

Effect of Preoperative Anxiety on Induction Haemodynamics in Adult Patients Undergoing Surgical Procedures Under General Anaesthesia

Original
Article

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ABSTRACT

Backgrounds: Preoperative anxiety leads to physiological as well as mental changes. Positive correlation has been found between preoperative anxiety and haemodynamic changes during induction of anaesthesia. In our study we used State Trait Anxiety Inventory(STAI®) to evaluate such correlation. Elevation of MAP and heart rate in pre-operatively anxious patients has been primary aspect of our study. Moreover, stress response to surgery stimulates gluconeogenesis, blood glucose levels in pre-operative anxiety patients have also been quantified. 40 patients under this prospective study were interviewed to fill out STAI® questionnaire 2 hours prior to surgery. Their vitals were noted after wheeling into OT, 5 minutes after securing i/v access, 5 minutes after fentanyl administration, prior to laryngoscopy, 1 minute after intubation, every 2 minutes thereafter, starting after 1 minute after intubation, for first 10min. Blood glucose levels were monitored during pre-operative period, 15 and 30 minutes after intubation.

Results: Of 43% male and 57% female population, females showed 1.5-fold higher STAI® scores than males, establishing positive correlation with percent changes in mean blood pressure and heart rate, during induction of anaesthesia. Overall, 40% patients exhibited high anxiety traits. Hemodynamic changes were quite significant prior to intubation, 1 minute after intubation. Furthermore, positive correlation was observed between state anxiety score and blood glucose levels after 15 and 30 minute of intubation.

Conclusions: Higher pre-operative anxiety levels are associated with more drastic changes in hemodynamic parameters and blood glucose levels. Conclusively, state anxiety score can be used as predictable entity for preoperative anxiety.

Key Words: Blood glucose levels, Haemodynamic changes, Preoperative anxiety, STAI®.

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BACKGROUND

An uneasy feeling of worry, apprehension, fear and tension is termed anxiety. It is a signal response of our body to observed physical or psychological threats that can have behavioural, emotional, cognitive, and physical symptoms^[1]. This emotional state of mind eventually stimulates neuroendocrine response which is associated with haemodynamic and metabolic effects^[2]. A major problem faced by patients undergoing surgical procedures is high levels of preoperative anxiety^[3]. In India, the prevalence of preoperative anxiety varies from 47% to 70.3% and could be the result of fear of unknown, fear of being sick and fear of death, wherein fear of the unknown correlates well with anxiety measuring techniques^[4-6].

Interestingly, levels of preoperative anxiety are variable in patients and can be the influence of several factors such as socio-demographical, psychosocial, anaesthesia, and

type of surgical procedure^[7]. Presently, numerous validated questionnaires are being used to get an idea about anxiety levels of patients. The focal point in assessment of the preoperative anxiety state was to develop a desirable questionnaire which was easy, fast and applicable for busy clinical practice. State-Trait Anxiety Inventory (STAI®) has been used to evaluate preoperative anxiety which has been approved by many researchers for its authenticity^[4].

Some patients are not able to tolerate physiological responses due to their preoperative anxiety levels which are evident by monitoring their haemodynamic parameters which often exhibit an increasing trend before or during surgery. We have assessed preoperative anxiety levels and its effects on induction haemodynamics in adult patients undergoing surgical procedures under general anaesthesia, to correlate the effects of pre-operative anxiety score,

as calculated by STAI[®], with induction haemodynamics (percentage changes in Heart Rate, Systolic Blood Pressure, Diastolic Blood Pressure, Mean Blood Pressure).

METHODS

The proposed study was carried out in the Department of Anaesthesia and Intensive Care in a tertiary care Hospital, New Delhi, India, after obtaining clearance from the Institute Ethics Committee (IEC), New Delhi, India on 12/11/2020 and the trial was registered prior to patient enrollment at CTRI registration REF/2021/03/041516, Date of registration: 18 March 2021. This was a Prospective Observational Cohort Study with a sample size of 40 patients conducted from 01st April 2021 to 31st May 2022. Written informed consent was obtained from all subjects.

Adult patients, 18-65 years old, of either sex, ASA Grade I/ II undergoing routine surgical procedures under general anaesthesia with endotracheal intubation giving valid informed consent were recruited for the study.

The following patients were excluded: those with psychiatric illness, treatment with anti-depressants and anxiolytics, on sedative medication or analgesics, neurologic illness, pregnant subjects, anticipated difficult airway, cardiac, renal, hepatic and respiratory co-morbidities, endocrine disorders such as Diabetes Mellitus, thyroid disorders etc..

The study by Kim *et al.*,^[8] observed a positive correlation between trait anxiety and percentage change in Mean Blood Pressure ($r=.476$). Taking this value as reference, the minimum required sample size with 80% power of study and 5% level of significance is 32 patients. To reduce margin of error, total sample size taken was 40 patients.

Methodology Flow Chart:

PAC done

Premedication - tab Alprazolam 0.5mg given at 10pm night prior to surgery in the ward STAI[®] was in the morning 2 hours prior to surgery.
Vital parameters (HR, NIBP, SpO₂) and blood glucose levels noted in preoperative room.

Patient wheeled into OT.
Monitors attached and baseline vital parameters noted.

Intravenous line secured.
Vital parameters recorded 5 minutes later along with the blood glucose level.

Pre-oxygenation performed for 3 minutes with 100% O₂.

Inj Fentanyl 2mcg/kg administered over 30 seconds.
Vital parameters recorded after 5 minutes.

Induction with inj Thiopentone sodium (5mg/kg) done. After loss of eyelash reflex, inj Rocuronium bromide (0.9mg/kg) given.

IPPV using closed circuit ventilation performed for two minutes using O₂+N₂O.
(1:1) at 6L/minute with Sevoflurane (2%) (MAC= 1.0).

Endotracheal intubation performed, air entry checked, EtCO₂ waveform observed, ET secured.
Vital parameters recorded.

IPPV continued using closed circuit ventilation with N₂O+O₂ (1:1) and Sevoflurane.
Vital parameters recorded at 1, 2, 4, 6, 8 and 10 minutes after intubation.
During this period no maneuvers like RT insertion, cleaning draping and positioning were done.

After 10 minutes of observation surgery started.
Blood glucose levels at 15 and 30 minutes postintubation noted during intraoperative period (Figure 1).

RESULTS

The present study was conducted on 40 patients, 17 males (42.5%) and 23 females (57.5%), respectively. Average age of both male and female patients was observed to be around 35 years falling under young patient category (Table 1, Figure 2).

Table (2) shows the State and Trait Anxiety Inventory[®] Score of patients based on gender. STAI[®]-S score was observed to be higher in females in comparison to males by 1.5 fold. Since the patients in our study were devoid of trait anxiety, STAI[®]-T scores were similar among both genders (Table 3).

Table 1: Distribution of gender and age:

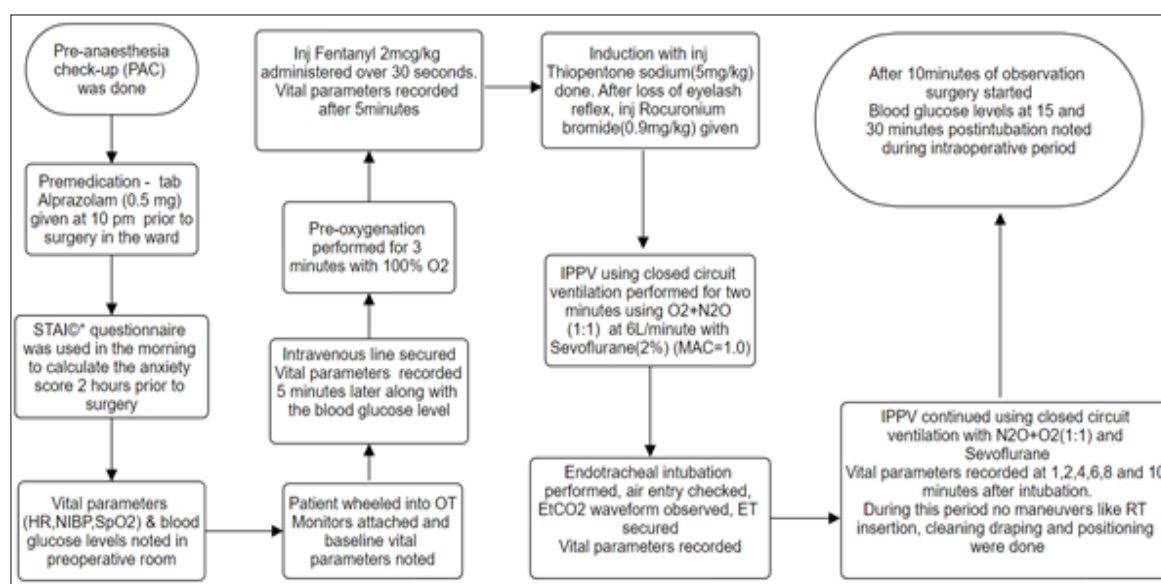
Gender	Frequency	Mean Age (years)	Range (Median)
Male	17	35.06±11.86	18-56(32)
Female	23	34.13±9.61	18-55(34)
Total	40	34.52±10.49	18-56(33)

Independent *t*-test, *p*-value= 0.786.

Upon analyzing the data by total patient group, it was noted that whilst 100% patient population in our study reported low trait anxiety, the proportion for state anxiety was found to be variable. 30% of total tested patients reported low anxiety, 30% showcased moderate anxiety and high anxiety was observed in 40% of the patients.

In order to assess the effect of pre-operative anxiety, haemodynamic parameters such as Heart Rate (HR), Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), SpO₂ before and after the surgical procedure were recorded.

A gradual increase in HR, SBP and DBP, MAP was observed until 5min after securing the IV line. However, a sharp drop in these levels was observed prior to intubation, followed by elevation in these values 1 minute after intubation which further started to stabilize by 7 minutes after intubation. Figure (1) depicts the changing trend of hemodynamic parameters.

**Fig. 1:** The research methodology.

HR: Heart Rate; NIBP: Non-Invasive Blood Pressure; IPPV: Intermittent Positive Pressure Ventilation; RT: Ryles Tube; ET: Endotracheal Tube; EtCO₂: End Tidal Carbon-di-oxide, MAC: Minimum Alveolar Concentration.

Pearson's Correlation Coefficient(*r*) depicted a strong correlation between state anxiety score and HR (*r*= 0.79), SBP(*r*= 0.695) and DBP (*r*= 0.395), MAP (*r*= 0.449), once the patient was wheeled into the OT (Table 2).

Over a period of time studies have been conducted to examine the relationship between stress and blood glucose levels in surgical conditions. In our study, there was a marginal elevation in the blood glucose levels upon securing an IV line. However, a steep rise (1.25 fold) was observed 15 minutes after intubation further followed by another mild elevation at 30 minutes (after intubation) as represented in Figure (2).

In comparison to baseline values, glucose levels were observed to be elevated by 2.8% after 5 minutes of securing an IV line, by 28% after 15 minutes of intubation and by 35% after 30 minutes of intubation.

A positive correlation was observed between state anxiety and blood glucose levels after 15 minutes and

30min of intubating the patients providing *r* values of 0.319 and 0.232, respectively. Although, no such correlation was observed in comparing trait score and mean change in blood glucose levels (Table 3, Figure 3).

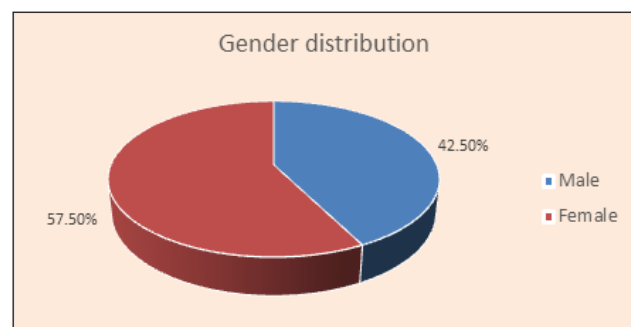
A 20% change in haemodynamic parameters is considered to be highly significant. In the present study, major changes were observed in HR values in comparison to other studied parameters. 28% patients showed these HR changes after wheeling into the OT (Table 4). This variation of 20% was observed in 30% patients (5 minutes after securing an IV line), in 20% patients (prior to intubation), 22.5% and 15% (1 minutes and 2 minutes after intubation) respectively depicted in Figures (4, 5).

Interestingly, 87% patients reported a 20% change in blood glucose levels at 15 minutes after intubation while 93% reported this change 30 minutes after intubation respectively. However none of the patients showed any change after 5 minutes of securing IV access (Tables 5-7, Figure 6).

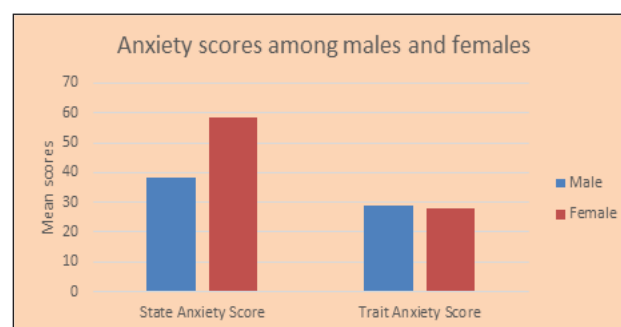
Table 2: State and Trait anxiety scores with gender distribution:

Anxiety score	Male (n= 17)	Female (n= 23)	Overall
State	38.24±6.18	58.30±20.43	49.77±18.76
Trait	28.94±4.10	27.87±4.03	28.33±4.04

Independent *t*-test, *p*-value= <0.001 (State), 0.414 (Trait).

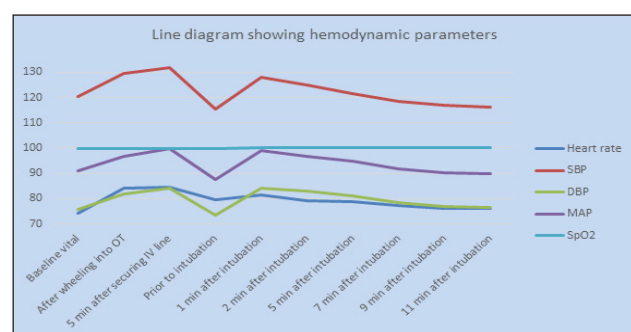
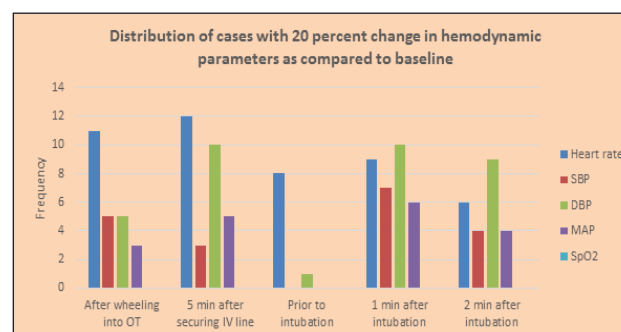
**Fig. 2:** Pie chart showing distribution of gender in the study.**Table 3:** Classification of STAI® scores:

Anxiety classification	State Anxiety	Trait Anxiety
No/Low anxiety	12(30%)	40(100%)
Moderate Anxiety	12(30%)	0
High Anxiety	16(40%)	0

**Fig. 3:** Bar diagram showing Anxiety scores among male and female gender.**Table 4:** Correlation coefficient of State Anxiety scores with % mean change in haemodynamic parameters:

% Change from baseline	Heart rate	SBP	DBP	MAP	SpO ₂
After wheeling into OT	0.793*	0.695*	0.395*	0.449*	0.008
5min after securing IV line	0.517*	0.667*	0.349*	0.467*	-0.021
Prior to intubation	0.432*	0.328*	0.203	0.251	-0.150
1min after intubation	0.253	0.059	-0.080	-0.103	-0.032
2min after intubation	0.237	0.036	0.053	0.002	-0.032
5min after intubation	0.260	0.173	0.045	0.052	-0.032
7min after intubation	0.113	0.144	-0.031	-0.017	-0.032
9min after intubation	0.089	0.152	-0.038	-0.020	-0.032
11min after intubation	0.098	0.123	-0.050	-0.049	-0.032

Pearson's correlation coefficient, *p*-value= <0.05.

**Fig. 4:** Line diagram showing trends of hemodynamic parameters before and after intubation.**Fig. 5:** Bar diagram showing distribution of cases with 20% change in hemodynamic parameters as compared to baseline.**Table 5:** Blood glucose parameters before and during surgical procedure:

Timing of glucose reading	Mean±SD(mg/dl)	Range(mg/dl)
Pre-operative area	103.78±10.58	83-138
5 minutes after securing IV line	106.70±10.91	85-140
15 minutes after intubation	132.25±11.52	112-170
30 minutes after intubation	139.25±13.81	114-178

Table 6: Mean percent change in blood glucose as compared to baseline:

Measurement of glucose level	% mean change
5 minutes after securing IV line	2.83
15 minutes after intubation	27.86
30 minutes after intubation	34.55

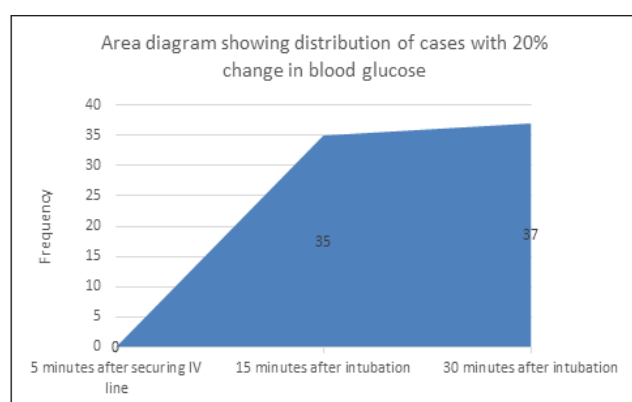


Fig. 6: Area diagram showing cases with 20% change in blood glucose levels from the baseline.

Table 7: Correlation coefficient of State and Trait Anxiety scores with % mean change in blood glucose:

Measurement of glucose level	State Anxiety score	Trait Anxiety score
5 minutes after securing I/V line	-0.146	-0.067
15 minutes after intubation	0.319	-0.268
30 minutes after intubation	0.232	-0.249

Pearson's correlation coefficient.

DISCUSSION

Surgery is a significant and life changing factor for many patients affecting their physical, personal, professional and economic lives dramatically. It also affect one's mental health causing pre-operative anxiety further leading to impactful physiological changes, hence causing anxiety.

In the present study, STAI® scale was used to assess the anxiety levels. State and trait anxiety scores were 49.77 and 28.33 respectively, reporting high state anxiety and low trait anxiety.

Our results indicated that patients with high anxiety levels showed a significant increase in MAP and HR values upon arrival in OT. This elevation was observed 1 minute after intubation as well. Also low anxiety patients revealed mild increase in HR, SBP, DBP and MAP values. Our study corroborates well with the findings of Muhiddin *et al.*, thereby concluding high preoperative anxiety increases the HR, SBP, DBP and MAP of the patient upon wheeling into the OT, while decreased preoperative anxiety leads to stable intraoperative haemodynamic status of patients during surgery^[9]. The major fall observed prior to intubation is as a result of induction agents playing their functional role in modulating the haemodynamic response^[10]. A major increase in HR, SBP and DBP values 1 minute after intubation is a consequence of the sympathoadrenal response to laryngoscope and endotracheal intubation which produces haemodynamic fluctuations^[10].

According to our study, there is a positive correlation of state anxiety with haemodynamic parameters with $p < 0.05$ which corroborates well with the study done by Kim *et al.*,^[8] wherein high preoperative anxiety has a significant association with changes in MAP and HR during anaesthesia induction. Moreover, the findings of our study are similar to that done by Raocharernporn *et al.*, who observed a significant increment in BP and HR values before the surgical procedure^[11]. Our study findings are in contradiction to the study by Goulart *et al.*, where no significant influence of anxiety was observed on hemodynamic parameters during dental treatment^[12]. The plausible explanation could be the type of surgery. Since severity of complications are less in case of dental surgeries in comparison to other surgical procedures and the administration of general anaesthetics. This would result in lesser fluctuations in haemodynamic parameters.

Our study had a mean age group of around 35 years, out of which 60% of the tested patients were found to have moderate to high state anxiety score. These anxiety scores have been linked to higher HR values since catecholamines are known to increase HR more commonly in the younger age group. According to Bullington *et al.*, hemodynamic responses due to tracheal intubation are observed to be highly significant in subjects aged between 35-50 yrs^[13]. According to Sun *et al.*, patients aged 40 years and below had an increased prevalence of pre-operative anxiety^[14]. In subjects aged 35 years and above, changes in haemodynamic parameters and state anxiety was statistically significant thereby signifying that surgical events can show state anxiety unlike trait anxiety strongly correlating with haemodynamic changes.

Studies have indicated that females showcase higher preoperative anxiety. In the present study, females showed higher mean STAI® score than males. However, there was no difference between the genders with respect to haemodynamic changes. This could be because there was no difference between genders in levels of anxiety.

Surgery being an alarming situation for the body gives rise to stress response which is characterized by increased pituitary hormone secretion and activation of sympathetic nervous system^[15]. The ultimate effect of which is increased catabolic activity by increased production of catabolic hormones like cortisol and glucagon. These endocrine and metabolic changes lead to increased gluconeogenesis and hyperglycemia. We observed a significant rise in blood glucose levels in 87% of patients 15 minutes after intubation. This rise can be attributed to the sympatho-adrenal response to laryngoscopy and endotracheal intubation resulting from catecholamine secretion^[15]. This influences insulin and glucagon levels, which are intimately associated with blood glucose regulation. Furthermore, an increase in glucose levels after 30 minutes can be attributed to the surgical stimulus altering the bodily response with respect to blood glucose levels.

CONCLUSION

The current study highlights the relationship between patients preoperative anxiety and haemodynamic parameters before and after intubation, and observed that state anxiety is a predictor of haemodynamic responses. Earlier studies had focused on anaesthetic maintenance for quantification of variations in haemodynamic parameters. However, our study focused on anaesthetic induction period wherein variations in haemodynamic parameters have been observed to be at the greatest extent. Also, we have observed that in order to predict haemodynamic responses, state anxiety is more useful than trait anxiety.

Our study would have assumed greater significance if we had continued to evaluate the stress response throughout the intraoperative period till the early post-operative period wherein pain scores and analgesic requirements would have led to more elaborate results. Furthermore, study of blood sugar, serum Cortisol and Catecholamine levels simultaneously would have also led to greater credence to our study.

Due to the Covid-19 pandemic, during the period of our study, and observation of Covid safety protocols, this led to limitations in our study design.

LIST OF ABBREVIATIONS

MAP: Mean arterial pressure; **DBP:** Diastolic blood pressure; **HR:** Heart rate; **ASA:** American society of Anesthesiologists; **STAI®:** State and Trait Anxiety Inventory® Score.

CONFLICT OF INTERESTS

There are no conflicts of interest.

REFERENCES

1. Videbeck S. Psychiatric-mental health nursing, 3rd Edn. (2013). Lippincott Williams and Wilkins.
2. Ahmetovic-Djug J, Hasukic S, Djug H, Hasukic B, Jahic A. Impact of Preoperative Anxiety in Patients on Hemodynamic Changes and a Dose of Anesthetic During Induction of Anesthesia. *Med Arch*. 2017 ;71:330.
3. Sigdel S. Perioperative anxiety. *Glob Anesth Perioper Med*. 2015; 1: 2.
4. Saini S, Dayal M. Preoperative anxiety in Indian surgical patients-experience of a single unit. *Indian J Appl Res*. 2016; 6; 476-9.
5. Bansal T, Joon A. A comparative study to assess preoperative anxiety in obstetric patients undergoing elective or emergency cesarean section. *Anaes Pain Int Care*, 2017;21: 25-30.
6. Vadhanan P, Tripaty DK, Balakrishnan K. Pre-operative anxiety amongst patients in a tertiary care hospital in India-a prevalence study. *JSAN*. 2017; 4: 5-10.
7. Yilmaz Inal F, Yilmaz Camgoz Y, Daskaya H, Kocoglu H. The Effect of Preoperative Anxiety and Pain Sensitivity on Preoperative Hemodynamics, Propofol Consumption, and Postoperative Recovery and Pain in Endoscopic Ultrasonography. *Pain Ther*. 2021;10:1283-93.
8. Kim WS, Byeon GJ, Song BJ, Lee HJ. Availability of preoperative anesthesia. *Kor J Anesth*. 2010; 58 :328-33.
9. Tadesse M, Ahmed S, Regassa T, Girma T, Hailu S, Mohammed A, Mohammed S. Effect of preoperative anxiety on postoperative pain on patients undergoing elective surgery: Prospective cohort study. *Ann Med Surg (Lond)*. 2021;73:103190.
10. Kanchi M, Nair HC, Banakal S, Murthy K, Murugesan C. Haemodynamic response to endotracheal intubation in coronary artery disease: Direct versus video laryngoscopy. *Indian J Anaesth*. 2011;55:260-5.
11. Raocharernporn S, Boonsiriseth K, Khanijou M, Wongsirichat N. Hemodynamic changes and pain perception-related anxiety after experiencing an impacted-tooth removal: clinical practice outcome. *J Dent Anesth Pain Med*. 2017;17:105-11.
12. Goulart JCF, Pinheiro MD, Rodrigues RV, Scannavino F. Influence of anxiety on blood pressure and heart rate during dental treatment. *Rev Odonto Cienc*. 2012;27:31-5.
13. Bullington J, Mouton Perry SM, Rigby J, Pinkerton M, Rogers D. The effect of advancing age on the sympathetic response to laryngoscopy and tracheal intubation. *Anesth Analg*. 1989 ;68:603-8.
14. Sun GC, Hsu MC, Chia YY, Chen PY, Shaw FZ. Effects of age and gender on intravenous midazolam premedication: a randomized double-blind study. *Br J Anaesth*. 2008; 101:632-9.
15. Reddy GV, Rao M. The study of blood glucose level changes during general anesthesia in patients undergoing surgery. *Int Arch Integer Med*. 2017; 4:110-5.