

# Comparison Of Transversus Abdominis Plan Block And Quadratus Lumborum Block For Postoperative Pain Control Following Laparoscopic Cholecystectomy

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## Research article

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# Abstract

**BACKGROUND** To compare Quadratus Lumborum Block (QLB) and Transversus Abdominis Plane (TAP) blocks for postoperative pain control following laparoscopic cholecystectomy. **Study and Design** Prospective randomized head-to-head clinical trial. **Methods** A total of 60 patients who were set to undergo elective laparoscopic cholecystectomy were randomly separated into two groups. QLB was preoperatively applied to 30 patients and TAP block was also applied to 30 patients. A record was made of the intraoperative additional fentanyl dose, and at postoperative 0-1-2-4-6-12-24 hours, records were made of cumulative morphine consumption, number of morphine requests, VAS values, shoulder pain, heartrate, systolic and diastolic blood pressure, SpO<sub>2</sub>, sedation score (Ramsey scale), itching, nausea and vomiting, respiratory depression, and other complications. **Results** In the examination of intraoperative additional fentanyl use, there was no requirement for additional fentanyl in 86.7% of the QLB group, while in 60% of the TAP group, there was seen to be at least one dose of additional fentanyl required. At all timepoints between 0 and 24 hours postoperatively, the cumulative morphine requests and morphine consumption values were significantly lower in the QLB group than in the TAP group. No statistically significant difference was determined between the groups with respect to nausea, vomiting, sedation, and itching as morphine-related side effects. **Conclusion** Morphine consumption was significantly lower in patients who underwent QLB procedure at 6, 12, 24, and 48 hours compared to the TAP group. In general, effective analgesia was provided by both methods, but more effective analgesia was determined to have been provided in the QLB group compared to the TAP group, and thus QLB can be preferable to TAP.

## Background

Laparoscopic cholecystectomy is a frequently applied operation. Compared to open cholecystectomy, it creates less surgical trauma and allows for more rapid recovery. However, following laparoscopic surgery, most patients have severe abdominal and shoulder pain and require strong analgesia in the early postoperative period (1, 2). The reasons for pain include the incision, visceral pain associated with the peritoneal irritation of carbon dioxide gas absorbed within the abdomen, and shoulder pain associated with diaphragmatic peritoneum irritation (3–6). At a lower rate, parietal type abdominal pain may be experienced due to the entry sites of the trocars in the abdominal wall (7). Although opioids provide strong analgesia in postoperative pain treatment, there may be side effects such as sedation, respiratory depression, nausea, vomiting and gastrointestinal ileus (5).

Abdominal wall blocks have started to be frequently applied as part of multimodal analgesia for pain control following abdominal surgery (8). TAP block can be used in procedures such as colostomy (9), laparoscopic cholecystectomy (10–15), caesarean sections (16–19), appendectomy (20, 21), abdominal hysterectomy (22, 23), colorectal surgery (24–27), hernia repair (28), prostatectomy (29), and abdominal surgical interventions (30, 31). QLB is a new regional anesthesia technique that is applied under ultrasound guidance for postoperative pain management in abdominal surgery and hip operations (32). In cadaver and voluntary studies related to QLB, distribution of a local anesthetic has been seen in the

thoracolumbar paravertebral area, and it is thought that it could provide effective analgesia following abdominal surgery (33–35).

The aim of this study is to compare QLB and TAP block for postoperative pain control following laparoscopic cholecystectomy. The primary aim is to compare the postoperative morphine requests and consumption of the patients applied with preoperative QLB and TAP block, and the secondary aim is to compare the VAS values and side effects related to morphine consumption.

As a result of the power analysis conducted for Independent Sample T Test, the required sample with was determined as at least 60 individuals in total. In this case, the power of the test was approximately 80.22%. (Reviewer 1) Alpha error (p value) was considered as  $p < 0.05$ . (Reviewer)

## Methods

Approval for the study was granted by the Clinical Research Ethics Committee (decision no: 2012-KAEK-15/1539, dated:25.10.2017). The study included 60 patients of the American Society of Anesthesiologists (ASA), scored 1-2-3, who underwent elective laparoscopic cholecystectomy. The patients were separated into two groups of QLB and TAP, using the block randomization method. Informed consent was obtained from all the patients.

The patients included in the study did not have opioid use (Reviewer )  
Each groups (group 1 and 2) includes 30 patients. (Reviewer )

At one hour preoperatively, the patients were admitted to the block room. ECG, non-invasive blood pressure (NIBP), and SpO<sub>2</sub> monitorization were applied and an IV access route was opened. Premedication of 0.3 mg/kg midazolam was administered by IV to the patients preoperatively. The block sealed envelope was given by the research coordinator to the anesthetist, who was to apply the block and who was blinded to the study. QLB or TAP block was applied according to the randomized groups.

TAP blocks were performed in the supine position and the QLB block was performed in the lateral decubitus position but the doctor who evaluated the data did not know what method (Reviewer 1)

The volunteer code, age, gender, BMI, and ASA score of the patients were recorded. The duration of the block, number of additional fentanyl doses intraoperatively and at postoperative 0-1-2-4-6-12-24 hours, total PCA morphine consumption, number of requests for morphine, VAS values, shoulder pain, heartrate, systolic and diastolic blood pressure, SpO<sub>2</sub>, sedation score (Ramsey scale), itching, nausea and vomiting, respiratory depression, and other complications were also recorded.

TAP block was applied to patients in Group 1. With the patient in a supine position, the area where the procedure was to be applied was cleaned with surgical solution. A linear USG probe was placed transversely over the iliac crest. The probe was then directed cranially until the three abdominal muscles—namely, the external oblique muscle, internal oblique muscle, and transversus abdominis muscle—could be clearly identified. Using the *in-plane* technique, a 21-gauge 100 mm needle was advanced from medial

to lateral. An injection of 20 ml 0.25% bupivacaine, which is used routinely in regional blocks, was made between the fascia of the internal oblique muscle and the transversus abdominis muscle (lateral TAP block). The same procedure was repeated on the other side.

QLB was applied to the patients in Group 2. With the patient in the lateral decubitus position, the area where the procedure was to be applied was cleaned with surgical solution. A linear USG probe was placed transversely over the iliac crest. There was no complications about using USG. (Reviewer )

The probe was then directed cranially until the three abdominal muscles—namely, the external oblique muscle, internal oblique muscle, and transversus abdominis muscle—could be clearly identified. The USG probe was then directed to the posterior of the muscle until the QL muscle could be clearly seen after the internal oblique muscle. The QL muscle, the psoas major muscle in the anterior, and the transverse process were visualized. Using the in-plane technique, a 21-gauge 100 mm needle was advanced from the posterolateral to the anteromedial. Passing the fascia on the anterior surface of the QL muscle, an injection of 20 ml 0.25% bupivacaine, which is used routinely in regional blocks, was made between the QL muscle and the psoas major muscle (anterior QLB/transmuscular QLB). The same procedure was repeated on the other side.

The duration of the procedure for each block was recorded, and at 30 mins. after the procedure was completed, the patient was transferred to the operating room. General anesthesia (2–3 mg/kg propofol, 1 cg/kg fentanyl, 0.6 mg/kg rocuronium) was applied with the standard procedure.

From the restricted randomization methods, the permuted block randomization method was applied for the grouping of the patients. Each patient was assigned a number from 1–60. With a block size of six, with three cases and three controls in each block, the patients were separated into 20 blocks by calculating three permutations of the six.

The study was designed as a double-blind study. Accordingly, the patients were unaware of which block was to be applied (patient blind). A statistics specialist who was not involved in the research applied the patient randomization using the permuted block randomization method and wrote which block was to be applied inside envelopes numbered from 1 to 60. The sealed envelopes were given to a designated researcher immediately before the procedure (researcher blind). This researcher applied the block that was written in the envelope without stating which one it was. After completion of the block procedure, another researcher who was unaware of which block had been applied recorded the intraoperative and postoperative monitorization values and made the evaluations (evaluating assistant researcher blind).

The dose of fentanyl was applied when the patient's arterial blood pressure %20 increased. (Reviewer)

As a result of the power analysis applied for the Independent Samples t-test using the PASS 11 software (power and sample size, version 11, for Windows), the total sample size required was determined to be at least 60 subjects. The power of the test in this situation was approximately 80.22%.

The data obtained in the study were analyzed using IBM SPSS version 24.0 software (IBM Corporation, Armonk, NY, USA). Descriptive statistics were stated as mean  $\pm$  standard deviation (SD), minimum, maximum, median, number (n), and percentage (%) values. Conformity of continuous variables to normal distribution was evaluated first with the Kolmogorov–Smirnov Goodness of Fit test. In the comparison between two groups, the t-test was applied to variables with normal distribution and the Mann–Whitney U test to those not showing normal distribution. In the intragroup comparisons, as the data did not conform to normal distribution in the Kolmogorov–Smirnov Goodness of Fit test, analyses of repeated measurements after the block application were made with the Friedman test. The Wilcoxon signed-rank test was applied to determine which group the difference originated from.

## Results

When the intraoperative mean arterial blood pressure (MAP) values were examined, the preoperative values were almost all equal, and at all the timepoints between 15 and 60 mins. intraoperatively, the MAP values in the TAP group were higher than those of the QLB group, but not to a statistically significant level ( $p > 0.05$ ).

TAP block was routinely used with our clinic, we considered it as a control group because of conventional methods, the pain was not relieved already (Reviewer 1)

VAS values shift up and down over time: The differentiation of patients education levels effects on their pain threshold.

The principal of PCA, morfine releases within a fixed time (in this study it is 20 minutes). Even if the patient demands to get more morfine, the device prevents in order to overdose. That is the reason of the diffrence between demands and useage.

## Discussion

The TAP block was first described by Rafi (36) in 2001 and by McDonnell et al. in 2004 as an area block based on anatomic location in abdominal surgery operations. Hebbard et al. (37) later described the TAP block approach as applied under USG guidance. TAP block is often used to provide postoperative analgesia in abdominal surgery. However, despite being effective in parietal pain, TAP block's insufficiency in visceral pain suggests that it does not provide adequate analgesia following abdominal surgery interventions. Nevertheless, the results of the current study showed that TAP block applied under USG guidance was effective on postoperative pain.

The QLB block was first described by R. Blanco as a posterolateral, abdominal local anesthetic injection to the anterolateral part of the QL muscle (type 1 QLB) (38). Then in 2013, J. Borglum et al. developed the QLB technique by injecting local anesthetic into the anterior surface of the QL muscle with a posterior transmuscular approach, taking the musculus erector spina, QL, PM, and L4 transverse process as references (39). In 2014, R. Blanco injected the local anesthetic in a more superficial plane to the posterior

section of the QL muscle, and QLB was thus defined as a safe method with fewer intraabdominal complications and less lumbar plexus damage (type II QLB) (40). In the current study, QLB was applied under USG guidance to the anterior surface of the QL muscle with a posterior transmuscular approach.

Hansen et al. reported that injections made to the interfascial area between the QL and PM muscles with a transmuscular QLB approach prevented the risk of unwanted penetration to the peritoneal cavity (41). In the current study, transmuscular QLB was applied and no peritoneal cavity penetration was encountered in any patient.

In a study by Murouchi, QLB was shown to provide longer-lasting and more widespread analgesia in laparoscopic ovarian surgery, and a 150 mg ropivacaine injection caused lower peak arterial ropivacaine concentrations compared to lateral TAP block (42). This demonstrated that QLB was a safer block than TAP when considering local anesthesia toxicity. In the current study, bupivacaine was used as the local anesthetic, but peak arterial local anesthetic concentrations were not examined. Nevertheless, local anesthesia toxicity was not observed in any of the patients applied with QLB or TAP block.

While the lateral TAP technique was preferred with considering that there could be pain in the trocar entry sites and below the umbilicus associated with carbon dioxide insufflation, the transmuscular QLB technique was selected because of the paravertebral spread in abdominal surgery, the lower risk of intra-abdominal complications, and the more extensive provision of analgesia to the dermatomes.

## Conclusion

In conclusion, the results of this study demonstrated that both QLB and TAP block are effective in postoperative pain control following laparoscopic cholecystectomy. However, compared to TAP block, QLB provided more effective postoperative analgesia, as there was a lower demand for morphine and less morphine consumption at all timepoints.

## Declarations

Ethics approval and consent to participate: Approval for the study was granted by the Clinical Research Ethics Committee (decision no: 2012-KAEK-15/1539, dated:25.10.2017).

Clinical Trials Number: NCT03112915

Consent for publication: Not applicable

Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

Funding: Not applicable

Authors' contributions: MK executed the study. HG organised the study. BK was there for the analysis part. SI subclassified the study. EH did the final recheck. All authors read and approved the final manuscript.

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Status: The study has been complicated.

This study adheres consort guidelines.

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## Figures

	QLB (n=30)	TAP (n=30)	p
<b>Additional Fentanyl Dosage</b>			
0	26 (86,7)	12 (40,0)	0.001*
1	4 (13,3)	17 (56,7)	
2	0 (0,0)	1 (3,3)	
<b>Total</b>	30 (100,0)	30 (100,0)	

\* Chi-Square Test

Figure 1

Comparison of Intraoperative Additional Fentanyl Dosage

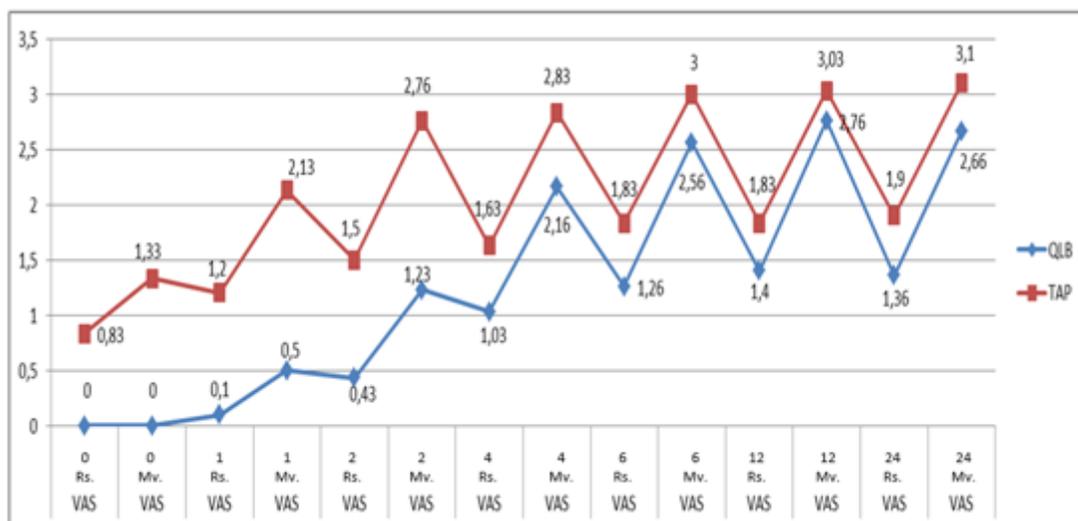


Figure 2

Postoperative Visual Analog Scale

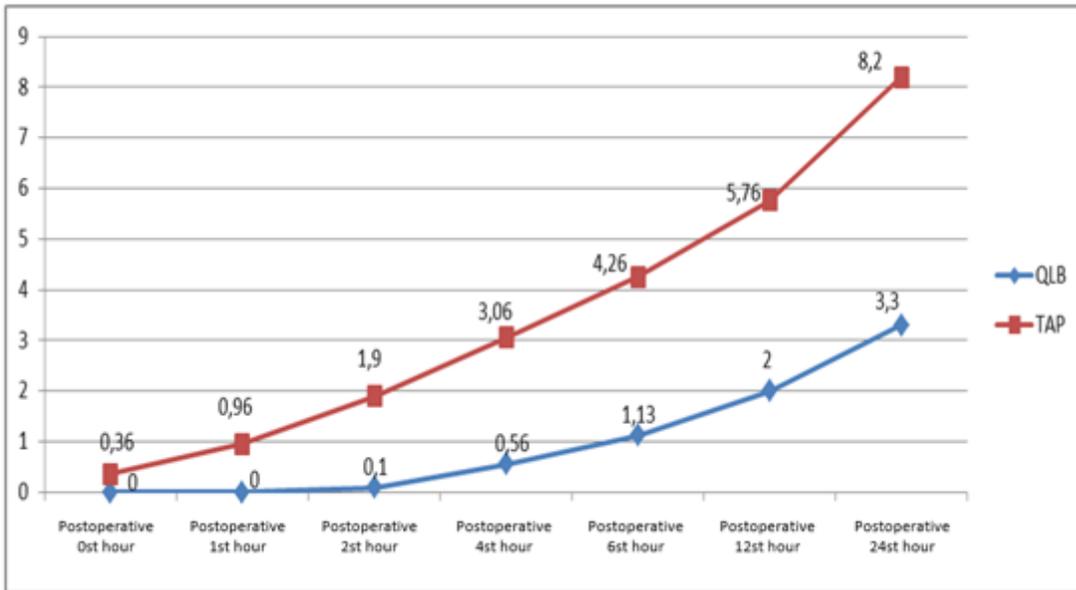


Figure 3

Postoperative Morphine Demand

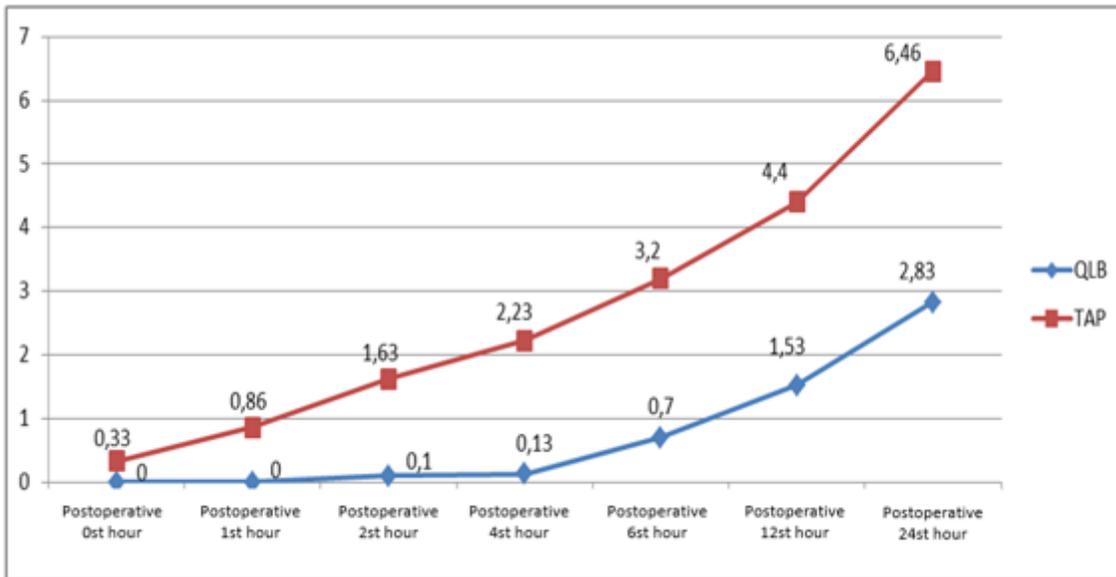
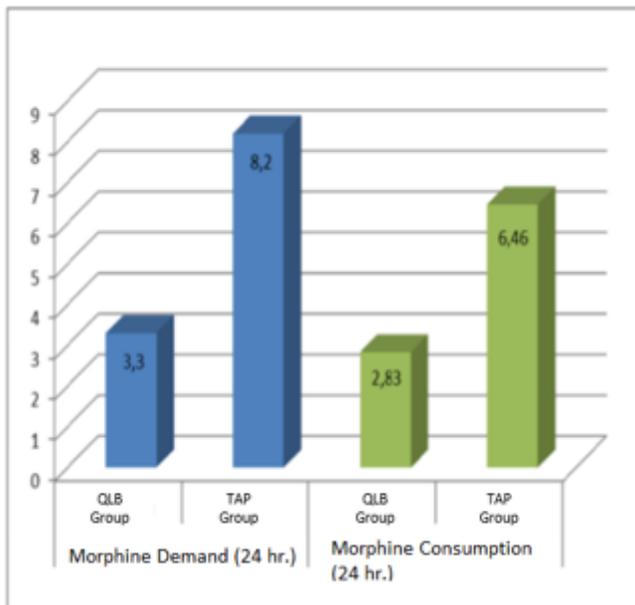


Figure 4

Postoperative Morphine Consumption



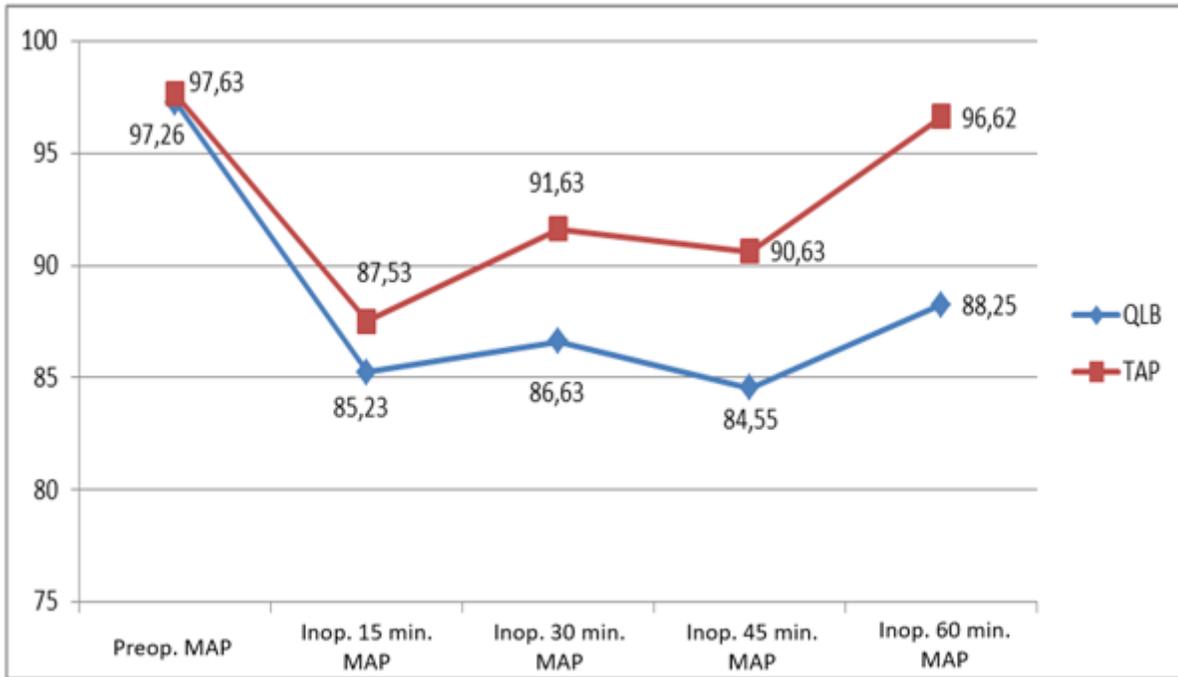
**Figure 5**

24-hour Total Morphine Demand and Consumption Average

	QLB (n=30)	TAP (n=30)	p
Age (Mean±Ss)	48,36±12,93	50,96±11,98	0.481*
Gender (F/M)	22/8	20/10	0.573**
BMI (Mean±Ss)	29,40±3,37	29,06±2,43	0.388*
ASA (I/II/III)	13/14/3	11/19/-	0.141**
Presence of add disease			0.723**
None (n/%)	17 (56,7)	16 (53,3)	
HT (n/%)	6 (20,0)	8 (26,7)	
Asthma (n/%)	1 (3,3)	2 (6,7)	
DM (n/%)	0 (0,0)	1 (3,3)	
DM+HT (n/%)	3 (10,0)	2 (6,7)	
Other (n/%)	3 (10,0)	1 (3,3)	
<b>Total</b>	<b>30 (100,0)</b>	<b>30 (100,0)</b>	
* Mann Whitney U Test			
** Chi-Square Test			

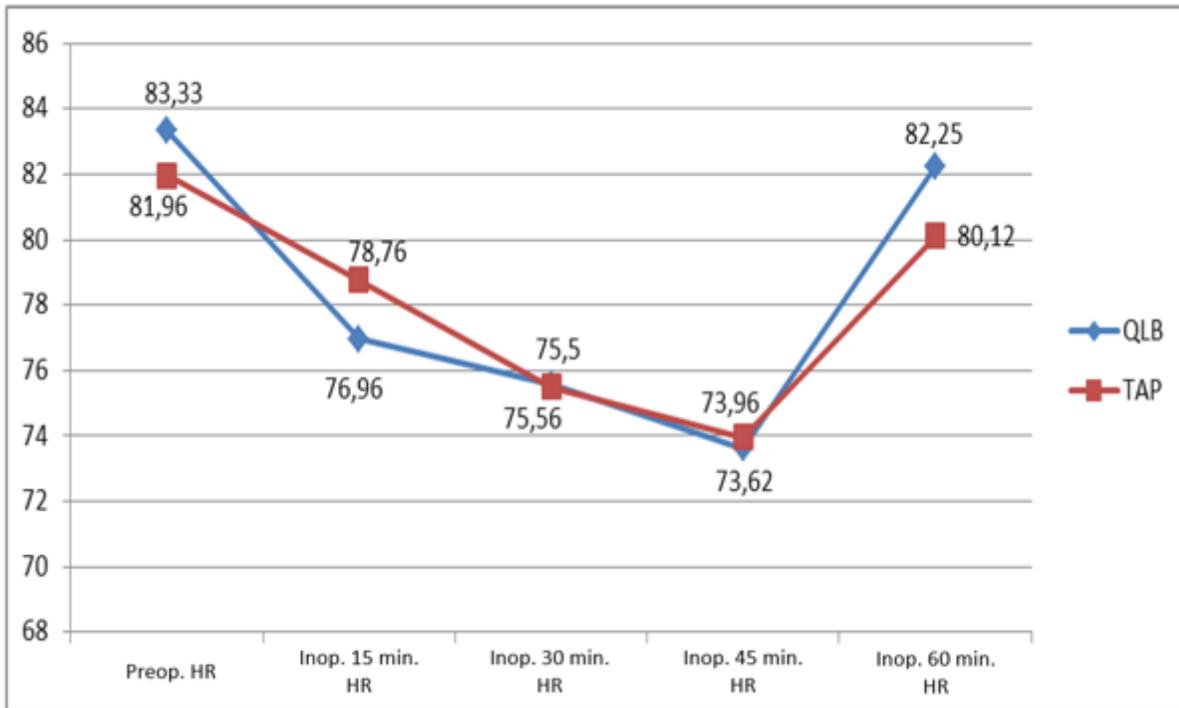
**Figure 6**

Comparison of some demographic and clinical features of the groups



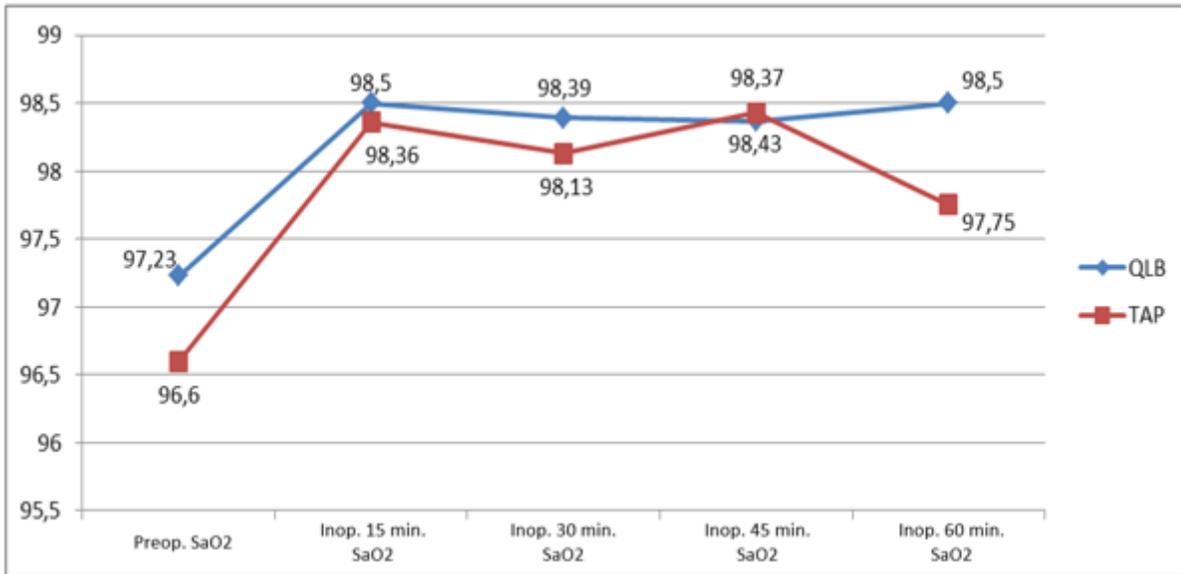
**Figure 7**

Time dependent formal representation of the MAP of the QLB and TAP groups



**Figure 8**

Time-dependent formal representation of the heart rate of the QLB and TAP groups



**Figure 9**

Time-dependent formal representation of the QLB and TAP groups' SaO2 levels

## Supplementary Files

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