

Result and discussion Hemodynamic status and suctioning Endotracheal suctioning for removing secretions, and thereby keeping the airway open and saving the lives of patients is necessary. However, failure to meet the standards in the implementation of these procedures can have numerous effects. Possible complications of endotracheal suctioning include hypoxia, bronchospasm, atelectasis, tracheal tissue injury, pneumonia associated with ventilator, increased intracranial pressure, hemodynamic instability and cardiac dysrhythmia (37). There was a study conducted in anesthetic intensive care unit at Tanta University Hospital. This study made a comparison between Deep endotracheal suction group and shallow endotracheal suction group and their effect on hemodynamic parameters. The results showed that changes of pulse, systolic and diastolic blood pressure, PaCO₂, PaO₂ and HCO₃ were similar in both shallow and deep endotracheal tube suctioning methods. However, significant differences were observed between deep and shallow suction groups regarding O₂ saturation and respiratory rate (38). In another study that included 19 sedated and intubated children, 0–18 years old. They were enrolled in an ongoing prospective observational study. We extracted systemic oxygen saturation, cerebral regional oxygen saturation, somatic regional (renal) oxygen saturation, heart rate, and systolic blood pressure and diastolic blood pressure for 5 26 minutes before and 5 minutes after each event and used these data for analysis. The result was closed and open endotracheal tube suctioning in sedated children is associated with transient but clinically insignificant changes in heart rate, blood pressure, cerebral regional oxygen saturation, systemic oxygen saturation, and somatic regional (renal) oxygen saturation. Saline instillation during endotracheal tube suctioning had no adverse effects on systemic or cerebral oxygenation (39). Also, some studies conducted a study in the effects of deep and superficial endotracheal suctioning on hemodynamic parameters and pain level in mechanically ventilated. However, there was a prospective, randomized, controlled experimental study was conducted on 37 patients who underwent superficial and deep endotracheal suctioning. The arterial blood pressure, heart rate, body temperature, respiratory rate, oxygen saturation levels and pain status of the patient were compared before and after endotracheal suctioning at 1 min, 5 min and 30 min. the result of study showed that superficial endotracheal suctioning caused fewer changes in hemodynamic parameters and pain levels of patients compared to deep endotracheal suctioning (40). Through observational study, 191 patients admitted to the neurological intensive care unit of a tertiary hospital requiring mechanical ventilation were included. The study stated that Endotracheal suctioning (ES) provokes a cumulative hemodynamic response by activation of sympathetic and parasympathetic circuits in the central nervous system. The 27 main findings of this study are that hemodynamic changes can be quantified during endotracheal suctioning and that a less pronounced increase in heart rate is associated with delayed arousal and worse functional outcome (41). The autonomic response reflects a complex interaction between the brain and cardiovascular system. Besides the cardiovascular intrinsic system and the endocrine system, the autonomic nervous system (ANS) regulates heart rate and blood pressure. The ANS in turn is controlled by the sympathetic and parasympathetic system. Well-known brain–heart interactions during brain injury include acute myocardial injury, ECG changes, and arrhythmias which are commonly observed in subarachnoid hemorrhages patients (42). Moreover, some studies conducted a study about the effect of pressure level during suctioning. Where, it compared the effect of two levels of

negative pressure (100 mmHg and 200 mmHg) in open endotracheal tube suction on the physiological indices among patients in the ICUs. The study revealed that with regard to the detrimental effect of endotracheal tube suctioning on arterial oxygen saturation and heart rate, suctioning with negative pressure of 200 mmHg is considered to be a low-risk procedure compared to suctioning with negative pressure of 100 mmHg, if standard procedures in open suction system are followed(43). 28 Some studies conducted a study about the effects of catheter insertion alone and catheter insertion with the application of negative pressure on the partial pressure of arterial oxygen (PaO₂) and heart rate prior to and following vagal blockade with atropine. the result showed no difference in the heart rate following vagal blockade(44). Another study has examined the autonomic mechanisms underlying changes in heart rate (HR) and systolic blood pressure (SBP) responses to endotracheal tube (ETT) suctioning and to compare the open versus closed methods of ETT suctioning on these measures and on arterial oxygen tension. Although there were no significant effects of ETT suctioning on the autonomic mechanisms of HR modulation and no significant differences between the two methods of suctioning, ETT suctioning resulted in an increase in HR, SBP, and PaO₂. However, there was a decrease in the parasympathetic nervous system indicator of HR variability (HRV) following open suctioning(45). In regarding the difference between superficial and deep suctioning is not only hemodynamic status, also the respiratory rate and oxygen saturation have been examined. The study evaluated respiratory rate (RR), arterial blood oxygen saturation (SpO₂) and number of suctioning in patients hospitalized in the intensive care units of Al-Zahra Hospital, Isfahan, Iran. Findings showed that Shallow and deep suctioning had a similar effect on RR and SpO₂. However, shallow suctioning caused further manipulation of patient's trachea than deep suctioning method. Therefore, it seems that deep endotracheal 29 tube suctioning method can be used to clean the airway with lesser manipulation of the trachea(46). In clinical trial, in patients under mechanical ventilation in the ICU of Al-Zahra Hospital, Isfahan, Iran. Heart rate (HR) and blood pressure (BP) were measured immediately before and 1, 2, and 3 min after deep suctioning. HR and BP were significantly increased after deep suctioning (47) Pain and suctioning The presence of pain during tracheal suctioning has been demonstrated in earlier studied. Some studies evaluated the effectiveness endotracheal suction and the way of suctioning on pain and agitation in patients under mechanical ventilation. The study reported a significant pain and agitation in patient underwent deep suctioning (48). Painful care procedures are the most common cause of stress in patients admitted to Intensive Care Units (ICUs). Tracheal suctioning is the most painful experience for ICU patients. The studies showed that endotracheal suctioning has a significant pain in mechanically ventilated patients(49). 30 In a study conducted in patients underwent deep and superficial endotracheal suctioning on hemodynamic parameters and pain level in mechanically ventilated neurosurgical patients. The study reported that patients had pain after exposure to deep suctioning. Also, There was no statistically significant difference between the effects of deep and superficial endotracheal suctioning in term of pain (50). However, pain behaviors and hemodynamic parameters examined through the effects of endotracheal suctioning and invasive procedures on hemodynamic parameters and pain behaviors in adult intensive care patients. The study reported that behavioral Pain Scale scores increased during the suctioning and invasive procedures compared to pre- suctioning(51) Pain assessment and management

are an important issue to ensure the comfort of patients in the intensive care unit, and reducing pain is an important nursing intervention. Therefore, it is important to evaluate pain correctly. For correct pain management, it is necessary to correctly determine the presence and severity of pain. So, clinical prospective study was conducted to determine whether endotracheal suctioning was painless and whether the Behavioral Pain Scale (BPS) was an accurate assessment tool to assess pain during endotracheal suctioning. The study showed that Endotracheal suctioning did not cause pain in conscious patients when the procedure was performed with the correct catheter in accordance with the guideline (52). 31 Due to the frequency and risks associated with endotracheal suctioning, there is a need to examine clinical practice critically and identify clinical research to guide practice. Correct technique and preparation by the clinicians can assist to reduce the risks of adverse events and the level of discomfort for the patients. So clinical trials conducted to investigate the effects of routine versus the minimally invasive endotracheal tube suctioning procedure on suction-related pain, airway clearance and airway trauma in patients who were intubated. The results of study mentioned a significant pain after routine suctioning (53).