

A systematic review of the effect of selected nursing procedures on pain and hemodynamic parameters in a patient with mechanical ventilator

Roshni Harinath Gupta¹, Kumari Gita Bhonu Paswan², Kumari Sita Bhonu Paswan³, Archana Kisan Honmane⁴, Pragati Dattatray Yele⁵, Ann Maria Thomas⁶

^{1,2,3,4,5} Researcher Student, D. Y. Patil University School of Nursing.

⁶ Research Guide, D. Y. Patil University School of Nursing.

ABSTRACT

Background: In critically ill patients, Pain is a major problem; efficient pain management depends on a systematic, comprehensive assessment of pain. In general, cardiac output is considered a major determinant of oxygen supply and thus its monitoring is regarded helpful.

Aim: The study aimed to review and synthesize current evidence on the impact of a systematic approach to pain assessment and hemodynamic monitoring on critically ill patient outcomes.

Methods: A comprehensive search for primary research articles was conducted using the Medline and PubMed, Eric, Cochrane, and Google scholar databases, using the keywords ‘assessment of pain in mechanically ventilated patient’, ‘changes in hemodynamic parameter during nursing procedures’, ‘impact of nursing procedures on mechanically ventilated patients’ were entered into a search engine. A number of highly pertinent papers relevant to the aims of the review were identified, only those papers, which satisfied the inclusion criteria, were selected for inclusion in this review.

Discussion: The findings from this review support that nurses should be educated with an assessment tool for pain and hemodynamic parameters so that quality care is administered as well as comfort to mechanically ventilated patient is considered while systematically doing the procedures in ICU

Conclusion: This knowledge can be used by health professional to guide the clinical practice and to improve the quality of care. There is convincing evidence to suggest that specific interventions can be employed to improve the comfort to patient and adopting them will bring extensive output in health care of the patient.

Keywords: Pain, Hemodynamic parameters, Nursing procedures, mechanical ventilation.

INTRODUCTION

Pain is often regarded as the fifth vital sign in regard to health care because it is accepted how in healthcare that pain, like other vital signs is an objective sensation rather than subjective. Hemodynamic parameter is a general term referring to the movement or flow of blood along with heart rate, blood pressure and resistance are major determinants of the amount of circulatory blood flow. Measurements of certain hemodynamic parameters such as blood pressure and heart rate can be determined non-invasively. Patients in critical care units are subject to intensive nursing care interventions such as repositioning, breathing and coughing exercises, tracheal suctioning, and line removals that add to their painful experiences as well as show changes in hemodynamic parameters. As a result, nurses are trained and expected to assess pain as well as hemodynamic parameters.

NEED FOR STUDY

Pain among mechanically ventilated patients is aggravated by factors such as stage of illness, invasive procedures, and hemodynamic parameters among mechanically ventilated patients routine specific nursing procedures and interventions. All the nursing procedures carried out in the ICU are for the defined care management of the patient. The need for the procedures however influences the pain and hemodynamic parameters. reviews will guide us in determining the changes we need to observe while doing the procedures so that patients do not experience mild to extensive discomfort.

Manal M. Al Sutari, Maysoon S. Abdalrahim, Ayman M. Hamdan-Mansour, and Shahnaz M. Ayasrah published a study in Journal of Research in Medical Science,2014 with regard to assessment of pain among mechanically ventilated patients in critical care unit. They assessed pain during multiple invasive procedures and surgical interventions. A total of 301 critically ill mechanically ventilated patients were surveyed for their pain levels using the BPS. During routine nursing interventions, significant and positive correlation to pain levels occurred in diastolic BP and heart rate. ANOVA indicated that there was a significant difference in pain level among patients in regards to the type of routine nursing interventions $F(4,300) = 108.3, P < 0.001$. The highest mean scores occurred among patients who were repositioned (mean = 9.13, SD = 1.59), then suctioned (mean = 8.29, SD = 1.87), then those who had invasive procedures (mean = 6.24, SD = 1.67), and had mouth care (mean = 5.24, SD = 1.21). The lowest mean score was among patients who had eye care (mean = 3.80, SD = 0.87). Interestingly, repositioning recorded the highest pain level, even more than invasive procedures. Yet repositioning is considered a routine and minor nursing intervention.

Safaa E Sayed ahmed, Gehan A Yonis and Hba A Al-Metyazidy(2016) publi a study that illustrated there was no significant increase in heart rate and slight reduction in blood pressure among patients of both groups of deep and shallow endotracheal suctioning before suction, immediately after suction and post 15 min. of suction procedure. This

interpreted that suctioning process has an effect of on vital signs. They stated that the heart rate of patients after endotracheal suctioning was significantly increased immediately after suction compared to the value immediately before procedure and returned to the normal levels after 5 min. of suctioning.

A study Published online 2014, Ali Afshari, Mahmoud Safari ,Khodayar Oshvandi, and Ali Reza Soltanian.. This study aimed to find the effects of the open and closed system suctioning methods on blood pressure, mean arterial pressure, heart rate, and percentage of arterial oxygen saturation, time, and costs in patients under mechanical ventilation. This clinical trial study was conducted on 40 patients in ICU. Patients' blood pressure, heart rate, arterial oxygen saturation, and length of suctioning procedure were measured and recorded immediately before and one, five, ten, and fifteen minutes after suctioning. Significant changes were observed in heart rate ($P = 0.025$) and percentage of arterial oxygen saturation ($P < 0.001$).

CONCEPTUAL FRAMEWORK

The development of specific nursing-based conceptual frameworks helps to define and link ideas when performing studies involving a number of different concepts. Through the use of nursing models and frameworks, knowledge gained from nursing research can be more readily disseminated into nursing practice.

Kenny's open system model was adopted for conceptual framework. This theory was introduced by Jennet W. Kenny. The open system model was formulated in the year 1999. The open system enumerates various aspects of system and interaction. She formulated various theories based on management. Open system theory is useful in breaking the whole process into sequential tasks to ensure goal realization. The three major aspects of the systems are:

Input

Throughput

Output

In this study input it refers to the effect of nursing procedures on pain and hemodynamic parameter in mechanically ventilated patient

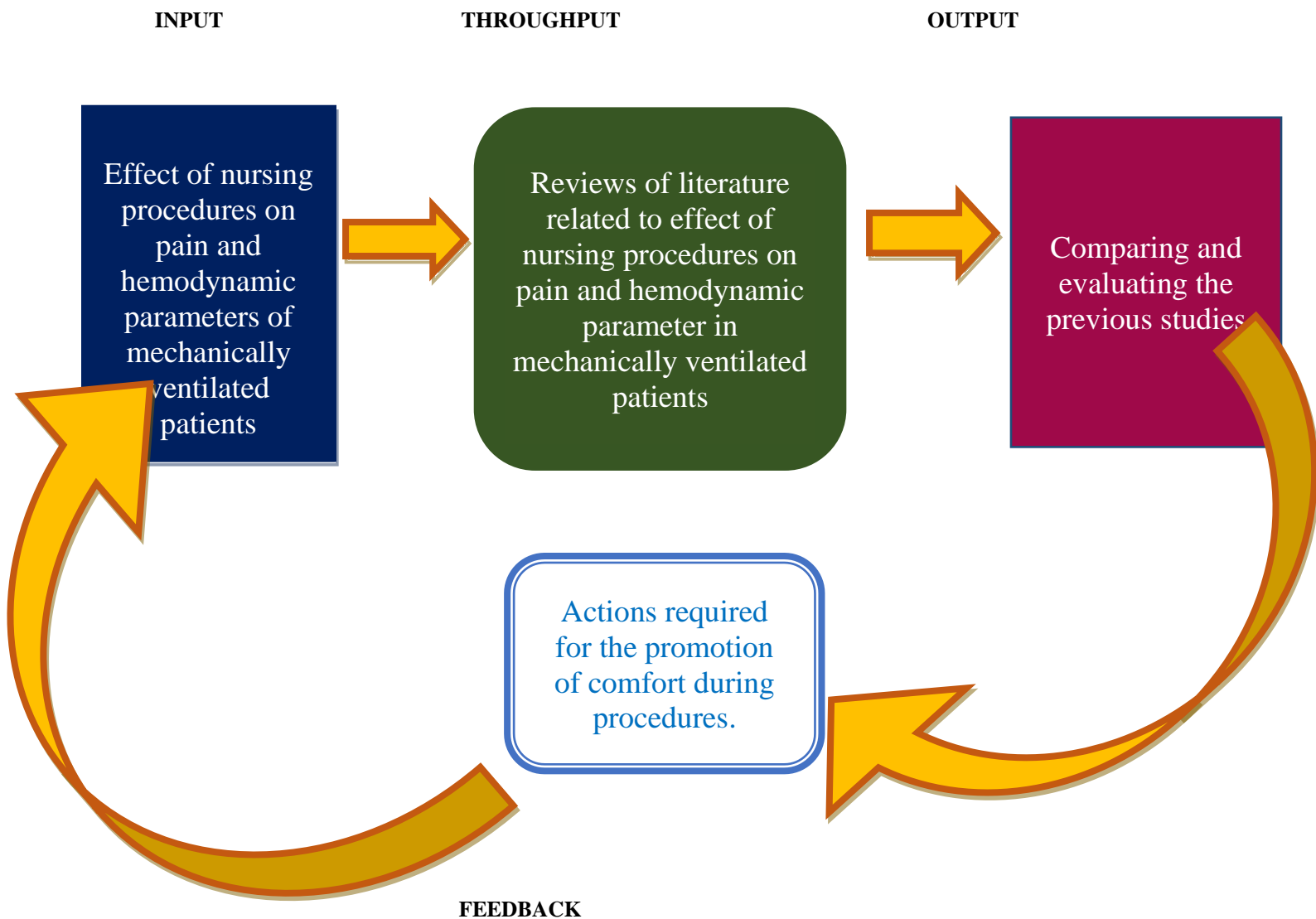
Throughput, in this study, is assessment of literature related to effect of nursing procedures on pain and hemodynamic parameter in mechanically ventilated patients

In this study, output is comparing and evaluating the studies reviewed

The feedback for the system refers to actions required for the promotion of comfort.

The graphical representation of conceptual framework based on the Open System Model Theory is shown in figure no.1

FIGURE NO. 1 CONCEPTUAL FRAMEWORK: OPEN SYSTEM MODEL THEORY



RESEARCH METHODOLOGY

Research methodology is a science of studying how research is done scientifically. In other words, it is a way to systematically solve the research problem by logically adopting various steps. Methodology helps to understand not only the products of scientific inquiry but the process itself.

SEARCH STRATEGY

A comprehensive search for primary research articles was conducted using the Medline and PubMed databases, Mendeley, using the keywords ‘Assessment pain’, “Hemodynamic parameters”, “Mechanical ventilation”, “Selected Nursing Procedures”, “Patient”, “Oral care”, ”Back care”, “Suctioning”, “Nursing Care”, “Turning Procedures”. The reference lists of retrieved articles were also examined as potential sources. Data were extracted by sample and setting, study design, methodological quality, and reported outcomes. The present study was conducted to the assessment of pain and hemodynamic parameter selected nursing procedures the patient is on mechanical ventilation. 16 articles were chosen for a detailed review of the full text and were included in our review.

INCLUSION CRITERIA

Primary studies were included if they met the following criteria:

- Researches published in English language between 2010 and 2020;
- Studies which implemented effect of nursing care on pain for patients mechanically ventilated
- Studies which implemented effect of nursing care on hemodynamic parameters for patients mechanically ventilated
- Studies in which Clinical outcome measures were reported.

EXCLUSION CRITERIA

- Studies published before 2010
- Studies concentrating on aspects of surgical procedures on mechanically ventilated patients
- Studies in which clinical outcomes were not measured. For example, studies which examined the effectiveness of an education intervention targeted at health care personnel but did not investigate clinical outcomes
- Research conducted in paediatric settings.

Table No.1 Summary of Studies Reviewed

Studies on assessment of pain in selected nursing procedures on the patient with mechanical ventilator					
Sr.no	Author	Research Design	Sample	Year of Study	Results/Findings
1.	Hend M Allam	Descriptive	92	2015	The study concluded that there was an increased pain intensity during turning procedures in patients on mechanical ventilation, which increased still more 10 min later, as did their physiological parameters (heart rate, respiration, blood pressure, oxygen saturation).
2.	Craig M. Dale, Sarah Carbone	Descriptive	33	2020	The study concludes participants described oral procedures as painful, discomforting, and emotionally distressing
3.	Robleda , F. Roche-Campot Et.al	Observational method	70	2016	The study concluded pain prevalence during the procedures (positioning and endotracheal aspiration) was 94%. Vital signs and BIS(bispectral index) values increased significantly during the procedures compared to resting conditions
4.	Raziyeh Dastdadeh ·Abbas Ebadi Et.al	A randomized controlled clinical trial	60	2015	The study concluded that both the groups experienced pain. Statistical differences were observed in the levels of pain and agitation in the open and closed suctioning
5.	Majid Akhond Razieh Froutan Et.al.	A parallel designed Clinical trial	120 patients	2016	The study concluded that independent t-test demonstrated no difference between overall pain intensity pain intensity during resting-state suctioning and dressing change scores among two groups before the intervention, however after the intervention, there was a significant reduction in the

					intervention group
6.	Betbhalin Mukhim, Manashi SenguptaEt.al	Exploratory research designs	30patient	2017	The findings revealed that majority of the patients experienced moderate pain, during turning. During endotracheal tube suctioning, the findings revealed that majority patients experienced moderate pain,. It concluded that patients under mechanically ventilator experienced pain during routine nursing procedures.

Table No.2 Summary of Studies Reviewed

Studies on assessment of hemodynamic parameters during selected nursing procedures on the patient with mechanical ventilator					
Sr.no	Author	Research Design	Sample	Year of Study	Results/Findings
1.	A Mercy Anchala	Experimental pre-test – post-test design	40	2016	The study shows that there was a significant difference in systolic blood pressure in left lateral position and oxygen saturation in semi fowler’s position.
2.	Dilek Özden	The quasi-experimental study design	120	2014	The study concluded that HR, arterial blood pressure and arterial blood gases of the patients who underwent open heart surgery were negatively affected by the open suction system and did not increase significantly as soon as suctioning was over during the closed suctioning procedure
3.	Ivan Göcze, Felix Streng Et.al	Descriptive study	200	2013	This study concluded HBE(head of bed elevation) to the 45° position is associated with significant decreases in MAP and ScvO2 in mechanically ventilated patients
4.	Masoomah Adib, Atefeh Ghanbari,Et.al	Randomized crossover clinical trail	37	2014	Systolic blood pressure diastolic blood pressure, average arterial pressure and heart rate increased over time immediately after the suction and then declined; in approximately 5 minutes after suction, it approached its baseline.
5.	Alireza Iradjpour, Mohammad Abbasinia	Single-blinded clinical trial	74	2014	HR and BP were significantly increased after suctioning

FINDINGS AND INTERPRETATION

Studies on assessment of pain in selected nursing procedures on the patient with mechanical ventilator

Hend M Allam did a study on Assessment of pain during turning procedures in patients on mechanical ventilation. A descriptive research design was used with convenient sampling techniques of adult men and women on mechanical ventilation and unconscious patients in ICUs at Benha University Hospital were included in the study. The duration of the study was 6 months, from May 2015 to October 2015. The results displayed (92 men and women patients), 87% had severe pain during turning procedures, which decreased to 4.3% 10 min after the procedure. There was no statistically significant difference between the level of pain for both men and women, as well as comorbid diseases. There was a highly statistically significant difference between behaviour indicators and physiological parameters before, during, and 10 min after the turning procedure.

Craig M. Dale, Sarah Carbone, et al. (2020) did a study on Recall of Pain and Discomfort during Oral Procedures Experienced by Intubated Critically Ill Patients in the Intensive Care. A qualitative descriptive design was used. 33 Participants were interviewed using object elicitation methods within seven days of discharge from the ICU. Data were analysed using directed content analysis methods. Participants reported a significant oral symptom burden during intubation with procedural oral pain (17, 51%), generalized oral discomfort (29, 88%), and oral dryness (31, 94%) predominating. The mean ICU procedural oral pain intensity score was 7 (range 4–8). Most participants described oral procedures as painful, discomforting, and emotionally distressing.

Robleda, F. Roche-Campot et al. (2016) did a study on evaluation of pain on mobilization and endotracheal aspiration in critically ill patients. A prospective, observational analytical study was made of procedures (endotracheal aspiration and mobilization with turning) in critically ill sedated patients on mechanical ventilation. A total of 146 procedures in 70 patients were analysed. Pain prevalence during the procedures was 94%. Vital signs and BIS values increased significantly during the procedures compared to resting conditions, but only the changes in BIS were considered clinically relevant. In the subgroup of patients receiving pre-emptive analgesia prior to the procedure, pain decreased significantly compared to the group of patients who received no such analgesia (-2 [IQR: $\{-5\}$ – 0] vs. 3 [IQR: 1 – 4]; $P < .001$, respectively).

Raziyeh Dastdadeh, Abbas Ebadi et al. (2015) did a study on Comparison of the Effect of Open and Closed Endotracheal Suctioning Methods on Pain and Agitation in Medical ICU Patients. A randomized controlled clinical trial was conducted in the general intensive care units of Khatam-ol-Anbia hospital and Sina hospital, Tehran, Iran. In total, 60 patients who were qualified to be included in the study were randomly assigned to either the intervention group or the control group. When necessary, suction was carried out for each patient using the standard technique. The patients' level of pain and agitation was measured in both groups at five stages (before, during, immediately after, 5 minutes after, and 15 minutes after the intervention) using the behavioural pain scale and the Richmond agitation sedation scale. Significant statistical differences in the pain and agitation at different times within each of the two groups were observed for both open and closed suction ($P > 0.001$).

Majid Akhond Raziéh Froutan et al. (2016) did a study to determine the effect of using a pain monitoring protocol on the pain intensity of ICU patients with decreased level of consciousness. This clinical trial was conducted on 60 nurses and 120 patients in the surgical ICUs of Imam Reza and Ghaem hospitals, Mashhad, Iran. The nurses in the intervention group were trained about pain management protocol in three 20-minute sessions (each session for 10 nurses). Before and after two weeks of training, the patients' pain intensity was monitored using the Nonverbal Pain Scale (NVPS) for three months during the resting-state, suctioning, and dressing change. The patients in the control group received routine nursery care. The results of independent t-test demonstrated no difference between overall pain intensity ($P=0.08$), pain intensity during resting-state ($P=0.11$), suctioning ($P=0.23$), and dressing change ($P=0.06$) scores among two groups before the intervention, however after the intervention, there was a significant reduction in the intervention group in comparison to the control group in all mentioned aspects ($P < 0.001$).

Betbhalin Mukhim, Manashi Sengupta conducted a comparative study to assess the level of pain during nursing procedures in ventilated, unconscious and/or sedated patients. A non-experimental study was conducted among 30 mechanically ventilated patients admitted in ICU (Intensive Care Unit), in Down Town hospital Guwahati, Assam during different nursing interventions, fifteen patients were assessed during turning and fifteen patients were assessed during endotracheal tube suctioning. Purposive sampling technique was used to obtain the sample. Biological parameters and the standardized tool: Behavioral Pain Scale (BPS) was used to measure the study variables. The findings revealed that majority (93.3%) of the patients' experienced moderate pain, whereas the remaining (6.7%) experience no pain during turning. During endotracheal tube suctioning, the findings revealed that majority (80%) of the patients' experienced

moderate pain, whereas the remaining (20%) experience no pain. The study also showed that there was no significant difference between the level of pain experienced during turning and endotracheal tube suctioning ($p < .05$).

Studies on assessment of hemodynamic parameters during selected nursing procedures on the patient with mechanical ventilator

A Mercy Anchala (2016) did a study to assess the effect of therapeutic positions on hemodynamic parameters among critically ill patients in the intensive care unit at Sri Ramachandra Medical Centre, Chennai. The study was aimed to determine the effect of therapeutic positions on hemodynamic parameters among critically ill patients. Experimental pre-test – post-test design was used. Samples were critically ill patients who got admitted in the C4 multi-disciplinary intensive care unit of Sri Ramachandra Medical Centre. Simple random sampling was used to select 40 samples. Hemodynamic parameters such as heart rate, respiratory rate, systolic blood pressure, diastolic blood pressure, oxygen saturation, mean arterial pressure and the background variables of critically ill patients were studied together. Positioned the patients on various therapeutic positions for every two hours by following turning schedule such as left lateral, supine, right lateral, supine and semi fowler's position was carried out for the study group patients, whereas the control group received the routine care. Hemodynamic parameters were assessed before and after the positioning for both the groups for three days. There was a significant difference in systolic blood pressure in left lateral position at (t value 3.317) $p < 0.001$

Dilek Ozden, Refia S Gorgulu(2014) did a quasi-experimental study to assess the effects of open and closed suction systems on the haemodynamic parameters in cardiac surgery patients. The study sample comprised 120 patients who underwent open heart surgery in the cardiovascular surgery intensive care unit of a state hospital in Turkey. Haemodynamic parameters were determined just before, right after, at the 5th and 15th minute after suctioning. The data were evaluated with the One-Way Analysis of Variance (ANOVA) for Repeated Measures, independent t-test and Bonferroni's test for further analysis (post hoc). Results: The difference between heart rate (HR) and mean blood pressure, mean PaO₂ and PaCO₂, SaO₂ and pH values measured before, right after and at the 5th and 15th minute after suctioning was found to be significant in patients who underwent the open suctioning procedure. It was determined that the difference between mean PaO₂ values was not significant and that SaO₂ versus SpO₂ values increased in patients who underwent the closed suctioning procedure. When the open and closed suction systems were compared, statistically significant difference was determined in terms of MAP, SpO₂. Conclusion: It was determined that HR, arterial blood pressure and arterial blood gases of the patients who underwent open heart surgery were negatively affected by the open suction system but did not increase significantly as soon as suctioning was over during the closed suctioning procedure.

Ivan Göcze, Felix Streng Et.al.(2013) conducted a study on the effects of the semi recumbent position on hemodynamic status in patients on invasive mechanical ventilation. Two hundred thermodynamically stable adults on invasive mechanical ventilation admitted to a multidisciplinary surgical intensive care unit were recruited. A sequence of HBE positions (0°, 30°, and 45°) was adopted in random order, and MAP and ScvO₂ were measured at each position. Patients acted as their own controls. The influence of degree of HBE and of the co variables on MAP and ScvO₂ was analysed by using linear mixed models. Changing HBE from supine to 45° caused significant reductions in MAP (from 83.8 mmHg to 71.1 mmHg, $P < 0.001$) and ScvO₂ (76.1% to 74.3%, $P < 0.001$). The study concluded HBE to the 45° position is associated with significant decreases in MAP and ScvO₂ in mechanically ventilated patients.

Masoomeh Adib, Atefeh Ghanbari, Et.al (2014) did a study effect of endotracheal suctioning with and without normal saline on hemodynamic and respiratory parameters in patients undergoing mechanical ventilation in ICU of Hospitals supervised by Guilan University of Medical Sciences. This randomized crossover clinical trial was conducted on two groups consisting of 37 mechanically ventilated patients by suctioning with and without normal saline. After at least 2 hours, the second stage was conducted and the patients were displaced in groups A and B. respiratory and hemodynamic parameters were measured at different intervals. Systolic blood pressure ($P = 0.20$), diastolic blood pressure ($P < 0.0001$), average arterial pressure ($P < 0.0001$) and heart rate ($P < 0.0001$) increased over time immediately after the suction and then declined; in approximately 5 minutes after suction, it approached its baseline. The mean respiratory rate, mean airway pressure, mean oxygen-saturated haemoglobin, mean end-tidal carbon dioxide were similar in both suction groups with and without normal saline during different time steps and no significant differences were observed.

Alireza Irajpour, Mohammad Abbasinia did a study on Effects of shallow and deep endotracheal tube suctioning on cardiovascular indices in patients in intensive care units. In this clinical trial, 74 patients were selected among those who had undergone mechanical ventilation in the ICU of Al-Zahra Hospital, Isfahan, Iran using convenience sampling method. The subjects were randomly allocated to shallow and deep suctioning groups. Heart rate (HR) and blood pressure (BP) were measured immediately before and 1, 2, and 3 min after each suctioning. Number of times of suctioning was also noted in both the groups. Data were analysed using repeated measures analysis of variance (ANOVA), Chi-square and independent t-tests. HR and BP were significantly increased after suctioning in both the groups ($P < 0.05$). But these changes were not significant between the two groups ($P > 0.05$). The suctioning count was significantly higher in the shallow suctioning group than in the deep suctioning group.

APPRAISAL OF STUDIES**STUDY DESIGN**

Out of the 6 studies included in the review of effect on pain while doing nursing procedures; 2 are descriptive, , 1 is observational,1 is randomized control trial, 1 is parallel classified clinical trial,1 is exploratory research design,. All these studies addressed the rate of compliance on pain the patient in ICU in the results.

Out of 5 studies included in the reviews of effect on hemodynamic parameter while doing nursing procedures 2 were quasi experimental studies, 1is randomized cross over clinical trial and 1 is single blind clinical trial All these studies addressed the rate of compliance on hemodynamic parameters the patient in ICU in the results.

SAMPLE

Jeanne Young (2005) suggest that carefully description of study participation setting sample selection and size should be reported. The authors state that descriptions of study participants' characteristics and setting in which they were studied are necessary so that readers can assess generalizability of the results of the study. The authors also explain that description of sample selection and size helps the readers to detect internal validity associated with ascertaining statistically significant and clinically important differences of a given size if such differences exist. Investigators for all the 11 studies reported participants, setting, sample size in their studies.

DATA COLLECTION

Relevant data for the selected studies were collected from different database like pub med scholar, mendeley, ERIC database library, coherence database Research gate.

RESULTS

There is wide variability data reported in the 11 selected studies. All the 6 studies gave the evidence of pain while doing oral care, changing the positions, suctioning, changing the dressing. All the 5 studies gave the evidence of rise in Heart rate and blood pressure during change in position, suctioning. The finding of these studies support recommendation regarding the use of CCPOT when the patient is unconscious.

DISCUSSION

ICU patients are at great risk for under-recognition and under treatment of pain with hemodynamic parameter.This special population needs ongoing assessment with selected nursing procedures.

However, In our study, Observational and experimental designs were able to produce approximately results with regard to pain and hemodynamic parameters. Assessment of pain behaviours was common, these assessments were observed and documented with the use of is widely accepted that the use of reliable behavioural pain assessment tool can assist health care providers in early identification of pain in critical ill patients and subsequently in the prompt of efficient management of pain. An assessment tool for hemodynamic parameters was not developed in the above studies which might help the nurses to identify the patient's discomfort.

CONCLUSION

The results highlighted those fluctuations in hemodynamic parameters are not always an accurate measure for the assessment of pair is critically ill patients. The absence of a changes in vital sign doesn't indicate the absences of a pain and should only be used in validated pain assessment tools according to the conscious status of the patients. Such as CPOT NRS or BPS. Therefore, ICU nurses should continue the critical role they play in pain management and the evaluation of pain, and use vital sign only in cases where objective scales applied. This study expanded knowledge about important aspects of nursing care. This knowledge can be used by health professional to guide the clinical practice and to improve the quality of care. There is convincing evidence to suggest that specific interventions can be employed to improve the comfort to patient and adopting them will bring extensive output in health care of the patient.

RECOMMENDATIONS

- Education is a must for the successful implementation of nursing practice. Systematic rationale of each procedure should be adopted while doing the procedures.
- Clinical guidance for the assessment of pain for the best care of patient is recommended.

- Clinical guidance for the assessment of hemodynamic parameters for the best care of patient is recommended
- Evidenced based protocols should be administered to improve the quality of care

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