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Comparison between Transversus Abdominis Plane Block and Rectus Sheath Block on Postoperative Pain in Lower Abdominal Surgeries

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ABSTRACT

Background: Many major lower abdomen operations cause significant pain and discomfort after the procedure. If postoperative pain is not addressed right once, it may hinder the patient's mobility, increasing the risk of serious complications. For these patients, a multimodal postoperative pain management program that offers superior analgesia with few adverse effects is necessary.

Objective: To compare the effect of postoperative transversus abdominis plane (TAP) block versus postoperative RS block on postoperative pain, analgesic requirements and hemodynamic changes after lower abdominal surgeries.

Patients and Methods: This study was conducted in Ain Shams University Hospitals, Egypt. 30 patients were randomly divided into 2 groups: Group A: Transversus abdominis plane (TAP) Group (15 Patients), and Group B: Rectus sheath (RS) Group (15 Patients).

Results: The TAP block (Group A) resulted in a more stable hemodynamic profile, with consistently higher mean arterial pressure (MAP) across all time points compared to the RS block (Group B). Additionally, 53.3% of the TAP group required the first morphine dose, significantly lower than 86.7% in the RS group, with the TAP group needing lower initial doses. These results imply that although both blocks work well, the TAP block may offer more consistent early postoperative pain control and reduce initial opioid requirements, whereas the RS block may be more beneficial later in the recovery period.

Conclusion: The comparison between TAP block and RS block for postoperative pain management in lower abdominal surgeries demonstrates that the TAP block provides superior initial pain relief, as evidenced by significantly lower immediate morphine requirements and lower MAP readings, indicating better hemodynamic stability.

Keywords: TAP block, MAP, RS block, Abdominal surgeries.

INTRODUCTION

Many major lower abdomen operations cause significant pain and discomfort after the procedure. If postoperative pain is not addressed right once, it may hinder the patient's mobility, increasing the risk of complications including arrhythmia, myocardial ischemia, and thrombosis. A multimodal postoperative pain management regimen that offers superior analgesia with few adverse effects is necessary for these individuals [(1)].

Postoperative pain is treated using a variety of techniques. It is possible to deliver opioids intravenously, neuraxially, or both. Opioids, however, can cause respiratory depression, nausea, vomiting, and urine retention. In an effort to decrease opioid use and improve postoperative analgesia, regional anesthetic methods are increasingly being employed [(2-4)].

The abdominal wall incision is responsible for a significant portion of the discomfort that patients suffer following abdominal surgery. The sensory afferents of the abdominal wall travel through the transverses abdominis plane superficial to the transverses abdominis muscle, piercing the posterior RS and passing between the rectus muscle and its sheath. TAP and RS blocks are utilized to block the sensory nerves of the anterior abdominal wall, which aids in pain reduction following lower abdominal procedures [(5-7)].

This study aimed to compare the effect of postoperative TAP block versus postoperative RS block on postoperative pain, analgesic requirements and hemodynamic changes after lower abdominal surgeries.

PATIENTS AND METHODS

This study is a prospective, randomized, controlled study. This study was conducted in Ain Shams University hospitals, Cairo, Egypt. The period of the study was 6 months. The study compared the efficacy of transversus abdominis plane (TAP) and rectus sheath (RS) blocks in managing postoperative pain among 30 patients, equally divided between the two groups. Both groups were demographically similar, ensuring reliable comparisons.

Inclusion criteria: Patients aged from 21 to 60 years, and patients ASA I or II having elective surgery on the lower abdomen.

Exclusion Criteria: patient's refusal, history of cardiac disease, known allergy to any of the study drugs, underlying liver or renal failure, chronic neurological or psychiatric condition, hemodynamically unstable patients, coagulopathy, obesity (BMI >35 kg/m^2) and infection of the skin where the needle was punctured.

Sample size: Setting power at 90% and α error at 0.05 and calculating sample size using the PASS 15.0 software in accordance with **Mohammad *et al.* [(8)],** the expected mean pain score in study groups 6 hours post-operatively were 4(1-6) and 3(1-4). The sample of 15 patients per group was needed to detect difference between two groups.

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Study procedures:

Qualified personnel were undergoing the study procedures:

A) Preoperative settings: Before surgery, all the patients were evaluated to make sure they met the aforementioned inclusion requirements through a thorough history gathering, physical examination, and laboratory testing.

Sampling method: The patients were split into two equal groups using computer program randomization: (1) TAP group (n =15 patient), and (2) RS group (n =15 patient).

B) Intraoperative settings:

- ECG, NIBP, SpO_2 was applied, and baseline readings were taken before induction, no sedation was given.
- Anesthesia was induced after a period of (3 to 5) minutes of preoxygenation with 100% oxygen with intravenous injection of fentanyl (1-2 μg/kg) and propofol (1-2 mg/kg) and a muscle relaxant (Atracurium 0.5 mg/kg) after loss of patient's consciousness.
- Mechanically controlled ventilation after ETT insertion to achieve adequate tidal volume and $ETCO_2$ with parameters starting from (Tv 500ml/RR 12 BPM/PEEP 5 cmH_2O).
- Anesthesia was maintained with 60% oxygen flow in air, 1-1.5% isoflurane, and atracurium boluses administered throughout time. At the completion of the procedure, all patients received neostigmine 0.05 mg/kg and atropine 0.1 mg/kg to alleviate residual neuromuscular blockade.

C) Postoperative settings:

1) In the (TAP) group, following surgery, using a linear probe, a bilateral ultrasound-guided TAP block was carried out. The external, internal, and transversus abdominis muscles were seen by sliding the probe in a medial-lateral manner after it was positioned transversely between the iliac crest and costal border in the anterior axillary line. Midway down the axillary line, the block was executed. After inserting the needle medially to laterally in-plane, 20 mL of bupivacaine 0.25% was administered under direct vision in the plane between the fascia deep to the internal oblique muscle on each side and the transversus abdominis muscle.

2) In the (RS) group, following surgery, a linear probe was used to do a bilateral ultrasound-guided RS block. To see the rectus muscle, RS, and external and internal oblique muscles, this was positioned transversely at the lateral side of the umbilicus and moved laterally. The location where the best visibility of the posterior RS was achieved was designated as the injection area. The needle was placed in-plane, and the RS was bilaterally injected with 20 mL of bupivacaine 0.25% on each side.

The following parameters were assessed and recorded:

1- Postoperative pain: Postoperative pain was measured using the Numeric Rating Scale (NRS) ranging from 0 (no pain) to 10 (worst imagined agony) at postoperative hours 1, 6, 12, and 24.

2- Analgesic requirements: If the pain score is more than 3, record the total morphine consumption at postoperative hours 1, 6, 12, and 24 (each single dosage equals 5 mg, with evaluation after 20 minutes).

3- Hemodynamic changes: HR and MABP were recorded at baseline, after GA induction, every 15 minutes until the completion of operation, immediately after recovery, and at 1, 6, 12, and 24 postoperatively.

Measure outcomes:

The main objective of this research was to compare the mean postoperative pain score between TAP block and RS block and secondary outcomes are to assess postoperative analgesic consumption and hemodynamic changes.

Ethical approval:

The Ethics Committee of Ain Shams Faculty of Medicine has given its approval to this investigation. Each participant completed a permission form when all information was received. Throughout its implementation, the study complied with the Helsinki Declaration.

Statistical analysis

SPSS version 23.0 was used for the analysis of recorded data. In the case of parametric (normal) distribution, the quantitative data were displayed as mean± SD and ranges, whereas non-parametric (non-normally distributed) variables were displayed as median with IQR. Additionally, qualitative characteristics were shown as percentages and numbers. Data were examined for normalcy using the Shapiro-Wilk and Kolmogorov-Smirnov tests. Using the independent-samples t-test of significance, two means were compared. Using qualitative data, the X^2-test was used to compare groups. The allowable margin of error was set at 5%, while the confidence interval was set at 95%. P-values less than 0.05 were regarded as significant. A P-value below 0.01 was deemed highly significant. An unimportant P-value was defined as greater than 0.05.

RESULTS

The mean age and BMI were nearly identical between the groups, with no significant differences. Both groups had an equal gender distribution. The ASA physical status classification was also similar between the groups, with no significant difference (Table 1).

Table (1): Comparison of Demographic Data among Group A and Group B

		Group A (n=15)		Group B (n=15)		Test value	P-value
		N	%	N	%		
Age (year)	**Mean ±SD**	39.3±11.16		39.26±10.37		t=0.017	0.987
	Range	23 - 55		23 – 55			
BMI (Kg/m^2)	**Mean ±SD**	26.0±4.92		26.3±4.90		t=0.167	0.868
	Range	18.5 - 34		18 – 33			
Sex	**Male**	7	46.7	7	46.7	0	1
	Female	8	53.3	8	53.3		
ASA	**I**	10	66.7	11	73.3	X^2=0.159	0.690
	II	5	33.3	4	26.7		

Using: t-Independent Sample t test for Mean±SD; X2= Chi- Square test, p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.01 is highly significant

There was no significant difference in the duration of surgery between the two groups (Table 2).

Table (2): Comparison of Duration of Surgery between Group A and Group B

	Group A (n=15)	Group B (n=15)	Test value	P-value
Duration of Surgery (min)	95.3±25.4	103.5±21.6	0.960	0.345
	60 – 139	68 – 137		

Using: t-Independent Sample t-test for Mean±SD; p-value >0.05 is insignificant.

At baseline, Group A has insignificantly lower MAP compared to Group B. This trend persists post-operatively at 1 hour, 6 hours, 12 hours, and 24 hours, with Group B consistently showing significant higher MAP values (Table 3).

Table (3): Comparison of MAP between Group A and Group B

	Group A (n=15)	Group B (n=15)	Test value	P-value
MAP baseline	74.9±1.71	76.5±3.81	0.749	0.460
	72 – 78	72 – 79		
MAP 1 hr post-operative	**73.9±9.96**	**81.7±7.11**	**5.846**	**<0.001****
	71 – 79	**75 – 87**		
MAP 6 hrs post-operative	**74.5±9.22**	**82.3±7.41**	**2.554**	**0.016***
	72 – 80	**76 – 87**		
MAP 12 hrs post-operative	**74.6±9.48**	**82.6±7.44**	**2.593**	**0.015***
	72 – 82	**74 – 88**		
MAP 24 hrs post-operative	**74.6±9.65**	**81.7±7.27**	**2.286**	**0.030***
	71 – 80	**77 – 84**		

*: Significant; **: Highly significant.

Group A consistently showed slightly higher HR values than Group B at base line and post-operatively (Table 4).

Table (4): Comparison of HR between Group A and Group B

	Group A (n=15)	Group B (n=15)	Test value	P-value
HR baseline	86.1±5.09	82.8±6.76	1.524	0.139
	76 – 95	74 – 95		
HR 1 hr post-operative	86.7±5.57	83.3±5.21	1.520	0.140
	75 – 96	73 – 96		
HR 6 hrs post-operative	86.3±5.20	83.1±6.82	1.475	0.151
	77 – 96	72 – 95		
HR 12 hrs post-operative	86.2±5.24	82.9±6.51	1.514	0.141
	76 – 96	73 – 94		
HR 24 hrs post-operative	86.4±5.23	82.9±6.69	1.580	0.125
	75 – 95	74 – 95		

Using: t-Independent Sample t test for Mean±SD; X2= Chi- Square test, p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.01 is highly significant.

At baseline and 1 hour post-operatively, both groups have similar NRS scores with no significant differences. However, at 6 hours post-operatively, Group A reported significantly higher pain score compared to Group B, while at 12 hours post-operatively Groub B reported higher pain score. By 24 hours post-operatively, pain scores equalized again, with both groups reporting similar low pain levels (Table 5).

Table (5): Comparison of NRS between Group A and Group B

	Group A (n=15)	Group B (n=15)	Test	P-value
NRS baseline	0 (0-1)	0 (0-1)	0.359	0.720
	0 – 1	0 – 1		
NRS 1 hr post-operative	0 (0-1)	1 (0-1)	1.271	0.204
	0 – 2	0 – 3		
NRS 6 hrs post-operative	**3 (3-4)**	**2 (2-3)**	**2.506**	**0.012***
	2 – 4	**2 – 5**		
NRS 12 hrs post-operative	**3 (3-3)**	**4 (4-5)**	**2.979**	**0.003***
	2 – 5	**2 – 5**		
NRS 24 hrs post-operative	1 (1-1)	1 (1-1)	-	-
	0 – 1	1 – 1		

Using: U- Mann Whitney test for Median (IQR); p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.01 is highly significant.

A significantly higher percentage of patients in Group B required the first dose of morphine (86.7%) compared to Group A (53.3%). The mean first dose of morphine was also significantly higher in Group B than in Group A. Both groups had an equal number of patients requiring a second dose of morphine (20%), with identical mean dosages. The total morphine dosage was comparable between the groups, indicating not significant overall difference in morphine consumption (Table 6).

Table (6): Comparison of Morphine Dosage among Group A and Group B

		Group A (n=15)		Group B (n=15)		Test value	P-value
		N	%	N	%		
Number of patients required 1st dose of morphine		**8**	**53.3**	**13**	**86.7**	**3.968**	**0.046***
1st dose of Morphine (mg)	Mean ±SD	**2.7±2.58**		**4.3±1.75**		**t=2.066**	**0.048***
	Range	**5 - 5**		**5 – 5**			
Number of patients required 2nd dose of morphine		3	20	3	20.0	0	1
2nd dose of morphine (mg)	Mean ±SD	1.0±2.07		1.0±2.07		0	1
	Range	5 - 5		5 – 5			
Total morphine Dosage (mg)	Mean ±SD	6.15±1.19		6.87±1.58		t=0.684	0.502
	Range	5 – 10		5 – 10			

t= Independent Sample t test; X^2= Chi- Square test, * significant; ** highly significant.

DISCUSSION

The current study compared between the results of TAP block **group (A)** and RS block **group (B)** for postoperative pain management. The study included two groups, each consisting of 15 patients. They were well-matched in terms of demographic and baseline characteristics, with mean ages of 39.3 ±11.16 years and 39.26 ± 10.37 years, respectively, and without significant difference in age (P=0.987).

Both groups had similar BMI with means of 26.0 ± 4.92 kg/m² for the TAP group and 26.3 ± 4.90 kg/m² for the RS group, showing no significant difference (P=0.868). The gender distribution was identical across both groups, with 46.7% male and 53.3% female participants. The American Society of Anesthesiologists (ASA) classifications were also comparable, with Group A having 66.7% ASA I, and 33.3% ASA II, and Group B having 73.3% ASA I and 26.7% ASA II (P=0.690). These well-matched baseline characteristics ensure that any differences in postoperative pain, analgesic requirements, and hemodynamic changes can be attributed to the efficacy of the TAP and RS blocks rather than demographic or baseline disparities, thereby enhancing the reliability and validity of the study outcomes.

Similarly, research by **Yörükoğlu *et al.*** [(2)] revealed that the analysis of baseline characteristics among the Control, TAP, and RS groups showed statistically insignificant differences in age, weight, or height. The mean age for the Control, TAP, and RS groups were 31.5 ± 4.48, 32.2 ± 5.58, and 31.4 ± 5.01 years, respectively (p=0.821). Mean weight were 76.3 ± 10.23 kg (Control), 76.1 ± 7.43 kg (TAP), and 75.9 ± 8.99 kg (RS) (p=0.983). Mean heights were 162 ± 5.19 cm (Control), 162 ± 5.14 cm (TAP), and 163 ± 5.93 cm (RS) (p=0.551).

Also, these results are in agreement **Mohammad *et al.*** [(8)] who revealed that there were no discernible variations in age, weight, or ASA between TAP block and RS block when comparing their demographic and operational features.

The comparison of the duration of surgery between the Group A and Group B revealed no significant difference. The mean duration of surgery for Group A was 95.3 ± 25.4 minutes, while Group B had a mean duration of 103.5 ± 21.6 minutes (P=0.345). The ranges of surgical durations were also similar, with Group A ranging from 60 to 139 minutes and Group B from 68 to 137 minutes. This consistency in surgical duration across both groups suggests that the time taken for the procedures was comparable.

In consistent with our study results **Yörükoğlu *et al.*** [(2)] **and Mohammad *et al.*** [(8)] showed that there weren't statistically significant variations in the length of operation between the groups under study.

The study's comparison of MAP between Group A and Group B demonstrated significant differences at all post-operative measured time points. Baseline MAP was comparable in Group A (74.9±1.71 mmHg) compared to Group B (76.5±3.81 mmHg) with a P-value of 0.460. This trend changed postoperatively, with Group B consistently showing higher MAP readings at 1 hour (73.9±9.96 mmHg vs. 81.7±7.11 mmHg, P=0.001), 6 hours (74.5±9.22 mmHg vs. 82.3±7.41 mmHg, P=0.016), 12 hours (74.6±9.48 mmHg vs. 82.6±7.44 mmHg, P=0.015), and 24 hours (74.6±9.65 mmHg vs. 81.7±7.27 mmHg, P=0.030) postoperatively, respectively. This may be explained by the fact that Group B's pain scores were higher than Group A's.

The RS group's persistently had higher MAP than the TAP group's raises the possibility that the TAP block has a more stable hemodynamic profile and can provide superior blood pressure control in the postoperative phase.

In the same line **Shields *et al.*** [(9)] compared the effectiveness of RS and TAP blocks for open retropubic prostatectomy analgesia, showing that the TAP block group had lower and more stable MAP readings, further supporting our findings.

The comparison of HR between Group A and Group B showed no statistically significant differences at any measured time points. Baseline HR was slightly higher in Group A (86.1 ± 5.09 bpm) compared to Group B (82.8 ± 6.76 bpm), but this difference wasn't significant (P=0.139). Similarly, at 1 hour (86.7 ± 5.57 bpm vs. 83.3 ±5.21 bpm, P=0.140), 6 hours (86.3 ± 5.20 bpm vs. 83.1 ± 6.82 bpm, P=0.151), 12 hours (86.2± 5.24 bpm vs. 82.9 ± 6.51 bpm, P=0.141), and 24 hours (86.4 ± 5.23 bpm vs. 82.9 ± 6.69 bpm, P=0.125) postoperatively, respectively. The HR remained higher in Group A but without significant differences. These results suggest that while the TAP block may provide a stable hemodynamic profile as indicated by lower MAP readings, it does not significantly affect the HR compared to the RS block.

In alignment with our study results **Mowafi *et al.*** [(10)] found that there were no discernible variations in HR across the groups when TAP and RS blocks were used in major gynecological surgery, further indicating that both blocks are effective and do not adversely impact HR.

The comparison of NRS scores for pain between Group A and Group B revealed significant differences at certain postoperative time points. At baseline, both groups had similar NRS scores (Group A: median 0, range 0-1; Group B: median 0, range 0-1) with no significant difference (P=0.720). One hour post-operatively, the NRS scores were still comparable and slightly higher for Group B (Group A: median 0, range 0-1; Group B: median 1, range 0-1, P=0.204). However, at 6 hours post-operatively, Group B reported higher pain scores (median 3, range 3-4) compared to Group A (median 2, range 2-3), with a significant difference (P=0.012). At 12 hours, the trend persisted, with Group B reporting higher pain scores (median 4, range 4-5) compared to Group A (median 3, range 3-3), also showing significant difference (P=0.003). By 24 hours

post-operatively, NRS scores in both groups were similar again (Group A: median 1, range 1-1; Group B: median 1, range 1-1). These results imply that although both blocks are useful for controlling postoperative pain, the TAP block provides better pain control at the 6-hour and 12-hour marks. This variation in pain relief timing indicates that the choice between TAP and RS blocks can be tailored based on the expected pain progression and patient needs during the postoperative period.

In accordance, **Yörükoğlu *et al.* [2] and Mohammad *et al.* [8]** revealed that postoperative pain measured by the NRS showed significant differences between Group I (RS block) and Group II (TAP block) at certain intervals. At 2 and 4 hours postoperatively, both groups had a median NRS score of 3, with no significant difference (p=0.35 and p=0.67 respectively). However, at 6 and 8 hours, Group I had higher pain scores (median 4) compared to Group II (median 3) with p-values <0.001, indicating better pain control in the TAP block group. By 12 hours, pain scores were similar again (p=0.44).These findings suggest that the US-guided TAP block provides more effective pain relief at the 6-hour and 8-hour marks compared to the US-guided RS block, while pain levels at other times are comparable between the two techniques.

In contrast **Mowafi *et al.* [10]** showed comparison of postoperative pain management using the NRS between surgical TAP block and RS block in morbidly obese patients undergoing major gynecological surgery revealed significant differences at specific postoperative intervals. At rest, the median NRS scores showed no significant difference at hour 0, 2, 12, and 24. However, at hour-6, the median NRS score for the TAP block group was significantly higher (4.0) compared to the RS block group (2.0), with a p-value of <0.001, indicating that the RS block provided better pain control at this time point.

The difference in findings could be attributed to various factors such as differences in patient populations, surgical procedures, anesthetic techniques, or pain assessment methods. For instance, variations in the degree of obesity, types of surgeries performed, or the specific protocols used for administering the blocks might influence the outcomes, also the block's coverage could matter. For instance, RS block is more successful than TAP block in surgeries involving midline or paramedian abdominal incisions above the umbilicus, whereas TAP block is only helpful for transverse or Pfannenstiel incisions below the umbilicus.

The analysis of morphine consumption between the TAP block group (Group A) and the RS block group (Group B) revealed significant differences in the need for the first dose of morphine. In Group A, 53.3% of patients required the first dose of morphine, compared to 86.7% in Group B, with a significant P-value of 0.046. Additionally, the mean dosage of the first morphine dose was significantly lower in Group A (2.7 ± 2.58 mg) compared to Group B (4.3 ± 1.75 mg), with a P-value of 0.048. There wasn't significant difference between the groups in the need for a second dose of morphine, with both groups having 20% of patients requiring it. The mean dosage for the second dose was identical in both groups (1.0 ± 2.07 mg). The total morphine dosage consumed did not significantly differ between the groups (Group A: 6.87 ± 2.58 mg, Group B: 6.15 ± 2.19 mg, P=0.502).

In the same line **Mohammad *et al.* [8] and Jadon *et al.* [11],** showed that the TAP group had a longer median delay to the first analgesic request than the control group (p<0.0001). The TAP group ingested a much lower median number of tramadol doses than the control group. The TAP group experienced decreased rest and movement pain levels throughout the whole research. According to the study's findings, TAP block, when utilized for multimodal analgesia for pain reduction, decreases supplementary opioid intake, increases the duration of analgesia, and lessens discomfort.

In agreement, **Peltrini *et al.* [12]** demonstrated that while the TAP block significantly reduces immediate postoperative pain and the need for initial analgesic doses, the total opioid consumption over 24 hours remains comparable to other analgesic methods. Similarly, a study by **Yu *et al.* [13]** found that although the TAP block provides superior early postoperative pain relief, overall morphine use does not significantly differ between TAP block and standard care. These studies corroborate the finding that total opioid consumption is similar across different analgesic techniques, reinforcing the validity of our study's results.

In consistence, **Shields *et al.* [9]** compared TAP and RS block, they found no appreciable variations in the overall amount of opioids needed after surgery.

CONCLUSION

The comparison between TAP block and RS block for postoperative pain management in lower abdominal surgeries demonstrates that the TAP block provides superior initial pain relief, as evidenced by significantly lower immediate morphine requirements and lower MAP readings, indicating better hemodynamic stability. Despite these initial benefits, overall morphine consumption and HR were comparable between the two groups over the 24-hour postoperative period. These results indicate that the two techniques are successful for managing postoperative pain. The TAP block may offer advantages in the early postoperative period, making it a preferable choice for immediate pain control following lower abdominal surgeries.

Conflict of Interest: None.
Financial Disclosures: None.

REFERENCES

1. **Verma N, Krishnendu S, Chandak A (2020):** Effectiveness of transverse abdominis plane block as a

method of regional anaesthesia in unilateral inguinal hernia repair. J Evolution Med Dent Sci., 9(42): 3097-3101.

2. **Yörükoğlu H, Şahin T, Kula A (2023):** Transversus abdominis plane block versus rectus sheath block for postoperative pain after caesarean delivery: a randomised controlled trial. Turkish Journal of Anaesthesiology and Reanimation, 51(1): 43-48.
3. **Lissauer J, Mancuso K, Merritt C *et al.* (2014):** Evolution of the transversus abdominis plane block and its role in postoperative analgesia. Best Practice & Research Clinical Anaesthesiology, 28(2): 117–126.
4. **May P, Wojcikiewicz T (2022):** Regional anaesthesia and fascial plane blocks for abdominal surgery: a narrative review. Digestive Medicine Research, 5: 42. doi: 10.21037/dmr-21-83
5. **Uppal V, Sancheti S, Kalagara H (2019):** Transversus abdominis plane (TAP) and rectus sheath blocks: a technical description and evidence review. Curr Anesthesiol Rep., (9)479: 487. DOI:10.1007/s40140-019-00351-y
6. **Petersen P, Mathiesen O, Torup H *et al.* (2010):** The transversus abdominis plane block: a valuable option for postoperative analgesia? A topical review. Acta Anaesthesiologica Scandinavica, 54(5): 529–535.
7. **Stamenkovic D, Bezmarevic M, Bojic S *et al.* (2021):** Updates on wound infiltration use for postoperative pain management: a narrative review. Journal of Clinical Medicine, 10(20): 4659. doi: 10.3390/jcm10204659.
8. **Mohammad I, Mostafa M, Hesham I *et al.* (2019):** The effect of ultrasound guided rectus sheath block versus transversus abdominis plane block for pain relief after total abdominal hysterectomy. The Medical Journal of Cairo University, 87: 2967–2975.
9. **Shields B, Hu V, Sabouri A *et al.* (2020):** Rectus sheath block versus transversus abdominis plane (TAP) block for open retropubic prostatectomy analgesia: a retrospective study. SN Comprehensive Clinical Medicine, 2: 2856–2862.
10. **Mowafi M, Elsenity M, Elbeialy M (2022):** Surgical transversus abdominis plane block versus surgical rectus sheath block for postoperative pain control in morbid obese patients undergoing major gynaecological surgery: a prospective, randomized, blinded study. Ain-Shams Journal of Anesthesiology, 14(1): 20. https://doi.org/10.1186/s42077-022-00223-4
11. **Jadon A, Jain P, Chakraborty S *et al.* (2018):** Role of ultrasound guided transversus abdominis plane block as a component of multimodal analgesic regimen for lower segment caesarean section: a randomized double blind clinical study. BMC Anesthesiology, 18: 1–7.
12. **Peltrini R, Cantoni V, Green R *et al.* (2020):** Efficacy of transversus abdominis plane (TAP) block in colorectal surgery: a systematic review and meta-analysis. Techniques in Coloproctology, 2: 787–802.
13. **Yu N, Long X, Lujan-Hernandez J *et al.* (2014):** Transversus abdominis-plane block versus local anesthetic wound infiltration in lower abdominal surgery: a systematic review and meta-analysis of randomized controlled trials. BMC Anesthesiology, 14:121. doi: 10.1186/1471-2253-14-121.