation between comorbidities and IAH incidence. Agreed with Anusha, (2022) in a study titled "Intra-abdominal pressure monitoring in critically ill patients admitted in intensive care unit (ICU) as a predictor of acute kidney injury" who reported about half of the studied sample had hypertension did not show any statistically significant correlation to raise in intra-abdominal pressure. Regarding smoking habits this study showed that the majority of studied sample were non smoker with no significant relation between smoking and IAH incidence. From the researcher point view most of study sample had diabetes mellitus and hypertension because they are the most common comorbidities in Egypt, none smoker because most of the studied sample were female.

Regarding ICU length of stay, the current study showed that there is no statistically difference between both groups regards ICU length of stay. Agreed with Mahran, Abd El-Hafez& Abbas, (2018) who reported that, there is no significant difference between IAH and normal IAP groups p .08 regarding ICU days .In study titled "Deterioration of mechanically ventilated patients in the presence of intra-abdominal hypertension". Moreover study done by Kanlerd, Nakornchai, Auksornchart& Watkwaw, (2020) titled "Incidence, Outcomes, and Factors Associated with Intra-Abdominal Hypertension and Primary Abdominal Compartment Syndrome in Abdomino pelvic Injury Patients" showed that, there is no significant difference between the patient who developed IAH and patients who didn't develop regarding length of ICU stay.

Disagreed with Blaser, et al.(2019) who reported that Patients with IAH had longer ICU and hospital lengths of stay than patients without IAH in study titled" Incidence, Risk Factors, and Outcomes of Intra-Abdominal Hypertension in Critically Ill Patients—A Prospective Multicenter Study (IROI Study)". From researcher point view, there are many extrinsic factors affecting length of ICU stay such as age, sex, clinical history, diagnosis and comorbidities.

Regarding mechanical ventilator day connection this study approved that duration of mechanical ventilation was longer in patients with IAH compared to those without; however, there is no statically difference in mechanical ventilator days and patients with IAH. Agreed with Nansubuga, et al (2020) reported that the duration of mechanical ventilation and length of stay in the ICU was longer in patients with IAH compared to those without; however, this was of no statistical significance in study titled" The prevalence, incidence and mortality associated with intra-abdominal hypertension among patients in intensive care units of a low-income country: a cohort study"

Disagreed with Blaser, et al.(2019) reported that Patients with IAH had longer duration of mechanical ventilation, than patients without IAH with a significant statistically difference in study titled" Incidence, Risk Factors, and Outcomes of Intra-Abdominal Hypertension in Critically Ill Patients—A Prospective Multicenter Study (IROI Study)". From the researcher point of view, duration of mechanical ventilator connection depends on many factors such as the diagnosis and its severity, lung compliance, hemodynamic status of the patients and age.

Regarding Abdominal Compartment Syndrome (ACS) frequency, this study showed that intra-abdominal hypertension patients who are exposed to the designed nursing intervention guidelines were significantly had ACS less than that among a matched control group patients. About one fifth (16%) were developed ACS in control group versus only two patients 4% in the study group. Agreed with Mahran, et al, (2018) in a study titled "Effect of Teaching Program on Nurses' Knowledge and Skills And Development Of Abdominal Compartment Syndrome Among Intensive Care Patients" reported that, there was nearly the same percentage of grade III IAH (IAP=21-25 mmHg) on admission among the control and study patients without occurrence of ACS among both group. Then, the ratios diverged after nursing intervention, one third of control patients develop ACS versus none of study patients.

Another study by Kanlerd, Nakornchai, Auksornchart& Watkwaw, (2020) titled "Incidence, Outcomes, and Factors Associated with Intra-Abdominal Hypertension and Primary Abdominal Compartment Syndrome in Abdomino pelvic Injury Patients" showed that, Six cases (15.8%) developed IAH. Only one patient (2.6%) from the IAH grade III developed renal failure after admission and developed ACS**.** From the researcher point of view**,** teaching guidelines alarm the nurses about the importance of measuring IAP, catastrophic effect of IAH and ACS development and the management algorism of IAH. Moreover, the in-service teaching program actually has positive and rapid effect on

nurses' knowledge and skills regarding managing intra-abdominal hypertension patients that can benefits the patients and decrease the percentage of ACS.

Regarding mortality rate, the current study showed that less than half of control group were died versus about one fifth in study group with significant difference in the both group. Agreed with Anusha, (2022) in a study titled "Intra-abdominal pressure monitoring in critically ill patients admitted in intensive care unit (ICU) as a predictor of acute kidney injury" reported that, about one fourth of the patients with elevated Intra-abdominal pressure died versus 12.5% died with normal intra-abdominal pressure with a statistically significant difference in the patients' mortality in relation to IAH.

In the same line, Smit, et al. (2020) reported that mortality percentage was higher in patients with intra-abdominal hypertension. In a study titled "Intra-abdominal hypertension and abdominal compartment syndrome in patients admitted to the ICU". Moreover, Pereira, et al, (2021) in a study titled "Intra-abdominal hypertension and abdominal compartment syndrome in the critically ill liver cirrhotic patient–prevalence and clinical outcomes. A multicentric retrospective cohort study in intensive care" reported that, The prevalence of IAH and ACS was very high, affecting more than three quarters and nearly one quarter, respectively. With significant statistically difference between non survivor patients and IAH.

In addition Khot, et al.,(2021) reported that there is a statistically significant correlation between IAH and ICU mortality in study titled"Incidence of Intra-Abdominal Hypertension and Abdominal Compartment Syndrome: A Systematic Review". Also, Murphy, et al. (2018). In study titled "Intra-abdominal hypertension is more common than previously thought: a prospective study in a mixed medical-surgical ICU." reported that overall ICU mortality was one fifth and was significantly higher for patients with intra-abdominal hypertension one third compared with patients without intra-abdominal hypertension (11%). Intra-abdominal hypertension of any grade was an independent predictor of mortality.

A contradictory study by Kanlerd, Nakornchai, Auksornchart& Watkwaw (2020) titled "Incidence, Outcomes, and Factors Associated with Intra-Abdominal Hypertension and Primary Abdominal Compartment Syndrome in Abdomino pelvic Injury Patients" showed that, there is no a significant difference between the patient who developed IAH and patients who didn't develop regarding patients outcome. From the researcher point of view, IAH and ACS affect mortality rate because they affect all body systems and cause multi-organ dysfunction/ failure. So, it is crucial for nurses to monitor intra-abdominal pressure to prevent intra-abdominal hypertension, Abdominal Compartment Syndrome and decrease mortality rate among critically ill patients**.**

Regarding mean SOFA score, the current study showed that intra-abdominal hypertension patients who are exposed to the designed nursing intervention guidelines will be significantly had mean SOFA scores less than that among a matched control group patients. Agreed with Mahran, Abd El-Hafez, & Abbas (2018) who reported, there is strong positive correlation between IAP and mean SOFA score and significant difference between IAH and normal IAP groups .In study titled "Deterioration of mechanically ventilated patients in the presence of intra-abdominal hypertension" Also, Samimian, Khaleghdoost, Ashraf, Hakimi, (2021) in a study titled "Effect of body mass index on intra-abdominal pressure" showed that, there was a significant relationship between IAP with SOFA score.

Disagreed with Pereira, et al, (2021) in a study titled "Intra-abdominal hypertension and abdominal compartment syndrome in the critically ill liver cirrhotic patient–prevalence and clinical outcomes. A multicentric retrospective cohort study in intensive care" reported that, Increased IAP wasn't associated with higher mean SOFA score.

4. Conclusion

Based on the results of the current study, this study provides general recommendations to guide professionals who care for patients with IAH. Applying a designed nursing intervention protocol might reduce ACS, reduce mortality percentage, and generally have been associated with improved patient outcomes. However, limited data are available on some aspects, showing the need for continued research on IAH&ACS management.

Effective management of ACS requires early detection, timely intervention, and a coordinated inter-professional approach. While the condition can have severe consequences, including multi-organ failure and prolonged recovery, prompt diagnosis and treatment can significantly improve patient outcomes. Establishing routine IAP monitoring, and fostering multidisciplinary collaboration are key strategies to enhance the care and recovery of patients with IAH, ACS.

5. Recommendations

- Nursing students' curriculum should be focused on the vital role of intra-abdominal pressure monitoring.
- The teaching and training programs about intra-abdominal pressure measurement should be performed through workshop, seminars, conferences and group discussion.
- ACS as a major life threatening complication has to be seriously monitored and managed on regular basis. Simple IAP monitoring procedure on patients in the ICU should be applied to predict the development of ACS and provide better care.
- Intra-abdominal pressure monitoring should be widely used in clinical practice because it is a safe, accurate, inexpensive, and rapid method for the clinical diagnosis of intra-abdominal hypertension.
- Replication of the study on a larger probability sample from different geographical locations.
- Investigate areas of conflict widely for a goal of input evidence based information in the management of patients with IAH.

6. Funding

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7. Conflict Of Interest

No conflict of interest

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