EFFICACY OF QUADRATUS LUMBORUM BLOCKS IN ROBOTIC NEPHRECTOMY- A RETROSPECTIVE REVIEW.

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Abstract

Abstract: With the implementation of enhanced recovery pathways (ERAS) in kidney surgeries, regional techniques are being considered an important aspect of multimodal analgesia. Abdominal blocks such as quadratus lumborum block (QLB) have been used as an effective analgesic in abdominal surgeries, however their efficacy in kidney surgery remains unknown. To our best knowledge, there are no clinical studies exploring the relationship between QLBs and post-operative opioid consumption in robotic laparoscopic nephrectomy. **Study Objectives:** Assess analgesic efficacy between QLB and post-operative opioid consumption in robotic laparoscopic nephrectomy. **Design and Setting:** A retrospective chart review was conducted by querying the electronic medical record system of 2,200 bed tertiary academic hospital center in New York City. **Outcomes:** The primary measured outcome was postoperative morphine milli equivalent (MME) consumption for the first 24 hours. Secondary outcomes include intra-operative MME, as well as postoperative pain scores measured on a visual analogue scale (VAS) scale at 2, 6, 12, 18, and 24 hours post-operatively. **Results:** The mean total post-operative MME in the pQLB group was 11 [4, 18] and 15 [5.6, 28] in the control group ($p = .001$). There was a significant reduction in intra-operative MME in the QLB group in comparison to the control group. This reduction was not seen in post-operative MME. There was no significant difference in pain scores at any of the measured time points up to 24 hours post-operatively. **Conclusion:** Our study provides compelling support that ultrasound guided QLB significantly decreased intra operative opioid requirements but did not have the same effect on postoperative opioid requirements following robotic kidney surgeries in the context of an ERAS pathway. **Keywords:** Kidney surgeries, Robotic laparoscopic nephrectomy, quadratus lumborum block (QLB), enhanced recovery pathways (ERAS)

Introduction:

Approaches to contemporary urologic procedures range from open incisions to minimally invasive or robotically-guided techniques (1). Contributions to postoperative pain patients undergoing these surgeries may include the size of incision, location of port sites, pelvic organ nociception, discomfort due to urinary catheter, or diaphragmatic irritation from residual pneumoperitoneum (2, 3). Inadequately controlled postoperative pain may have harmful physiologic and psychological consequences that potentially increases perioperative morbidity and mortality (4, 5). Poor control of acute post-operative pain is associated with a higher incidence of progression to chronic pain (6). Excellent pain control is a cornerstone of enhanced recovery after surgery (ERAS) pathways, and specifically, multimodal analgesia after renal surgeries has yielded beneficial peri-operative outcomes such as improved functional recovery, reduced incidence of post-operative nausea and vomiting (PONV), mitigation of adverse effects of narcotics, all culminating in shorter hospital lengths of stay and increased patient satisfaction (7).

With varying success, regional anesthetic techniques such as neuraxial anesthesia, transverse abdominis plane (TAP) blocks and lumbar plexus blocks have been employed as part of ERAS protocols for renal surgeries. Similarly, systemic opioids, non-steroidal anti-inflammatory drugs (NSAIDs), magnesium and lidocaine have also been studied (8). The posterior quadratus lumborum block (pQLB) is an abdominal

truncal block first described by Blanco in 2007 (9). He characterized it as an ultrasound (US) guided posterior TAP block (9). Anatomically, pQLB involves the injection of local anesthetic (LA) into a contiguous TAP interfascial plane that extends posteriorly to the thoracolumbar fascia (TLF) investing the quadratus lumborum muscle superiorly. The analgesic effect is produced by LA spread along these fascial planes targeting intercostal nerves that provide sensory innervation to the abdominal wall. Potential spreading patterns in cephalo-caudad as well as antero-posterior directions have been described, with potential involvement of paravertebral or neuraxial spaces (8).

Three types of QLB have been described and have anatomical names which describe the location of LA deposition around the QL muscle: QL1 or lateral, QL2 or posterior, and QL3 or transmuscular. Other modifications such as the paramedian sagittal oblique (PSO) and transverse oblique paramedian (TOP) orientations (10) also exist. These types of QLBs add complexity and diversity, but uncertainty to the efficacy of QLB in general. Based on the available literature on efficacy, ease of block placement, and complication profiles, we have adopted the pQLB as part of our ERAS protocol for robotic nephrectomies.

Previous studies have shown that the addition of pQLB to a regimen of morphine and NSAIDs to be associated with a significant reduction in opioid consumption in abdominal surgeries (11, 13). However, the efficacy of pQLB in renal surgeries remain unknown. To our best knowledge, there are no clinical studies exploring the relationship between pQLB and post-operative opioid consumption in robotic laparoscopic nephrectomy.

Materials And Methods:

Mount Sinai Institutional IRB approval for human subject research was obtained and a waiver for informed consent for retrospective chart reviewed was approved by IRB. All methods were performed in accordance with the relevant guidelines and regulations. We included all patients who underwent robotic and laparoscopic kidney surgeries between January 2015 and May 2018 at a 2,200 bed academic medical center. The anesthesia information management system, Compurecord (Philips Medical, Andover, MA, USA), electronic medical record PRISM (GE, USA) and EPIC (Epic Systems Corporation, Verona, WI, USA) were queried. Intra operative opioid, post-operative opioid consumption, information about blocks performed and pain scores over the first postoperative 24 hours were collected.

All patients were monitored using standard ASA monitors and neuromuscular blockade was administered to facilitate endotracheal intubation after anesthetic induction. All anesthetics were maintained with inhaled agents. All patients received opioids intraoperatively at the discretion of the anesthesia practitioner depending on the intraoperative MAP and heart rate.

Patients were positioned in lateral decubitus position with operative side up. Posterior QLB were performed under direct visualization with an ultrasound machine (Sonosite Inc., Bothell, WA, USA) using a 13 – 6 MHz broadband curvilinear probe. Blocks were performed by an attending anesthesiologist, or by a resident or a fellow under direct supervision, either prior to surgical incision or after the dressing was applied at the end of surgery. Blocks were placed with an insulated 22-gauge 50 mm block needle

(Pajunk, Geisingen, Germany) inserted in an in-plane medial to lateral approach. After negative aspiration, 30 milliliters (ml) of long acting LA (0.25% bupivacaine or 0.2% ropivacaine) was injected in 5 mL aliquots, with direct visualization of spread in the intersection of pQLB and the TAP fascial planes.

Surgery was performed by two surgeons at the hospital locations, all specializing in robotic guided laparoscopic nephrectomies. We excluded open procedures or surgeries that were converted to open incisions. We also excluded patients who were administered patient-controlled analgesia (PCA) postoperatively or patients who received other forms of regional anesthetics.

The surgical incisions for robotic guided laparoscopic partial nephrectomy involved 3–4 keyhole incisions each measuring 1 cm in the abdomen. All patients were expected to remain in the hospital for 48 hours after surgery.

Outcomes:

The primary measured outcome was postoperative morphine milli equivalent (MME) consumption for the first 24 hours. Secondary outcomes include intra-operative MME, as well as postoperative pain scores measured on a VAS scale at 2, 6, 12, 18, and 24 hours post-operatively. Intra operative MME was calculated based on total intraoperative consumption of ketamine, remifentanyl, fentanyl, hydromorphone and morphine. Post-operative MME was calculated based on total administration of fentanyl, hydromorphone, morphine and oxycodone. Peri-operative consumption of acetaminophen, gabapentin and ketorolac was also calculated.

Intraoperative maintenance anesthetic either volatile anesthetic or monitored anesthesia care after endotracheal intubation was recorded.

Statistical Analysis:

Descriptive data are reported as a number (%), mean ($\pm$ standard deviation) or median (interquartile range [IQR]). For group comparisons, two-sample t-test or the Wilcoxon-Mann-Whitney tests was used for continuous data, and Chi-square or Fisher Exact test was used for categorical data, as appropriate. Linear regression models were built to compare the log-transformed intraoperative and postoperative MME use between the pQLB and control groups. Covariates such as age, gender, American Society of Anesthesiology (ASA) status, diabetes, hypertension, anesthesia team (resident or certified nurse anesthetist CRNA), anesthesia method (volatile anesthetic or total intravenous anesthesia TIVA), surgical duration and hospital site were adjusted between the two groups.

Logistic regression model using the generalized estimating equations method was used to compare the incidence of severe pain (pain score ≥ 7) between the two groups during the first 24-hour period following surgery, and to test whether this incidence difference was the same over time. Odds ratios of reporting severe pain (visual analogue scale VAS of more than 7) at 2, 6, 12, 18 and 24 hours post operatively and

the corresponding confidence intervals derived from the empirical standard errors were recorded. Analysis was performed using SAS 9.4 (SAS Institute Inc., Cary, NC). All tests were 2-sided and statistical significance was defined as a p value < 0.05, unless specified.

Results:

Out of the total 722 patients identified, 148 were excluded based on predetermined criterion. Two hundred eleven of the 554 patients who underwent laparoscopic/robotic assisted partial nephrectomies, received a pQLB as part of their analgesic strategy (Fig. 1).

Demographic data appear in Table 1. There was no significant difference between groups. Blocks were administered prior to surgical incision in 90.52% (191) and 9.48% (20) after closure.

The median surgical duration was 136 [IQR 118, 161] minutes in the pQLB group and 151 [120, 182] minutes in the control group ($p = 0.001$). The median total intraoperative MME in the group receiving the pQLB was 10 [3, 25], compared to 55 [40, 85] in the group that did not receive the block ($p = 0.001$). Specifically, total intra-operative fentanyl administration was significantly reduced in the pQLB group ($p = 0.007$). The mean total post-operative MME in the pQLB group was 11 [4, 18] and 15 [5.6, 28] in the control group ($p = .001$) (Table 2). After covariate adjustment between the two groups, the reduction in post-operative MME in the pQLB group was not significant.

The median pain scores at various time points(2,6,12,18,24hours) ranged from 2 [IQR 0–5] to 4[IQR 0–6] for the pQLB group, and 2 [IQR 0–5] to 3[IQR0-5] in the control group(p value > 0.05)(Table 3). Additionally, there was a trend towards greater reduction of intraoperative MME when block was placed after surgery (Table 4). There was no significant difference in pain scores during the first 24 hours between the two groups. However, the odds of having severe pain tends to be consistently higher in the pQLB group (Table 5).

Table 1
Demographic variables

Variables	POSTERIOR QL BLOCK <i>n</i> = 211 <i>n</i> = 211	NO POSTERIOR QL BLOCK <i>n</i> = 343	P value
Age (in years)	60 ± 13	59 ± 12	0.5
Sex(Male/Female)	75/136	136/207	0.3
Diabetes	34(16%)	64(18%)	0.4
Hypertension	115(54.5%)	214(62.4%)	0.05
Smoking Status(Yes/No)	19(11.1%)	51(14.8%)	0.04
Anesthesia Team	200(94.7%)	259(75.5%)	0.01
Resident	11(0.03%)	84(24.5%)	
CRNA			
Resident			
CRNA			
Hospital Site	21(10%)	65(19%)	0.005
MSH	190(90%)	278(81%)	
MSW			
Anesthesia Type	173	17	0.001
MAC	38	326	
Volatile			
ASA Status	8	11	0.07
1	126	168	
2	67	139	
3	10	25	
4			
Surgery Duration (min)	136 [118, 161]	151 [120, 182]	0.001

Variables	POSTERIOR QL BLOCK <i>n</i> = 211 <i>n</i> = 211	NO POSTERIOR QL BLOCK <i>n</i> = 343	P value
Type of surgery	127(60%)	233(68%)	0.001
Laparoscopic	84(40%)	110(32%)	
Robotic	121(57.3%)	229(66.7%)	
Partial	90(42.6%)	114(33.2%)	
Radical			
Block timing	191(90%)	-	0.001
Before Incision	20(10%)	-	
After Surgery			
Local anesthesia	202(95.8%)	-	0.001
Bupivacaine	9(4.2%)		
Ropivacaine			

Age, sex reported in mean and standard deviation. Surgery duration in median [IQR]. Categorical data- diabetes, hypertension, smoking status, anesthesia team, hospital site, anesthesia type, ASA status, type of surgery, block timing and local anesthesia reported in n percent.

Table 2
Intra-operative and post-operative variables

VARIABLES	POSTERIOR QL BLOCK		NO POSTERIOR QL BLOCK		P value
	n = 211		n = 343		
Number of patients	MEDIAN[IQR]	Number of patients	MEDIAN[IQR)		Intra operative opioids:
Ketamine (in mg)	108	140[100, 151]	14	124[88, 156]	0.3
Remifentanil (in mg)	4	1.8[1.4, 2.1]	23	1.2[0.9, 2.0]	0.2
Acetaminophen (in mg)	128	1000[1,000,1,000]	109	1000[1,000, 1,000]	0.4
Ketorolac (in mg)	4	30[30, 30]	13	30[30, 30]	0.7
Fentanyl (in mcg)	211	100[0, 250]	343	500[300, 600]	< 0.001
Hydromorphone (in mg)	211	0[0, 0]	343	0[0, 1]	< 0.001
Morphine (in mg)	0	0[0, 0]	0	0[0, 0]	1
Total Intra operative MME	211	10[3, 25]	343	55[40, 85]	< 0.001
Post-operative opioids:					
Acetaminophen (in mg)	26	1300[650, 1300]	65	975[650, 1300]	0.35
Fentanyl (in mcg)	117	100[75, 100]	192	100[75, 150]	0.007
Hydromorphone (in mg)	108	1[0.75, 1.5]	155	1.5[1, 2.5]	0.001
Oxycodone (in mg)	134	12.5[10, 30]	200	20[10, 30]	< 0.001
Morphine (in mg)	31	4[2, 6]	100	8[4, 12]	< 0.001
Gabapentin (in mg)	3	300[100, 800]	6	450[300, 600]	0.79
Ketorolac (in mg)	12	53[30, 60]	39	60[45, 90]	0.10
Total post-operative MME	211	11[4, 18]	343	15[5.6, 28]	0.001

Intra operative and post-operative variables in number, median and interquartile range [IQR] with p value.

Table 3
Pain scores

Time Interval	POSTERIOR QL Block(<i>n</i> = 211)			No POSTERIOR QL Block(<i>n</i> = 343)			P value*
	Minimum	Maximum	Median[IQR]	Minimum	Maximum	Median[IQR]	
Q2	0	10	4[0, 6]	0	10	3[0, 5]	0.06
Q6	0	10	2[0, 5]	0	10	3[0, 5]	0.21
Q12	0	10	2[0, 5]	0	10	3[0, 5]	1
Q18	0	10	3[0, 5]	0	10	3[0, 5]	0.64
Q24	0	10	3[0, 5]	0	10	2[0, 5]	0.07

* Wilcoxon rank sum test

Pain scores at q2, q6, q12, q18 and q24 in median and interquartile range [IQR] with p value.

Table 4: Effect of QL block on MME during and after surgery.

Period	QL block	Variables	*Logarithmic scale of MME Difference	Standard Error	p-value	Overall p-value
Intraoperative	Overall	Yes	-0.63	0.30	0.033	0.033
		No	(ref)			
	Block timing	After surgery	-1.02	0.50	0.042	0.065
		Before incision	-0.54	0.31	0.079	
		Not done	(ref)			
Postoperative	Overall	Yes	-0.27	0.38	0.480	0.480
		No	(ref)			
	Block timing	After surgery	-0.85	0.64	0.184	0.411
		Before incision	-0.14	0.39	0.727	
		Not done	(ref)			

* Based on linear models adjusting for age, gender, diabetes, hypertension comorbidities, ASA status, anesthesia team, anesthesia method, surgical duration and hospital site.

Table 5: Odds ratio of having severe pain for POSTERIOR QL block over time post-surgery

Time Point	OR	95% CI	p-value*
2h	1.52	(0.83, 2.80)	0.180
6h	1.01	(0.54, 1.91)	0.965
12h	1.27	(0.68, 2.32)	0.465
18h	1.37	(0.79, 2.69)	0.236
24h	1.92	(0.99, 3.71)	0.052

* P-value =0.391 for the time*QL interaction term. Odds ratios were adjusted for age, gender, diabetes, hypertension comorbidities, ASA status, anesthesia team, anesthesia method, surgical duration and hospital site.

Discussion:

This is a retrospective review of patients who underwent robotic and laparoscopic kidney surgeries. There was a significant reduction in intra-operative MME in the group of patients who received a pQLB in comparison to the control group. This reduction was not seen in post-operative MME, nor was there any significant difference in pain scores at any of the measured time points up to 24 hours postoperatively.

Managing postoperative pain in kidney surgeries presents a unique set of challenges. In our multimodal analgesic and ERAS pathways, avoidance of NSAIDs and opioids is prudent owing to concerns of nephrotoxicity with accumulation of active and nondialyzable metabolites (12). The possibility of impaired creatinine clearance must be considered when dosing other opiates as well. With the increasing numbers of kidney surgeries occurring worldwide, further exploration of modern analgesic techniques is timely (18).

Ultrasound guided regional anesthesia is highly beneficial after abdominal surgery. Truncal blocks such as TAP blocks have been performed in donor nephrectomies and was found to have reduced pain scores and reduced morphine consumption during the first 24 hours post-operatively(14,15). Li et al performed a placebo controlled randomized control trial in partial and radical nephrectomy and found that pre-operative TAP block was effective in reducing intra-operative and post-operative opioid consumption but had no effect on pain scores and length of stay (16). The pQLB, a variation of the posterior TAP block, is being studied extensively in abdominal surgeries. Blanco et al compared TAP blocks to pQLBs after caesarian section under spinal anesthesia. He concluded that pQLB significantly reduced the consumption of morphine after cesarean delivery in comparison to TAP blocks (17).

However, the efficacy of pQLB in kidney surgeries remains heterogeneously ambiguous. Elsharkawy et al reported that the use of transmuscular QLB provided appropriate sensory blockade for open urological surgeries (18). Using a pQLB approach, Zhu et al concluded that patients in the pQLB group had lower sufentanil consumption in the first 24 hours after laparoscopic nephrectomy when compared to the control group (19). In contrast, Boulianne et al did not observe a reduction in postoperative opioid administration at 24 hours with a pQLB in patients undergoing elective colorectal surgery. Post-operative pain scores were actually lower in the control group (20).

Although QLBs are widely adopted into practice despite firm evidence on their efficacy, complications, and nerve targets or local anesthetic (LA) spreading patterns, there have been some mixed results regarding effectiveness of pQLB. Various authors conclude that it is important to consider the type of pQLB while interpreting study results. Kukreja et al demonstrated that the VAS pain score at 24 hours and cumulative opioid consumption were significantly lower in the anterior QLB group after total hip arthroplasty (THA) as compared with controls (21). Without a pQLB comparison group, Green et al suggested that the use of transmuscular QLB in patients undergoing THA shortened the length of stay to an average of 2.9 days in comparison to 5.1 days. The intraoperative fentanyl use was also considerably lower in the block group under general anesthesia (22). In major orthopedic procedures, Hebl et al., showed that ERAS programs utilizing peripheral nerve blocks had significant impacts on perioperative outcomes, such as shortened hospital length of stay and fewer adverse events such as ileus and urinary retention (23). Patients participating in ERAS pathways had lower post-operative pain scores, opioid requirements, and incidences of adverse effects.

The timing of the performance (pre or postoperatively) of the pQLB is an important factor that is rarely studied. The pre-incision pQLB timing in our study was not associated with reduction of total MME for both the intra-operative and post-operative periods, with the odds ratio of having lower pain scores if the block was performed after the conclusion of surgery. Surgical incision triggers an inflammatory reaction to damaged tissues that induces central sensitization of pain pathways. It has been proposed that antinociceptive protection provided by pre-emptive treatments should extend into the postoperative period to effectively cover the inflammatory phase. In turn, pre-emptive analgesia focuses on minimizing central sensitization and potentially decreasing the incidence of developing chronic neuropathic pain. (24) Similar to our study, Olanipekun et al conducted a study comparing pre incisional and post incisional ilioinguinal and iliohypogastric nerve block to control post-operative pain in children after herniotomy.

They concluded that though the mean pain scores were lower in the pre-incision group at 6 hours, they were higher at 24 hours in comparison to the post-operative block group. (25)

Our study has limitations that are inherent to a retrospective study. Anesthetic practices and regional anesthetic techniques were not controlled nor standardized, thus the true efficacy and effectiveness of pQLB could be underreported. Randomized controlled trials assessing the efficacy should focus on standardization of techniques including the types of QLB utilized. The size of our surgical cohort was sufficient to demonstrate statistical significance. Despite pQLB being performed in patients under general

anesthesia, because patients, surgeons, anesthesiologists, nor perioperative personnel were not blinded from the techniques, placebo effects might have influenced the narcotic demands in the pQLB group, and nonblinded practitioners could introduce further bias.

In conclusion, our study provides compelling support that ultrasound guided pQLB significantly decreased intra operative opioid requirements but did not have the same effect on postoperative opioid requirements following robotic kidney surgeries in the context of an ERAS pathway.

Declarations

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Detail of Author contributions:

PP: Primary investigator responsible for study design and planning, IRB approval, data collection, subject recruitment, manuscript writing and preparation, data analysis, safety monitoring and responding to adverse events/outcomes.

AO: Research assistant involved in data collection.

HML: Primary statistician involved in data analysis, manuscript editing.

YL: Primary investigator responsible for study design and planning, data collection, subject recruitment, manuscript writing and preparation, data analysis, safety monitoring and responding to adverse events/outcomes.

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Figures

Figure 1

FLOW DIAGRAM