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Analgesic Efficacy of Systemic versus Interfascial Dexamethasone in Anterior Quadratus Lumborum Block for Laparoscopic Cholecystectomy: A Retrospective Cohort Study

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ABSTRACT

Objective: The anterior quadratus lumborum block (aQLB) is commonly used for postoperative pain relief following laparoscopic cholecystectomy (LC). Dexamethasone is known to prolong and enhance analgesia when used as an adjuvant in peripheral nerve blocks. Some studies suggest that systemic administration may be as effective as perineural administration. However, studies directly comparing interfascial administration of dexamethasone in fascial plane blocks with systemic administration remain limited. This study aims to compare the analgesic efficacy and side-effect profiles of interfascial versus systemic administration of dexamethasone with the aQLB.

Methods: This retrospective study included 72 patients who underwent elective LC under general anesthesia. All patients received preoperative bilateral aQLBs. Patients were assigned to Group IV (n=33), which received intravenous dexamethasone, or to Group IF (n=39), which received interfascial dexamethasone. The primary endpoint was the time to first rescue analgesic. Secondary endpoints were 24-hour tramadol use, intraoperative remifentanil consumption, numeric rating scale scores at 1,4,8,12, and 24 hours, and side effects.

Results: No statistically significant difference was observed between groups in the time to first rescue analgesia; however, median times favored Group IF (5.3 hours vs. 4 hours). The median total tramadol consumption in the first 24 hours was 100 mg [interquartile range (IQR): 150 mg] in Group IV and 75 mg (IQR: 100 mg) in Group IF, with no significant difference between the groups (p=0.256). Numeric rating scale scores and remifentanil use were similar. Nausea was significantly more frequent in Group IF (41%) than in Group IV (18%) (p=0.036).

Conclusion: Both systemic and interfascial administration of dexamethasone, when combined with an aQLB in patients undergoing LC, provided comparable postoperative pain relief. However, systemic administration was associated with a lower incidence of postoperative nausea, suggesting it may be preferable for patients at higher risk of this side effect.

Keywords: Adjuvant, dexamethasone, fascial plane blocks, postoperative analgesia, anterior quadratus lumborum block, laparoscopic cholecystectomy

INTRODUCTION

Laparoscopic cholecystectomy (LC) is widely recognized as one of the most commonly performed routine surgical procedures. Although LC typically causes less intense pain than open cholecystectomy, patients may still experience moderate to severe postoperative pain. This pain may arise from somatic sources at the trocar entry sites, from visceral sources related to gallbladder manipulation, or from carbon dioxide insufflation in the abdomen (1). Postoperative pain is often managed with opioid analgesics. However, opioid use is associated with undesirable side effects such as nausea, vomiting, sedation, itching, dependence, prolonged hospital stays, and increased healthcare costs.

Therefore, the use of truncal blocks as part of multimodal analgesia has increased in recent years (2,3). Anterior quadratus lumborum blocks (aQLB) are among the techniques used for postoperative analgesia after abdominal surgery. Studies have demonstrated effective analgesia in the T7-L2 dermatomal regions (4). Various adjuvants can be used in block applications to enhance the duration and efficacy of analgesia provided by local anesthetics.

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Dexamethasone is a glucocorticoid known for its ability to prolong the effects of local anesthetics and suppress inflammation when used as an adjuvant (5,6).

Extensive research has been conducted on the perineural use of dexamethasone in extremity surgeries (6-8). Although dexamethasone is widely used, its perineural administration is considered off-label by both the European Medicines Agency and the U.S. Food and Drug Administration, which raises concerns among some clinicians. As a result, intravenous administration has become more common in recent years (9).

Conflicting results have been reported in the literature regarding the perineural versus systemic administration of dexamethasone for peripheral nerve blocks. In a meta-analysis of adjuvants for supraclavicular brachial plexus blocks, systemic administration of dexamethasone provided a longer duration of sensory blockade than perineural administration in upper extremity blocks (10). In the same study, a longer duration of analgesia was also observed in the perineural group; however, this difference was not statistically significant. Furthermore, in a study comparing plasma concentrations of dexamethasone after systemic and perineural administration during upper extremity surgeries, similar plasma levels were detected via both routes, which were attributed to the rich vascularity and close anatomical relationship between nerves and blood vessels, facilitating systemic absorption (11). Similarly, Desai et al. (12), in a meta-analysis of lower-extremity peripheral nerve blocks, reported that the duration of analgesia was longer with perineural than with systemic administration of dexamethasone. This was explained by lower vascularity in the lower extremity relative to the upper extremity; however, the difference was not clinically significant.

No studies have directly compared the analgesic efficacy of systemic versus interfascial dexamethasone administration in fascial plane blocks. In studies investigating local anesthetic pharmacokinetics, it has been reported that ropivacaine reached high plasma concentrations shortly after administration in the erector spinae plane and serratus intercostal fascial plane blocks, a finding associated with rapid absorption (13). However, studies specifically addressing QLB remain limited. Given the absence of major vascular structures between fascial layers, systemic absorption of dexamethasone in these blocks may be slower than that in extremity blocks, potentially allowing interfascial administration to provide a longer duration of analgesia than the intravenous route.

This retrospective study compared the analgesic efficacy of interfascial versus systemic dexamethasone administration in patients who underwent preoperative aQLB for elective LC.

METHODS

Study Design and Ethical Approval

This retrospective, single-center study was conducted at University of Health Sciences Türkiye, Gaziosmanpaşa Training and Research Hospital. Ethical approval was granted by the Non-Interventional Research Ethics Committee of University of Health Sciences Türkiye, Gaziosmanpaşa Training and Research Hospital (approval no: 86, date: 18.06.2025). The ethics application specified that part of the data for the interfascial adjuvant group would be drawn from a previously approved clinical study at our institution, titled "Comparison of the Postoperative Analgesic Efficacy of Adjuvant Quadratus Lumborum Block in Laparoscopic Cholecystectomies" (approval no: 40, date: 10.05.2023). Permission was granted to use this data for secondary analysis.

After obtaining ethical clearance, a retrospective review was conducted of 84 patients who underwent elective LC between January 1, 2024, and June 1, 2025. Twelve patients were excluded due to incomplete follow-up documentation regarding postoperative analgesia or use of non-tramadol rescue analgesics.

Patient Selection

In this retrospective study, we reviewed the records of patients who underwent elective LC under general anesthesia and who received a preoperative bilateral aQLB. Among these patients, those who had received dexamethasone via either the interfascial or the systemic route were included in the study. Patients over 18 years of age and classified as American Society of Anesthesiologists (ASA) physical status I-II were included. Patients classified as ASA III-IV and those who had received rescue analgesics other than tramadol were excluded from the analysis.

Intervention and Group Descriptions

In our clinic, fascial plane blocks are generally performed to provide postoperative analgesia and reduce intraoperative opioid requirements following LC. In our clinic, aQLBs are routinely performed preoperatively and bilaterally under ultrasound guidance, with patients in the lateral decubitus position. A convex ultrasound probe (2-6 MHz; MyLabseven, Esaote Europe, Netherlands) and a 100-mm nerve block needle (Stimuplex® Ultra; B. Braun, Melsungen, Germany) were used. The standard local anesthetic solution consists of 20 mL of 0.25% bupivacaine, administered bilaterally. For interfascial dexamethasone administration, each side receives 20 mL comprising 10 mL of 0.5% bupivacaine, 9 mL of normal saline, and 1 mL (4 mg) of dexamethasone.

Participants were divided into two groups based on the method of adjuvant delivery.

Patients who received interfascial dexamethasone (8 mg) coadministered with the local anesthetic were included in Group IF, whereas those who received systemic dexamethasone (8 mg) intravenously during the intraoperative period were included in Group IV.

General Anesthesia and Postoperative Analgesia Protocol

In our clinic, a standard general anesthesia protocol is used for ASA I-II patients. Induction is performed by intravenous administration of midazolam (0.04 mg/kg), fentanyl (1 μg/kg),

lidocaine (0.5 mg/kg), propofol (2 mg/kg), and rocuronium (0.6 mg/kg). Anesthesia maintenance involves sevoflurane and a continuous infusion of remifentanil at a rate of 0.05-0.2 µg/kg/min, adjusted based on the patient's hemodynamic status. All surgical procedures are carried out using the standard four-port technique with a maximum intra-abdominal pressure of 12 mmHg.

In our clinic, it is routine practice to administer intravenous paracetamol (1 g), tramadol (1 mg/kg), and ondansetron (0.1 mg/kg) to patients at the end of surgery. Neuromuscular blockade is typically reversed with either sugammadex (2 mg/kg) or a combination of neostigmine (0.04 mg/kg) and atropine (0.02 mg/kg), at the discretion of the anesthesiologist. Postoperative pain management in the general surgery ward routinely consists of 1 g paracetamol every 6 hours, with 100 mg intravenous tramadol administered when the resting numeric rating scale (NRS) score is ≥4.

Data Collection

Data were retrospectively collected from patients' anesthesia and postoperative analgesia follow-up forms. Block procedures were recorded in the block registry located in the operating room block area, while postoperative analgesia data were gathered from dedicated follow-up forms maintained for each patient. In our clinic, all patients who receive truncal blocks are visited by an anesthesiologist at 1,4,8,12, and 24 hours postoperatively. The time to first rescue analgesia, total tramadol consumption, resting and dynamic (during coughing) NRS scores, and side effects such as nausea, vomiting, and shoulder pain are documented in the postoperative analgesia follow-up forms. Patients' demographic data and ASA scores are recorded in both the anesthesia and analgesia follow-up forms. Intraoperative remifentanil consumption was extracted from the anesthesia records.

Outcome Measures

The primary objective of this study was to evaluate the effect of interfascial versus systemic administration of dexamethasone on the time to first rescue analgesia in patients undergoing anterior QLB during elective LC. Secondary outcomes included total postoperative tramadol consumption, NRS scores at rest and during movement, intraoperative remifentanil use, and the incidence of adverse events such as nausea, vomiting, and shoulder pain.

Statistical Analysis

Descriptive statistics were presented as mean ± standard deviation, median [interquartile range (IQR)], frequency, and percentage, depending on variable type. Data distribution was assessed using the Kolmogorov-Smirnov test. For variables with a normal distribution, the independent samples t-test was used, while the Mann-Whitney U test was applied to non-normally distributed variables. The chi-square test was used to compare categorical data. Time to first rescue analgesia was analyzed with Kaplan-Meier survival curves. All statistical analyses were performed using SPSS version 28.0 (IBM Corp., Armonk, NY), and a p-value less than 0.05 was considered statistically significant.

RESULTS

A total of 72 patients were included in the analysis. The demographic characteristics of both groups were similar (Table 1).

No statistically significant difference was found between the groups regarding the time to first rescue analgesia (p=0.497; Table 2). The need for rescue analgesia was observed in 54.5% of patients in Group IV and 51.3% of patients in Group IF. Kaplan-Meier analysis was performed for patients who required rescue analgesia. Although the curves suggest that patients in Group IV tended to need rescue analgesia earlier, the log-rank test showed no statistically significant difference between the groups (p=0.463; Figure 1). The Kaplan-Meier curves also indicated that in Group IV, all patients had received rescue analgesia by the 10th postoperative hour, whereas in Group IF all patients had received it by the 13th postoperative hour.

During the first 24 hours postoperatively, the median total tramadol consumption was 100 mg (IQR: 150 mg) in Group IV and 75 mg (IQR: 100 mg) in Group IF, with no statistically significant difference between the groups (p=0.256; Table 2). Additionally, intraoperative remifentanil consumption did not differ significantly between the two groups (Table 2).

Resting NRS and dynamic NRS scores were similar across all evaluated time points (Table 3).

Analysis of side effects showed that nausea occurred in 18% (6 patients) of patients in Group IV and 41% (16 patients) of patients in Group IF. This difference was statistically significant: Group IF exhibited a higher rate of nausea (p=0.036; Table 4). However, there were no significant differences between groups regarding vomiting or shoulder pain (Table 4).

DISCUSSION

This study compared the analgesic effectiveness of interfascial and systemic dexamethasone in patients undergoing elective LC who received a preoperative aQLB for pain relief. The time to first rescue analgesia, total postoperative opioid use, intraoperative remifentanil consumption, and NRS scores were similar between the groups, but the incidence of nausea was significantly lower in the group that received systemic dexamethasone.

QLBs are used for postoperative pain control after surgeries involving the lower thoracic area, abdomen, retroperitoneal space, and inguinal region (14,15). In our clinic, the anterior approach to the QLB technique is commonly preferred for LC procedures. First described by Børglum et al. (16), the aQLB is believed to offer more effective pain relief, possibly because of the high density of mechanoreceptors in the anterior thoracolumbar fascia (4,17).

Previous studies have shown that dexamethasone, when used as an adjuvant in peripheral nerve blocks, may extend analgesic

duration and enhance postoperative pain control (6,9). However, research on the effectiveness of adjuvants in fascial plane blocks remains limited.

A randomized controlled trial evaluating the addition of dexamethasone to local anesthetics in aQLB for LC demonstrated a significantly prolonged time to first rescue analgesia compared with the saline control group (18). Arafa et al. (19) randomized pediatric patients undergoing renal surgery into three groups receiving interfascial dexamethasone, intravenous dexamethasone, or aQLB alone. Both dexamethasone groups had significantly lower total morphine consumption, longer time to first rescue analgesia, and lower pain scores than the aQLB-alone group. The time to first rescue analgesia did not differ between the two dexamethasone groups; however, total tramadol consumption was significantly lower in the interfascial dexamethasone group. Consistent with previous findings, our study found that the median total tramadol consumption within the first 24 hours was 100 mg (IQR: 150 mg) in Group IV and 75 mg (IQR: 100 mg) in Group IF, indicating lower consumption in the interfascial group. However, this difference was not statistically significant. Additionally, there was no significant difference in the time to first rescue analgesia between patients who received systemic dexamethasone and those who received interfascial dexamethasone as an adjuvant. The median times to first rescue analgesia were 4 hours in Group IV and 5.3 hours in Group IF, though this was not statistically significant. Kaplan-Meier analysis of the time to first rescue analgesia showed that patients in Group IV requested analgesia earlier than those in Group IF. Although not statistically significant, this finding suggests that interfascial administration of the adjuvant may prolong the time to request analgesia compared with systemic administration.

In this study, the need for rescue analgesia was similar between the groups, with approximately half of the patients requiring it in each arm. These relatively low rates were attributed to an effective multimodal analgesia protocol combined with the aQLB block. NRS scores remained consistently low, staying below 4 at all time points in both groups. Intraoperative remifentanil consumption was likewise comparable, in line with the observed postoperative analgesic outcomes.

In two separate meta-analyses comparing perineural and systemic dexamethasone administration in peripheral nerve blocks—one including 11 studies with a total of 914 patients and the other including 9 studies with a total of 801 patients—perineural administration was shown to prolong the duration of analgesia more effectively than systemic administration (7,8). These effects of dexamethasone on analgesic efficacy are believed to result from several mechanisms, including suppression of inflammatory

Table 1. Comparison of demographic data and operational durations among groups

	Group IV (n=33)		Group IF (n=39)		p*
	n	%	n	%	
Gender					
Female	26	78.8	33	84.6	0.522
Male	7	21.2	6	15.4	
	Mean ± SD		Mean ± SD		
Age (yr)	46.2±11.09		45.3±9.8		0.734
BMI (kg/m^2)	26.9±3.4		27.9±5.1		0.326
Operation time (min)	52.9±12.0		56.2±14.3		0.477

Values are presented as mean ± SD or number and percentage n (%)
Group IV: Intravenous dexamethasone group, Group IF: Interfascial dexamethasone group, BMI: Body mass index, SD: Standard deviation, *: p<0.05

Table 2. Comparison of intraoperative remifentanil consumption, total analgesic consumption, and time to first analgesic use between grup

	Group IV (n=33)	Group IF (n=39)	p*
	Median (IQR)	Median (IQR)	
Intraoperative remifentanil consumption (mcg/kg)	180 (125)	210 (160)	0.261
Total tramadol consumption (mg/day)	100 (150)	75 (100)	0.256
Time to first rescue analgesia (hour)	4.0 (5.5)	5.3 (6.9)	0.497
	n (%)	n (%)	
Patients requiring rescue analgesia	18 (54.5)	20 (51.3)	0.782
Patients not requiring rescue analgesia	15 (45.5)	19 (48.7)	

Values are presented as median (IQR)
Group IV: Intravenous dexamethasone group, Group IF: Interfascial dexamethasone group, IQR: Interquartile range, *: p<0.05

mediator release, inhibition of ectopic neuronal discharges, and blockade of potassium channel-mediated discharges in nociceptive C fibers (20-24).

In the experimental animal model study conducted by Matsuda et al. (25), co-administration of dexamethasone with local anesthetics significantly prolonged the duration of analgesia. This effect was observed exclusively with perineural administration, whereas the same dose administered intramuscularly (systemically) did not produce a comparable effect. Specifically, perineural dexamethasone extended the duration of sciatic nerve block with ropivacaine to more than 360 minutes, while systemic administration of dexamethasone failed to achieve this outcome. Histological analyses indicated that the effect was mediated through glucocorticoid receptor activation and was closely associated with the suppression of neuronal nitric oxide synthase (nNOS) expression in the dorsal root ganglion.

Furthermore, perineural administration of the NOS inhibitor L-NAME significantly prolonged block duration, supporting the involvement of peripheral mechanisms. These findings suggest that the analgesic-prolonging effect of dexamethasone is not solely attributable to systemic absorption but also to direct perineural mechanisms. In addition to suppressing NOS production, the vasoconstrictive properties of dexamethasone may further prolong the duration of action of the local anesthetic by delaying its systemic absorption.

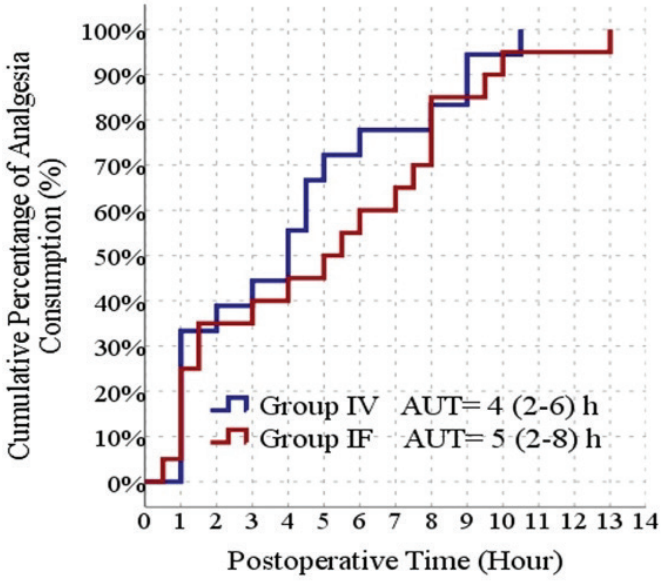

Figure 1. Comparison of time to first analgesic request between Group IV and Group IF: Kaplan-Meier analysis. Median time to first rescue analgesia was 4.0 hours (95% CI: 1.9-6.1) in Group IV and 5.0 hours (95% CI: 1.7-8.3) in Group IF (log-rank test, p=0.463)
Group IV: Intravenous dexamethasone group; Group IF: Interfascial dexamethasone group, CI: Confidence interval, AUT: Analgesic using time
Note: CI values in the figure are rounded to the nearest whole number for visual clarity

Moreover, in the management of rebound pain—a phenomenon that can occur after the resolution of a peripheral nerve block—single-dose dexamethasone administered with the block has been shown to reduce its incidence (26). In addition, intravenous dexamethasone has been reported to decrease rebound pain, demonstrating an effect comparable to that of perineural administration (27). Overall, these findings suggest that the analgesic effect of dexamethasone is multifactorial, with systemic absorption playing a role; however, experimental data highlight that perineural mechanisms, particularly nNOS suppression via glucocorticoid receptor activation, substantially contribute to prolonging block duration.

Additionally, it has been suggested that interfascial dexamethasone administered during anterior QLB can reach the paravertebral space via spread of the block, thereby exerting a central analgesic effect. This effect is thought to aid in reducing central sensitization by inhibiting nuclear factor kappaB (NF-κB) activity. As a transcription factor, NF-κB plays a key role in regulating inflammatory activity and has been associated with

Table 3. Comparison of rNRS and dNRS values between groups

	Group IV (n=33)	Group IF (n=39)	p*
	Median (IQR)	Median (IQR)	
rNRS 1. hour	2 (2.0)	2 (1.0)	0.287
rNRS 4. hour	1 (1.0)	1 (2.0)	0.744
rNRS 8. hour	1 (1.0)	1 (1.0)	0.760
rNRS 12. hour	1 (1.0)	1 (2.0)	0.908
rNRS 24. hour	1 (1.5)	1 (1.0)	0.621
dNRS 1. hour	3 (2.0)	3 (1.0)	0.369
dNRS 4. hour	3 (1.0)	3 (2.0)	0.535
dNRS 8. hour	3 (1.5)	2 (1.0)	0.852
dNRS 12. hour	1 (2.0)	2 (2.0)	0.327
dNRS 24. hour	1 (2.5)	2 (2.0)	0.839

Values are presented as median (IQR)
Group IV: Intravenous dexamethasone group; Group IF: Interfascial dexamethasone group, IQR: Interquartile range, rNRS: Resting numeric rating scale; dNRS: Dynamic numeric rating scale, *: p<0.05

Table 4. Comparison of postoperative side effects between the groups

	Group IV (n=33)		Group IF (n=39)		p
	n	%	n	%	
Nausea	6	18.2	16	41.0	**0.036***
Vomiting	2	6.1	3	7.7	0.786
Shoulder pain	7	21.2	12	30.8	0.359

Values are presented as number and percentage n (%)
Group IV: Intravenous dexamethasone group; Group IF: Interfascial dexamethasone group, *: p<0.05

the development of chronic and pathological pain (28). However, we were unable to evaluate the long-term effects on chronic pain because of the retrospective design and limited follow-up. Our analysis primarily focused on acute postoperative pain outcomes.

The use of intravenous dexamethasone for prophylaxis of nausea and vomiting is well established in the literature (29). It is also known to reduce surgical stress and inflammation, facilitate early patient mobilization, and, therefore, is included as standard practice in enhanced recovery after surgery (ERAS) protocols. In this study, patients who received intravenous dexamethasone showed a notably lower incidence of postoperative nausea than those who received interfascial dexamethasone, a finding attributed to its antiemetic effects. The incidence of vomiting was low and similar in both groups. The incidence of shoulder pain was higher in the IF group, although the difference was not statistically significant.

Study Limitations

A limitation of this study is that it was conducted at a single center. With a multicenter design and a larger sample size, more generalizable results could have been achieved. Another significant limitation is the retrospective design, which may have introduced bias despite inclusion of all eligible patients. Additionally, the relatively low volume of local anesthetic used for QLB might have affected block efficacy. The lack of standardized analgesic protocols, such as patient-controlled analgesia, is another methodological limitation. Chronic pain follow-up could not be conducted, limiting evaluation of long-term outcomes. Lastly, the absence of a control group represents another limitation, as only patients who received a block are systematically recorded in our analgesia follow-up forms.

CONCLUCION

This retrospective study showed that both interfascial (perineural) dexamethasone—administered as an adjuvant to the aQLB during LC—and systemic (intravenous) dexamethasone were similarly effective for postoperative analgesia. There were no significant differences between groups in total tramadol consumption or in time to first rescue analgesia; however, the interfascial dexamethasone group may offer a slight advantage in analgesic efficacy. However, further research with larger patient populations is needed to confirm this potential benefit. Notably, the incidence of postoperative nausea was significantly lower among patients who received systemic dexamethasone, suggesting that systemic administration may be preferable for patients at risk of postoperative nausea.

Ethics

Ethics Committee Approval: University of Health Sciences Türkiye, Gaziosmanpaşa Training and Research Hospital. Ethical approval was granted by the Non-Interventional Research Ethics Committee of University of Health Sciences Türkiye, Gaziosmanpaşa Training and Research Hospital (approval no: 86, date: 18.06.2025).

Informed Consent: Retrospective study.

Footnotes

Author Contributions: Concept - S.Ş., D.G.M., V.D.; Design - S.Ş., D.G.M., V.D.; Data Collection and/or Processing - S.Ş., D.G.M., V.D.; Analysis and/or Interpretation - S.Ş., D.G.M., V.D.; Literature Search - S.Ş.; Writing - S.Ş.

Conflict of Interest: The authors have no conflicts of interest to declare.

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