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Postintubation hypotension in elective surgery patients: a retrospective study

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ABSTRACT

Objective. Postintubation hypotension (PIH) is a common and recognized adverse event associated with poor outcomes in emergency medicine patients requiring endotracheal intubation. Our objectives were to determine the incidence of PIH following tracheal intubation in elective surgery patients.
Materials and Methods. A retrospective study by reviewing the anesthesia records of all patients presenting for elective surgery requiring tracheal intubation between February 1, 2017, and March 1, 2017 was performed. Patients were divided into 2 groups according to the severity of the operation: Group S1 (major surgery) and Group S2 (minor surgery). The primary outcome measure was the incidence of PIH. PIH was claimed when systolic blood pressure (SBP) decreased below 90 mm Hg or decreased more than 20% from the baseline in two consecutive measurements at least 15 minutes after intubation. Secondary outcome measures included the relationship between PIH and anesthetic induction agents used to facilitate ETI and ASA physical status.
Results. A total of 291 elective surgery patients were identified. The primary outcome of PIH was observed in 10.3% with no difference between study groups (major surgery-10.2% vs. minor surgery-10.3%). Most of the patients who developed PIH were ASA II score (76.6%) and propofol was the most commonly used intravenous anesthetic associated with hypotension (96.7%).
Conclusion. Although a transient decrease in systolic and diastolic blood pressure has been reported in most patients undergoing intubation for elective surgery, development of PIH occured only in 10.3% of patients. Most of the patients who developed PIH were administered propofol.

Keywords: post-intubation hypotension, elective surgery, endotracheal intubation, adverse events

INTRODUCTION

In order to protect the airway and provide positive pressure ventilation, endotracheal intubation (ETI) is the most common method for patients undergoing a surgical procedure under general anesthesia. Laryngoscopy and ETI usually cause an increase in blood pressure (BP) by 20 to 25 mm Hg in the normotensive patients as a result of a sympathetic nervous system response to a potent stimulus (1, 2). However, most of the induction agents administered to facilitate intubation affect cardiac output and systemic vascular resistance which are the main determinants of the arterial blood pressure. Therefore, the cardiodepressive and vasodilatory effects of anesthetics in conjunction with positive pressure ventilation and other factors can lead to arterial hypotension after intubation known as postintubation hypotension (PIH) (2). PIH was defined in relation to the systolic blood pressure (SBP) just before intubation as a decrease in SBP below 90 mm Hg or a decrease of more than 20% from the baseline in two consecutive measurements at least 15 minutes after intubation.
In attempt to identify those patients who are likely to develop hemodynamic instability after intubation several studies were conducted (1, 3-6). The results suggested that an impairment of adaptive mechanisms usually able to maintain an adequate blood pressure, like in eldery patients, severely ill or patients with decreased intravascular volume can lead to PIH occurrence. Thus, this adverse event is most usually seen in the emergency patients for whom intubation is often a lifesaving procedure. Therefore, a focus group in the previous research about PIH were critically ill patients in the emergency department (ED) and intensive care unit (ICU) settings, as well as major trauma patients, all of which are typically unstable and physiologically fragile (1, 3-8, 10, 13-14, 16). Although these studies have found that PIH significantly impacts patient outcome and emphasized the importance of the PIH occurrence, there is little known about PIH in optimized patients during everyday surgery. The primary objective of this study was to determine the incidence of PIH in elective surgery patients. The secondary objective aimed to associate PIH with the medications used to facilitate ETI and ASA physical status.

MATERIALS AND METHODS

This is a retrospective study of patients who were intubated for elective surgery in the University Department for Anesthesiology, Resuscitation and Intensive Care of Clinical Hospital Sveti Duh, between February 1, 2017, and March 1, 2017. After the Institutional Ethical Committee approved the study, data were collected from the anesthesia records completed by the anesthesiologist or anesthesiology resident who also performed ETI. It is important to underline that every ETI was not protocol based but individualized to the needs of the patient and based on the experience and judgment of the anesthesiologist in charge. Inclusion criteria were all patients 18 years of age or older who required ETI for the surgery, regardless of the method of intubation. The sample size was dependent on the number of ETI

cases performed during the study period. From the surgery records, we obtained information on the type of the surgical procedure performed on each subject, and according to the severity of the operation, the patients were divided into 2 groups: Group S1 (major surgery such as abdominal and major urology procedure) and Group S2 (minor surgery as laparoscopic abdominal and gynecological procedures). The other data were collected from the anesthesia records: patient demographics (age, sex), preoperative evaluation of American Society of Anesthesiologists (ASA) physical status classification score (I-IV) and type of induction agent used. Systolic and diastolic blood pressure during the 30-minute period before and after intubation were also extracted from anesthesia records. Regarding blood pressure monitoring techniques, both invasive and non-invasive measurements where equally included. The primary outcome was the incidence of PIH defined as a decrease in systolic blood pressure below 90 mm Hg or a decrease of more than 20% from the baseline in two consecutive measurements at least 15 minutes after intubation compared with the SBP just before intubation. Secondary outcome measures included the relationship between PIH and anesthetic induction agents used to facilitate ETI as well as with ASA physical status.
Descriptive statistical analysis was performed for the patients' characteristics and the type of surgery according to the severity of the operation. We calculated absolute and relative frequencies (in percentage) to describe categorical data and mean ± standard deviation for continuous data.

RESULTS

During the study period between February 1, 2017, and March 1, 2017, a total of 291 elective surgery patients (168 females and 123 males, mean age 54.59±18.78 years) were identified. The demographic data of the two study groups are shown in Table 1. The number of patients that underwent minor surgical procedures was significantly higher (79.7%) compared to the number of patients that underwent major surgery (20.2%). Group S1 patients were older (61.76±13.83 vs. 52.80±19.47, p = 0.001) compared to Group S2 patients. The most commonly used intravenous anaesthetic in general anesthesia patients was propofol (71.8%). Both surgery groups were similar with the respect to medications administered. There were no significant differences in ASA physical status between groups, and most of the patients were ASA II status.
The primary outcome of PIH is shown in table 2. PIH was observed in 30 of 291 patients (10.3%) during the 30-minute period after ETI. There is no difference in the incidence of PIH regarding the type of the surgery (major surgery-10.2% vs. minor surgery-10.3%). Most of the patients that developed PIH were ASA II score (76.6%). Interestingly, only 2 patients evaluated as ASA III had a PIH incident. The medication that triggered PIH the most was propofol. Of the 30 patients that had PIH, 29 of them received propofol prior to ETI. Regarding the propofol-administered group, occurrence of propofol-induced hypotension was 13.7%. None of the patients after induction with etomidate experienced PIH.

DISCUSSION

In the literature a lot of attention has been given to the ETI associated adverse events regarding technical and mechanical complications of intubation, or physiological disturbances such as hypertension and desaturation (2). However, hemodynamic alteration is most commonly seen in the rapid sequence induction and intubation (RSII) is postintubation hypotension (1, 3). Several different authors reported poor outcomes of the ED patients after experiencing PIH. Their course of treatment usually results in extended ICU and hospital length of stay (3-7). Some of the reasons for prolonged hospitalization are acute myocardial infarction and renal dysfunction that are more likely to occur in patients who developed PIH (6, 8). Finally, the degree of importance of this reduction in blood pressure in the post-intubation phase in PIH is independently associated with in-hospital mortality (3-8).
Although primarily seen as a complication in emergency medicine patients, clinical experience suggests it is also frequent event in anesthesia practice (9). In the emergency setting, the range of PIH incidence is from 23% to 44%, but there is almost no information about its occurrence in elective surgery patients (8). In our study the incidence of PIH is 10.3% in patients requiring general anesthesia for the purpose of elective surgery. These data are similar with those from Griesdale et al, conducted in Canada, where severe hypotension occurred in 9.6 % of critically ill patients after intubation. However, in their study the SBP of less than 70 mm Hg was interpreted as PIH, which is quite lower than the BP values observed in our patients (3). Reviewing the literature, there is no general agreement on which is the criteria regarding the BP values for declaring PIH. Whereas some studies determine PIH as a SBP after intubation equal to or less than 90 mm Hg or 20% decrease in a SBP from a baseline, others take into account permissive hypotension regarding unstable trauma patients and uses SBP values as low as 80 mm Hg or less (8). While PIH is an entity that concerns a wide range of patients with different hemodynamic conditions, it is almost impossible to set a firm boundary, especially when it comes to cut-off values of SBP for standardizing the PIH definition.
Another questionable issue in the comparison with Griesdales' study is the difference in the patient population. Every manipulation performed in critically ill patients will presumably cause physiologic alterations that are bigger in magnitude, more numerous in occurrence and more poorly tolerated (1, 2). That assumption is confirmed by a different study conducted in the ICU setting from Green et al where an incident of PIH was recorded in almost a half of the patients requiring ETI (10). Considering that the subjects being observed are in a state of acid-base imbalance, cardiopulmonary deteriorated, having septic-induced hemodynamic alterations, hemorrhage, hypovolemia and other condictions requiring intensive care treatment, it is expected for them to have a high rate of PIH (2).
One of the few reports that has evaluated the incidence of PIH in relatively healthy patients undergoing general anesthesia found them also susceptible to develop clinically significant hypotension after intubation. Green et al while observing the vascular surgery patients recorded the occurrence of PIH to be 60.0%. The explanation for such a high incidence of PIH lies in these patients typically having atherosclerosis and a noncompliant vascular system that predispose them to various hemodynamic perturbations (9). The difference in the severity of patients' condition between studies can be assessed by the ASA status comparation. The ASA classification score, which is a commonly used index for quantifying the amount of physiological reserve that a patient possesses, provided us an insight in overall measure of patients' health (11). Patients in our study were predominantly ASA II score (62.5%) and therefore with a better health status compared to the aforementioned vascular study population where ASA III scores (58%) were most common. Regarding critically ill patients

Table 1. Characteristics of study population according to the procedure

	Overall	S1	S2	p
Patients, n (%)	291(100)	59 (20,3)	232 (79,7)	p = 0,001*
Age, mean ± SD	54,59±18,78	61,76±13,83	52,80±19,47	p = 0,098
Sex, n (%)				p = 0,010*
Female	168 (57,7)	25 (42,4)	143 (61,6)	
Male	**123 (42,3)**	**34 (57,6)**	**89 (38,4)**	
ASA, n (%)				
I	**58 (19,9)**	**7 (11,8)**	**51 (21,9)**	
II	**182 (62,5)**	**38 (64,5)**	**144 (62,2)**	
III	**50 (17,2)**	**14 (23,7)**	**36 (15,5)**	
IV	**1 (0,4)**	**0 (0,0)**	**1 (0,4)**	
Type of drug, n (%)				
Propofol	**209 (71,8)**	**44 (74,6)**	**165 (71,1)**	
Thiopental	**46 (16,5)**	**10 (16,9)**	**36 (15,5)**	
Etomidate	**36 (12,4)**	**5 (8,5)**	**31 (13,4)**	

S1-major surgery; S2-minor surgery. SD-standard deviation.
* p <0,05 is statistically significant
ASA-American Society of Anesthesiologists. ASA-I, healthy; ASA-II, mild systemic disease, no functional limits; ASA-III, severe systemic disease, functional limitations; ASA-IV, severe systemic disease, constant threat to life.

Table 2. Association between study population and postintubation hypotension

	PIH, n (%)	No PIH, n (%)
Type of surgery		
S1	6 (10,2)	53 (89,8)
S2	24 (10,3)	208 (89,7)
ASA, n (%)		
I	**5 (16,6)**	**53 (20,3)**
II	**23 (76,6)**	**159 (60,9)**
III	**2 (6,8)**	**48 (18,4)**
IV	**0 (0,0)**	**1 (0,4)**
Type of drug, n (%)		
Propofol	**29 (13,7)**	**180 (86,1)**
Thiopental	**1 (2,2)**	**45 (97,8)**
Etomidate	**0 (0,0)**	**36 (100,0)**

PIH-postintubation hypotension. S1-major surgery; S2-minor surgery.
ASA-American Society of Anesthesiologists. ASA-I, healthy; ASA-II, mild systemic disease, no functional limits; ASA-III, severe systemic disease, functional limitations; ASA-IV, severe systemic disease, constant threat to life.

with their poor physiologic reserve that could be understood as an ASA score of II or greater, hypothetically more PIH incidents would be expected with increased ASA score. However, our study as well as the other with general anesthesia patients (9), demonstrated that ASA level could not be used as a reliable tool to predict PIH occurrence. Although we found no difference in the incidence of PIH regarding extensiveness of the procedure, in the vascular research group major surgery such as abdominal aortic aneurysm repair, amputations, and embolectomy were associated with an increased probability of PIH occurrence when compared to minor vein stripping or soft tissue operations (9). The different type of surgery and the subsequent different type of patients in terms of diversity in comorbidities and severity of illness, possibly influenced the variability in results.

Although the exact pathophysiology of PIH remains unclear, it has consistently been associated with medications administered during intubation (4, 6-8). Hypotension is a well-described side-effect following propofol administration with an incidence varying from 6.7 to 35.5% in numerous previous studies (11). The mechanism of action which leads to a decrease in arterial blood pressure is explained by its activity at a cellular level as a calcium antagonist by reducing vascular tone, depressing myocardial contractility and inhibiting compensatory tachycardia (12). Our study confirmed this claim while almost all patients who developed PIH were given propofol for induction (96.7%).

However, there is an explanation for the entity of propofol-induced hypotension on which we can affect in the circumstances of everyday elective surgery patients. Bilotta et al conducted a study in which they hypothesized that hemodynamic changes induced by intravenous propofol are associated with the infusion rate (12). Their findings suggested that in low-risk non-premedicated patients, the degree of hypotension depended on the infusion rate and recommended lower propofol infusion rates for all patients regardless of the assessed preoperative risk.

Etomidate is the induction agent used in compromised patients at high risk because of its minimal cardiovascular effects. Its stable hemodynamic profile was also seen in our study where there was no incedence of PIH in the etomidate group of patients. Controversial results are found in the Glidewells research where the usage of etomidate significantly reduced the MAP in trauma patients (13). A plausible explanation is the differences in patient health status as well as our relatively small group that received etomidate for ETI. Another explanation could be good clinical judgment of our anesthesiologists on anticipating hemodynamic instability which led them to select etomidate as the induction agent.

Our study has several limitations including its relatively small sample size, retrospective design, and short-term follow-up. As a retrospective study of an existing dataset it is dependent on the availability of the information recorded and accuracy of data entry. Since the database is completed by the anesthesiologist in charge, they might have been subject to self-report and recall biases. Another important issue is premedication of patients including their blood pressure-lowering medication taken on the morning of the surgery. In our institution there is no standardized protocol for preoperative administration of antihypertensives and anxiolytics since we practice an individualized approach tailored to the patient needs. Moreover, variation in anesthetic technique and also the way of treatment of the hypotension in the peri-intubation phase are inevitable.

As several studies suggested that PIH is a transient phenomenon that resulted from the patients' underlying pathophysiological state (15-16), the aim of this research was to investigate whether PIH is a common event after intubation in scheduled and therefore optimized patients. Although the majority of patients had a drop in BP after intubation without clinical significance, it is important to emphasize that 10.3% of them had severe hypotension with prolonged duration and questionable impact on the outcome. Further research is required to address this question and establish the importance of PIH in patient safety.

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