ISSN: 2377-4630

Feierman et al. Int J Anesthetic Anesthesiol 2023, 10:161
DOI: 10.23937/2377-4630/1410161
Volume 10 | Issue 1
Open Access

International Journal of
Anesthetics and Anesthesiology

ORIGINAL ARTICLE

The Use of the Liposomal Bupivacaine in the Quadratus Lumborum Block and Early Surgery Are Key Elements in Facilitating Ambulatory Robotic-Assisted Laparoscopic Radical Prostatectomy

Yehoshua Feierman, Piyush M Gupta, MD, Daniel Escobar, MD, Akram Hossain, MD, Logan Fairchild, DO, David Silver, MD, Ervin Teper, MD, and Dennis Feierman, MD, PhD*

Maimonides Medical Center, Brooklyn, New York, USA

***Corresponding author:** *Dennis Feierman, Maimonides Medical Center, Brooklyn, New York, USA*

Abstract

Objective: To show that the addition of Quadratus Lumborum Block (QLB) to multimodal perioperative pain management decreases perioperative opioid use, decreases pain scores, and facilitates same day discharge after robotic assisted laparoscopic radical prostatectomies (RALP).

Methods: We performed a retrospective comparative of patients who underwent RALP for prostate cancer from 2016 to 2020. Our study group consisted of 179 patients who received a bilateral QLB. There were 128 patients who underwent the same procedure but received infiltration at the incision sites by the surgical team. The primary outcome was length of stay (LOS), and secondary outcomes included post-operative pain scores and perioperative opioid use.

Results: The mean LOS was statistically significant lower in QLB group compared to the control group: 6.9 hrs. vs. 25.7 hrs. Respectively, $p < 0.001$. Intraoperative use of opioids was also significantly less in the QLB group, 23.9 mg (morphine equivalents) vs. 32.0 mg in the control group, $p < 0.001$. Peak pain scores were not significantly different at 0, 2, and 4 hours (Table 1); however, the difference in peak pain scores at the 6 hrs. Interval was significant lower in the QLB group (1.17) vs. the control group (2.84), $p < 0.001$.

Conclusions: This study suggests that ambulatory RALP for prostate cancer is achievable. The majority of patients that received QLB and stayed overnight were patients that had their procedure performed later in the day. Therefore, successful RALP can be an ambulatory procedure with excellent pain control, via the use of a QLB, and when performed earlier in the day.

Background

Prostate cancer is the most common cancer in American men, other than skin cancer. About 1 in 8 men will be diagnosed with prostate cancer during his lifetime. The 5-year and 10-year survival rate for men suffering from prostate cancer is 98% [1]. However, the survival rate was not always this high. In fact, the death rate dropped by around half from the mid-1990s to the mid-2010s as a result of advances in screening and treatment. The search for a technique that would guarantee increased efficacy and decreased morbidity had a profound impact on the treatment of prostate cancer as in any other area of medicine. In today's era, after over one hundred years of surgical developments and innovations, we treat and cure prostate cancer with robotic surgery.

Radical perineal prostatectomy, developed in 1904 at Johns Hopkins Hospital by Hugh Hampton Young, was among one of the first prostate procedures [2,3]. In 1947, the retropubic approach was introduced by Terrance Millin [4] and, in 1991, Schuessler and colleagues reported on the first laparoscopic radical prostatectomy [5]. From September 1991 to May 1995, a total of 9 laparoscopic procedures were analyzed. This initial study was used to determine if there were any significant benefits to using a laparoscopic approach compared to using a more invasive radical retropubic

Citation: Feierman Y, Gupta PM, Escobar D, Hossain A, Fairchild L, et al. (2023) The Use of the Liposomal Bupivacaine in the Quadratus Lumborum Block and Early Surgery Are Key Elements in Facilitating Ambulatory Robotic-Assisted Laparoscopic Radical Prostatectomy. Int J Anesthetic Anesthesiol 10:161. doi.org/10.23937/2377-4630/1410161

Accepted: August 25, 2023: **Published:** August 27, 2023

prostatectomy. After operating on 9 patients under general endotracheal anesthesia using laparoscopic RRP, and comparing the results from using a radical retropubic prostatectomy, the laparoscopic methods were found to not have any advantages. The use of laparoscopic technology was found to be time consuming and, due to a lack of technology and usage of the laparoscopic approach at that time, required new specialized equipment and technical training. Laparoscopic radical prostatectomies were thought to have a disadvantage due to prolonged operative times, steep learning curves, and a failure to demonstrate major advantages over open surgery [5]. However, more in depth studies began to take place as laparoscopic surgery became more popular. Laparoscopic radical prostatectomy became more feasible and monetarily cheaper through time and experience. As surgeon experience increased, operating time decreased along with lower associated morbidity rates and hospital time [6-8]. In 2004, the Henry Ford Hospital described the first robotic prostatectomy and soon after surgeons were publishing data comparing radical retropubic prostatectomy (RRP, Standard of care at that time) to robotically assisted laparoscopic radical prostatectomy (RALP). The effects of 30 consecutive patients undergoing conventional RRP were compared to 30 consecutive patients who underwent RALP. Although RALP was found to be a longer and more costly approach, it appeared that patients experienced less blood loss, less pain, as well as earlier discharge from their hospital. For surgeons who were experienced in RRP, it was also suggested that it would be reasonably easier for them to learn RALP [9,10].

Recent trends indicate a shift toward RALP for prostate cancer versus a traditional open surgical approach [11,12]. In today's world, RALP is the preferred surgical approach for prostate cancer surgery and a reference treatment option for localized, intermediate, and high-risk prostate cancer [13,14]. Robotic assistance demonstrates benefits in less intra-operative blood loss, decreased length of hospital stay, and faster post-operative recovery which also leads to lower hospital bills and patients returning to work in a shorter time period. Even with a discharge as early as postoperative day 1, the cost of the robot still overshadows the savings of a shorter hospital stay [15]. In places like France, the UK, and Germany where increasing the length of a patients stay does not increase hospital bills, some may assume that decreasing hospital length is in fact not in the patients benefit; rather, it is a social pressure to reduce costs and increase profits [12]. However, by reducing patient stay post-surgery to an outpatient procedure, this can reduce risk of infection by eliminating patients' exposure to different floors, faculty, and other patients. Making RALP an outpatient procedure also can improve patient perception of the procedure, thus raising their morale and confidence pre and post-operation [12,16]. Martin, et al. demonstrated that all of their patients surveyed were discharged the same day after RALP and had unanimously high satisfaction scores, with most scores over 90% on the Patient Judgment System-24 [15]. Therefore, if same day discharge has multiple benefits to both patients and global medical cost, how can we ensure same day discharge for all of our patients undergoing RALP in our hospital?

Even though robotic assistance reduces blood loss, transfusion requirements, improves dexterity and, therefore, has better rates of urinary continence and erectile function post-operatively, when doing a head-to-head comparison to open approach, it has not shown a significant reduction in post-operative pain [17]. With pain being one of the highest reported factors as a deterrent to same-day discharge, optimal pain management is crucial to postoperative recovery [18,19]. After RALP, abdominal and incisional pains are prominent sources of moderate dynamic pain scores [20,21]. Currently, there is no optimal pain management protocol for patients undergoing radical prostatectomy, and, more importantly, there is a lack of a opioid sparing protocol. Given that it is a high probability that we have already achieved a peak in surgical advances and techniques, we now shift our focus to anesthetics in hopes of better managing postoperative pain. However, head-to-head comparisons have not shown a significant reduction in post-operative pain with the robotic-assisted approach [17]. The Quadratus Lumborum Block (QLB) is safe, is relatively easy to perform under ultrasound guidance, and has gained popularity over the past decade [22]. We hypothesize the QLB may be a useful addition to multimodal perioperative pain management, minimizing opioid use, decreasing pain scores, and facilitating same day discharge.

Methods

After IRB approval, we performed a retrospective comparative analysis of ASA 2&3 patients who underwent robotic-assisted laparoscopic radical prostatectomy (RALP) for prostate cancer from 2016 to 2020. Our study group consisted of 179 patients who received a bilateral QLB with liposomal bupivacaine and 0.25% bupivacaine post-induction of general anesthesia, but prior to surgical incision. The control group consisted of 128 patients who underwent the same procedure but received infiltration of liposomal bupivacaine and 0.25% bupivacaine mixture at the incision sites by the surgical team. The primary outcome was length of stay (LOS), and secondary outcomes included post-operative pain scores (0-10) at 2, 4 and 8 hours and perioperative opioid use (in IV Morphine equivalents).

QLB steps

The patients were positioned in the lateral decubitus position. A curvilinear low frequency ultrasound probe was positioned on the flank between the iliac crest and the twelfth rib. Ultrasound depth was set to about

6-10 cm to optimize the image. The anterior abdominal muscles were identified and traced posteriorly to the point of them conjoining to form the aponeurosis, posterolateral to the QL muscle. The quadratus lumborum anatomy was confirmed based upon the posterolateral position to the psoas major muscle, depth to the aponeurosis of the conjoining anterior abdominal muscles, and anterior position to the lumbar transverse process. The QL 1 (lateral) block was accomplished by injecting 10 mL of 0.25% bupivacaine between the aponeuroses of the internal oblique and transversus. The QL 3 (anterior) block was accomplished by injecting 10 mL of 0.25% bupivacaine followed by 5 mL of liposomal bupivacaine diluted to 10 mL with normal saline (5 mL of liposomal bupivacaine and 5 mL of normal saline) medial to the QL muscle, between the QL and psoas major muscles. This was repeated on the opposite side. Additionally, a mixture of 10 mL liposomal bupivacaine and 10 mL 0.25% bupivacaine infiltrated into their operative wounds. The control group received a mixture of 10 mL liposomal bupivacaine and 10 mL 0.25% bupivacaine infiltrated into their operative wounds. Statistical analysis was performed using a Student T-Test for continuous variables and using the Fisher Exact Test for non-continuous variables.

Results

Table 1 shows the demographic data for both groups. The data was nearly identical for both groups and was not statistically different (Table 1). Report peak pain scores were not significantly different at 0, 2, and 4 hours (Table 2), likely due to the residual effect of general anesthesia and intraoperative narcotics. However, the difference in peak pain scores at the 6-8 hrs. interval was significant lower in the QLB group (1.17) vs. the control group (2.84), $p < 0.001$. The use of intraoperative opioids was also significantly less in the QLB group, 23.9 ± 8.73 mg (morphine equivalents) vs. 32.0 ± 10.13 mg in the control group, $p < 0.001$ (Table 2). The use of opioids in the PACU was slightly lower in the QLB group compared to the control group (2.00 ± 2.35 vs, 2.24 ± 2.44, respectively) but this was not statistically significant ($p < 0.657$, Table 2).

Length of surgery was similar in all groups and was not statistically significant (Table 3). Additionally, case end time were similar for the QLB cases compare to the non-QL block cases; all 1st cases on average end at the same time at 12:55 vs. 13:02 and the 2nd case also ended at nearly the same time 18:13 vs. 17:33, QL block, vs. non QL block respectively (Table 3).

The mean LOS was lower and statistically significant

Table 1: Demographic data.

Group	Demographic Data (X ± SD)					
	Age (years)	Weight (kg)	Height (in)	BMI	ASA	N
Control	61.7 ± 7.5	85.1 ± 14.9	68.0 ± 3.1	28.5 ± 4.4	2.4 ± 0.5	128
QLB	62.7 ± 7.4	85.6 ± 15.2	68.3 ± 5.3	28.7 ± 4.9	2.4 ± 0.5	179
p value	0.33	0.73	0.51	0.82		

Demographic data on both groups. p values were obtained using the Student T-Test assuming equal variance.

Table 2: Comparison of QLB vs. Control Group.

	N	Mean	SD	p
QLB LOS[1]	179	6.88	7.93	< 0.001
Control LOS[1]	128	25.68	14.70	
QLB Pain[2] 0 hr	178	0.68	1.68	0.219
Control Pain[2] 0 hr	128	0.98	2.09	
QLB Pain[2] 2 hr	170	3.82	3.59	0.214
Control Pain[2] 2 hr	117	4.37	3.43	
QLB Pain[2] 4 hr	123	2.50	2.86	0.721
Control Pain[2] 4 hr	91	2.35	2.69	
QLB Pain[2,3] 6-8 hr	47	1.17	2.26	< 0.001
Control Pain[2,3] 6-8 hr	101	2.84	2.82	
QLB OR Opioid use[4]	179	23.93	8.73	< 0.001
Control OR Opioid use[4]	128	32.03	10.13	
QLB PACU Opioid use[4]	179	2.00	2.35	0.657
Control PACU Opioid use[4]	128	2.24	2.44	

QLB: Quadratus Lumborum Block. [1]Length of Stay (LOS) in hours was calculated from the time of arrival in the PACU until discharge; [2]pain score on a scale of 0-10: 10 = maximum pain; [3]The last set of pain scores was obtained in the 6-8-time frame; [4]Opioid use was recorded in an IV morphine equivalent dose (mg).

Table 3: The length of surgery for the various groups was compared using the Student T-Test.

		N	Length of Surg (Min)	Case end time	Over night	% Over-night	% SDD
All Cases	QLB	179	221[a]		31	17	83[d]
	Control	128	226		128	100	0
1st Case	QLB	111	224[b]	12:55	2	2	98[e]
	Control	74	235	13:02	74	100	0
2nd Case	QLB	68	217[c]	18:13	29	43	57[f]
	Control	54	212	17:33	54	100	0

[a]All QLB cases were compared to all Control cases: $p < 0.44$; [b]1st QL block case were compared to 1st Control cases: $p < 0.12$; [c]2nd QLB case were compared to 2nd Control cases: $p < 0.53$. (Student T-Test). The same day discharges (SDD) for the various groups were compared using the Fisher Exact Test; [d]All QLB cases were compared to all Control cases: $p < 0.00001$; [e]1st QLB cases were compared to 1st Control cases: $p < 0.00001$; [f]2nd QLB cases were compared to 2nd Control cases: $p < 0.00001$.

Table 4: Comparison of QLB to a theoretical control group.

		N	Overnight (N)	Overnight (%)	Same day discharge (%)	p
All Cases	QLB	179	31	17%	83%	
	Control (Theoretical)	128	47	35%	65%	0.00001
1st Case	QLB	111	2	2%	98%	
	Control (Theoretical)	74	22	30%	70%	0.00001
2nd Case	QLB	68	29	43	57	0.0032
	Control (Theoretical)	54	38	70	30	

in QLB group (6.88 ± 7.93 hrs., X ± SD) compared to the control group: 25.7 ± 14.70 hrs., $p < 0.001$, (Table 2). We express the data as same day discharge vs. patients that stayed overnight. All patients that did not have a QLB were discharged after at least after one overnight stay. Only 17% of the patients that had a QLB stayed overnight ($p < 0.00001$, Table 3). Abaza, et al. found that significantly more patients were discharge home if they had their surgery performed earlier in the day [23]. If the cases were grouped as 1st case vs. 2nd or later case, only 2% of the patients stayed overnight if they had a QLB and were the 1st case of the day (Table 3, $p < 0.00001$).

Discussion

The Quadratus Lumborum Block (QLB) is a novel truncal block that involves injecting local anesthetic adjacent to the quadratus lumborum muscle [24]. The QLB is currently used for cesarean section, hip hemiarthroplasty, inguinal hernia repair, and nephrectomies [25]. Multiple studies have shown the QLB's efficacy in reducing opioid requirements and postoperative pain to promote recovery after these stated surgeries [24,26-29]. A recent study showed that the use of a Transversus Abdominis Plane (TAP) block reduced length of stay in post-partum patients that had a cesarean delivery [30]. However, the QLB has shown superiority to TAP block. Along with reduced consumption of postoperative morphine and pain scores compared to the TAP block, the QLB has been shown to help patients significantly post-surgery [31,32]. Therefore, we have started using the QLB in our robotic-assisted laparoscopic prostatectomies.

In this retrospective analysis, we compared patients who received bilateral QLB with liposomal bupivacaine and 0.25% bupivacaine to patients who underwent the same procedure but received infiltration of liposomal bupivacaine and 0.25% bupivacaine mixture at the incision sites by the surgical team at the end of the procedure. Length of stay and use of intraoperative opioids was significantly lower in patients who received QLB. All patients that did not receive QLB were discharged from the hospital after at least one postoperative day. In comparison, only 17% of patients that had QLB required hospital admission postoperatively. Reported peak pain scores were not significantly different at 0, 2, and 4 hrs. (Table 2); however, the difference in peak pain scores at the 6 hr. interval was significant between QLB group (1.17) when compared to the control group (2.84), $p < 0.001$.

In a large series of 500 patients being offered same day discharge after RALP, it was implicated in their study that same day discharge was a viable option [23]. With approximately 49% of the 500 patients being discharged home on the same day (and 65% of the last 100 patients), it was determined that most of these patients had no significant health risks after discharge. While observing patients who stayed overnight, it was found that in every case these patients had reported high pain scores. When looking at the data for patients who were 1st start cases, approximately 69.5% of patients were discharged on the same day, compared to 2nd and 3rd cases, which were 42% and 2% of patients respectively [23]. This is analogous to what we found in our study where non-first cases had significantly higher overnight stays compared to first cases (30% vs. 2%). However, before QLB performed, the mindset was not to discharge patients undergoing RALP on the same day. Therefore, to accurately compare the patients who were discharged on the same day with and without QLB, we used the data from Abaza, et al. in respect to those who had same day discharge [23]. By taking our control group (128 patients) and taking the best percentage of same day discharge for all cases (65%, last 100 patients), 81 patients could have been discharged and 47 would have stayed overnight. While using this best-case data from Abaza, et al., our data for the QLB would still be statistically better compared to the hypothetical control group (Table 4, $p < 0.0001$).

This is due to the QLB eliminating pain, one of the leading causes of overnight admissions. If we were to look at only 1st day cases, where 69.5% of patients were discharged on the same day [23], we would still have significantly better same day discharge rates (98% vs. 69.5%) with QLB ($P < 0.0001$; Table 4). Other factors can also play a role in preventing same day discharges, i.e., late finishing times. When we looked at Abaza, et al., their 2nd cases ended on average at 1:00 pm with 57% staying overnight and their 3rd cases ended at 4:00 pm with over 97% stayed overnight. Our group of 2nd cases ended on average at 5:30 pm for our control group and at 6:00 pm for the QLB group (Table 3). Even if we combined their data for all non-1st cases, 70% of their cases stayed overnight. Even using the combined data with a 70% overnight stay, in our QLB group only 43% stayed overnight despite having even later finishing times. Although same day discharge may be regarded as an option regardless of QLB, many patients may stay in the hospital due to their pain scores or surgeon uncertainty [23]. By offering QLB, these factors can be eliminated therefore decreasing patients' pain, and creating RALP into an outpatient procedure.

We respectfully disagree with practitioners from Europe that one of the main motivations for same day discharge is to save money [12]. In regard to a socialized system of medicine, increasing the length of stay still incurs charges. Although it may not be reflected within patient medical bills, somebody has to pay for the use of the hospital facilities. Furthermore, besides facility charges, keeping a patient overnight has the potential to delay another patient's surgery due to lack of occupational area within the hospital and increased of length of stay has been associated with a higher odds ratio of mortality [33].

Summary

Although this is a retrospective study, the data certainly suggests that QLB provides significant pain control after a RALP. Furthermore, this might result in a shorter length of stay, decreasing hospital cost, and hospital associated morbidity and mortality.

References

1. ASCO (2022) Prostate Cancer: Statistics.
2. Young HH (2002) The early diagnosis and radical cure of carcinoma of the prostate. Being a study of 40 cases and presentation of a radical operation which was carried out in four cases. 1905. J Urol 168: 914-921.
3. Young HH (2002) The early diagnosis and radical cure of carcinoma of the prostate. Being a study of 40 cases and presentation of a radical operation which was carried out in four cases. 1905. J Urol 167: 939-946.
4. Millin T (1947) The surgery of prostatic obstructions. Ir J Med Sci 22: 185-189.
5. Schuessler WW, Schulam PG, Clayman RV, Kavoussi LR (1997) Laparoscopic radical prostatectomy: Initial short-term experience. Urology 50: 854-857.
6. Guillonneau B, Vallancien G (2000) Laparoscopic radical prostatectomy: The Montsouris experience. The Journal of urology 163: 418-422.
7. Guillonneau B, Vallancien G (2000) Laparoscopic radical prostatectomy: The Montsouris technique. J Urol 163: 1643-1649.
8. Rassweiler J, Seemann O, Schulze M, Teber D, Hatzinger M, et al. (2003) Laparoscopic versus open radical prostatectomy: A comparative study at a single institution. J Urol 169: 1689-1693.
9. Menon M, Tewari A, Vattikuti Institute Prostatectomy T (2003) Robotic radical prostatectomy and the Vattikuti Urology Institute technique: An interim analysis of results and technical points. Urology 61: 15-20.
10. Menon M, Tewari A, Baize B, Guillonneau B, Vallancien G (2002) Prospective comparison of radical retropubic prostatectomy and robot-assisted anatomic prostatectomy: The Vattikuti Urology Institute experience. Urology 60: 864-868.
11. Kim SP, Hollenbeck BK, Parker WR, Labo J, Wood DP Jr (2008) Feasibility and safety of robot-assisted salvage prostatectomy for recurrent prostate cancer following radiation therapy. J Robot Surg 2: 81-83.
12. Ploussard G, Almeras C, Beauval JB, Gautier JR, Loison G, et al. (2022) Same-day discharge surgery for robot-assisted radical prostatectomy in the era of ERAS and prehabilitation pathways: A contemporary, comparative, feasibility study. World J Urol 40: 1359-1365.
13. Ploussard G (2018) Robotic surgery in urology: Facts and reality. What are the real advantages of robotic approaches for prostate cancer patients? Curr Opin Urol 28: 153-158.
14. Mottet N, van den Bergh RCN, Briers E, Broeck TVD, Cumberbatch MG, et al. (2021) EAU-EANM-ESTRO-ESUR-SIOG Guidelines on Prostate Cancer-2020 Update. Part 1: Screening, Diagnosis, and Local Treatment with Curative Intent. Eur Urol 79: 243-262.
15. Martin AD, Nunez RN, Andrews JR, Martin GL, Andrews PE, et al. (2010) Outpatient prostatectomy: Too much too soon or just what the patient ordered. Urology 75: 421-424.
16. Kotamarti S, Williams T, Silver M, Silver DA, Schulman AA (2020) Rethinking the need for overnight admission after robotic-assisted laparoscopic prostatectomy. J Robot Surg 14: 913-915.
17. Awad H, Walker CM, Shaikh M, Dimitrova GT, Abaza R, et al. (2012) Anesthetic considerations for robotic prostatectomy: A review of the literature. J Clin Anesth 24: 494-504.

18. Dobbs RW, Nguyen TT, Shahait M, Lee DJ, Kim JL, et al. (2020) Outpatient Robot-Assisted Radical Prostatectomy: Are Patients Ready for Same-Day Discharge? J Endourol 34: 450-455.

19. Joshi GP, Schug SA, Kehlet H (2014) Procedure-specific pain management and outcome strategies. Best Prac Res Clin Anaesthesiol 28: 191-201.

20. Woldu SL, Weinberg AC, Bergman A, Shapiro EY, Korets R, et al. (2014) Pain and analgesic use after robot-assisted radical prostatectomy. J Endourol 28: 544-548.

21. Magheli A, Knoll N, Lein M, Hinz S, Kempkensteffen C, et al. (2011) Impact of fast-track postoperative care on intestinal function, pain, and length of hospital stay after laparoscopic radical prostatectomy. J Endourol 25: 1143-1147.

22. Akerman M, Pejcic N, Velickovic I (2018) A Review of the quadratus lumborum block and ERAS. Front Med (Lausanne) 5: 44.

23. Abaza R, Martinez O, Ferroni MC, Bsatee A, Gerhard RS (2019) Same day discharge after robotic radical prostatectomy. J Urol 202: 959-963.

24. Blanco R, Ansari T, Riad W, Shetty N (2016) Quadratus lumborum block versus transversus abdominis plane block for postoperative pain after cesarean delivery: A randomized controlled trial. Reg Anesth Pain Med 41: 757-762.

25. Elsharkawy H, El-Boghdadly K, Barrington M (2019) Quadratus lumborum block: Anatomical concepts, mechanisms, and techniques. Anesthesiology 130: 322-335.

26. Ishio J, Komasawa N, Kido H, Minami T (2017) Evaluation of ultrasound-guided posterior quadratus lumborum block for postoperative analgesia after laparoscopic gynecologic surgery. J Clin Anesth 41: 1-4.

27. Murouchi T, Iwasaki S, Yamakage M (2016) Quadratus lumborum block: Analgesic Effects and Chronological Ropivacaine Concentrations After Laparoscopic Surgery. Reg Anesth Pain Med 41: 146-150.

28. McCrum CL, Ben-David B, Shin JJ, Wright VJ (2018) Quadratus lumborum block provides improved immediate postoperative analgesia and decreased opioid use compared with a multimodal pain regimen following hip arthroscopy. J Hip Preserv Surg 5: 233-239.

29. Corso RM, Piraccini E, Sorbello M, Bellantonio D, Tedesco M (2017) Ultrasound-guided transmuscular quadratus lumborum block for perioperative analgesia in open nephrectomy. Minerva Anestesiol 83: 1334-1335.

30. Feierman DE, Kim J, Bronstein A, Miller A, Dgheim C, et al. (2021) The use of bilateral transversus abdominis plane blocks with liposomal bupivacaine on postoperative cesarean delivery patients during COVID-19 pandemic is associated with reduced narcotics use and reduced length of stay. Womens Health (Lond) 17: 17455065211058046.

31. Liu X, Song T, Chen X, Zhang J, Shan C, et al. (2020) Quadratus lumborum block versus transversus abdominis plane block for postoperative analgesia in patients undergoing abdominal surgeries: A systematic review and meta-analysis of randomized controlled trials. BMC Anesthesiol 20: 53.

32. Oksuz G, Bilal B, Gurkan Y, Urfalioglu A, Arslan M, et al. (2017) Quadratus lumborum block versus transversus abdominis plane block in children undergoing low abdominal surgery: A randomized controlled trial. Reg Anesth Pain Med 42: 674-679.

33. Lingsma HF, Bottle A, Middleton S, Kievit J, Steyerberg EW, et al. (2018) Evaluation of hospital outcomes: The relation between length-of-stay, readmission, and mortality in a large international administrative database. BMC Health Serv Res 18: 116.