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Appendectomy Pain Control by Transversus Abdominis Plane (TAP) Block in Children

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Abstract

Background: Pain control after surgery in children is very important. Despite having good analgesic effects, the use of opioids is, however, limited due to side effects.

Objectives: This study was aimed to investigate the effect of transverse abdominis plane (TAP) block on the intensity and frequency of pain after appendectomy in children.

Methods: In a single-blinded clinical trial, 40 children aged from 4 to 16 years, candidates for the appendectomy, were divided randomly to intervention and control groups. The intervention group received ultrasound-guided TAP block using 0.25 mL/kg of 0.25% bupivacaine in the Petit triangle after general anesthesia. Postoperative pain was assessed within the first 24 hours after surgery based on the Wong-Baker FACES Pain Rating Scale (WBFP).

Results: There was a reduction in WBFP scores at 2 hours after appendectomy in the intervention group compared with the control group (5.05 ± 2.83 vs 6.30 ± 2.2063). Also, the pain intensity within 24 hours after surgery in the intervention and control groups was 3.10 ± 1.33, and 3.60 ± 1.63 respectively according to WBFP scale ($P > 0.05$).

Conclusions: The TAP block was effective to reduce pain after appendectomy in children, however, there was no significant difference between intervention and control groups. Further studies with larger sample sizes are needed to be done in this area of research.

Keywords: Appendectomy, Children, TAP Block, Wong-Baker FACES Pain Scale, Pain

1. Background

Acute pain control after surgery is one of the basic medical issues and challenges (1). Routinely the opioids are used for pain control after surgery; however, the widespread use of opioids has numerous side effects and delay postoperative recovery (2, 3). According to the World Health Organization guidelines, the excessive use of opioids decreases the patients' satisfaction (4, 5). Appendectomy is one of the most common surgeries among adults as well as children with the risk of 8% during the whole life. The use of opioids for pain control in children is limited due to their side effects (6-8). More recent studies have shown that Tap block reduces postoperative pain, as well as analgesic drug usage (9, 10). The duration of the block is variable and effective analgesia have been reported up to 36 hours after a single injection (11). The monitoring of the patient during procedures includes the monitoring of blood pressure, ECG and pulse oximetry (12). Seyedhejazi et al. showed that caudal block by bupivacaine and adrenaline in preterm infants is more effective and safe than spinal anesthesia and reduced the need for analgesics after surgery (13). In a study by Carney et al. in 2010 in children with the appendectomy, infiltration of local anesthesia by TAP block up to 48 hours after was effective in comparison to the placebo for pain control surgery (14).

2. Objectives

Considering the importance of postoperative analgesia, few studies on the use of bupivacaine for pain control after appendectomy in children and controversy in this context, we designed this study; thus the aim of this study was to investigate the effect of TAP block on the intensity and frequency of pain after appendectomy in children.

3. Methods

After obtaining approval from the Ethics Committee of Tabriz University of Medical Sciences, this single-blind ran-

domized clinical trial study registered on clinical trials Iranians, IRCT code: IRCT201503024041N11. Inclusion criteria were children with ASA (American Society of Anesthesiologists) class 1 or 2, aged 4 to 16 years, who were candidates for an appendectomy.

Exclusion criteria also included obese children (BMI > 95th for age & sex), perforated appendices, other surgeries along with appendectomy, allergy to local anesthetic drugs, chronic use of analgesic drugs, and organic and psychological dysfunction. Based on a previously published paper (15), the sample size was estimated at 40 patients (20 in each group), with regard to the power of 80% and 5% error. After obtaining written informed parental consent and approval from the local Ethics Committee, 40 children aged from 4 to 16 years that were candidates for appendectomy were divided randomly into two groups by permuted blocks and using software available on Online URL: HTTP: //www.stat.ubc.ca/Nrolin/statssize/bz.htmf. Both groups underwent general anesthesia for appendectomy with midazolam 0.03 mg/kg, fentanyl 2 μg/kg, propofol 3 - 4 mg/kg, lidocaine 1-2 mg/kg, atracurium 0.5 mg/kg. All patients were intubated with age-appropriate size of an endotracheal tube according to the formula of (age /4+ 4). In the intervention group after general anesthesia, in the supine position the padding was placed below the waist, and ultrasonography (USG, sonosite M-turbo) probe (Hockey stick, 6 - 13 MHZ) was placed in the abdominal wall on the mid-axillary line between the lower ribs and the iliac crest, needle along the probe after the detection of external oblique muscle and internal oblique and transverse abdominal muscle entered to the skin. Bupivacaine 0.25% with adrenaline 1/200000, 0.25 mL/kg (maximum 20 mL) was injected in Petit triangle between the internal oblique and transverse abdominus muscles. After appendectomy by the McBurney method, the pain score based on Wong-Baker FACES Pain Rating Scale (WBFP) (16) were recorded in the recovery and during the first 24 hours after surgery, including first every 2 hours up to 8 hours and then every 4 hours for the next 16 hours. If the pain score was equal or greater than 4, intravenous acetaminophen 10 mg/kg was used and for pain scores less than 4, oral acetaminophen was prescribed. Also, in case of the first time for medication use, the total dose of analgesic after surgery, as well as the severity and incidence of postoperative complications, were recorded in both groups. A P value < 0.05 was considered statistically significant.

4. Results

The mean age of the patients in the intervention and control groups were respectively 9.90 ± 2.1 and 10.10 ± 2.31 years. The duration of general anesthesia was 69.00 ± 18.75 minutes for intervention groups and 76.00 ± 17.51 minutes in the control group (P = 0.230). The mean systolic and diastolic blood pressure at different times before and after surgery in the two groups showed no statistical difference ($P > 0.05$). The mean heart rate of the patients showed no statistically significant difference ($P > 0.05$) in the two groups before and 24 hours after surgery in different hours (every 4 hours). Pain intensity was equal in all patients of the two groups after surgery and in recovery, based on the WBFP score (Table 1). The mean time of the need for the first analgesic after surgery in the intervention and control groups was 9.81 ± 8.89 and 8.81 ± 6.75 hours, respectively (P = 0.460). The mean frequency of analgesic consumption during the 24 hours after surgery in the intervention and control groups was 1.15 ± 0.75 and 1.30 ± 0.92 times, respectively (P = 0.575).

The average dose of acetaminophen in the intervention and control groups was 137.50 ± 98.50 mg and 191.25 ± 107.07 mg, respectively (P = 0.107). Although the mean dose of acetaminophen in the intervention group was less than the control group, this difference was not statistically significant (P = 0.107). In none of the two groups, postoperative complications were seen and the duration of hospital stay 24 hours after appendectomy was not significantly different in both groups (P = 1.00).

5. Discussion

The use of multi-modal analgesia, effectively reduce pain after surgery and improve the outcome of the patient. The use of opioids because of undesirable side effects is limited in pediatric age group. The use of anesthesia around the spinal cord can cause restriction of movement and cardiovascular and gastrointestinal complications. Thus in order to improve the quality of recovery time and reduce the consumption of opioids, the use of local minimally invasive analgesic techniques is necessary, particularly in abdominal surgery (15). According to the result of this study, pain intensities were low after surgery and during recovery, based on the WBFP score in the two groups. The difference in the mean pain scores was not statistically significant ($P > 0.05$) in both groups in the interval of 24 hours after recovery. Seyedhejazi et al. in 2014, compared caudal block with the block of an ilioinguinal iliohypogastric nerve by bupivacaine and clonidine and showed that both methods are nearly identical and there is no statistical difference between the two methods in decreasing pain intensity and opioids usage. This study reported that peripheral nerve blocks were a useful method and comparable to caudal anesthesia in pain relief (16). The result of our study revealed that the first time request for the postoperative analgesics in the control group was earlier than the intervention group; however, this difference was not statistically significant (P = 0.460). The frequency of the use of analgesics in the first 24 hours after surgery in the control group was slightly more than the interven-

Table 1. Pain Intensity Based on VAS Scores During the 24 Hours After Surgery

Time of Check	All Patients	Control Group	Intervention Group	P Value
2 hours after surgery	5.68 ± 2.58	6.30 ± 2.20	5.05 ± 2.83	0.128
4 hours after surgery	5.48 ± 1.76	6.0 ± 1.80	4.95 ± 1.60	0.059
6 hours after surgery	5.15 ± 1.87	5.55 ± 1.84	4.75 ± 1.86	0.181
8 hours after surgery	4.55 ± 2.03	4.75 ± 2.12	4.35 ± 1.98	0.542
12 hours after surgery	4.35 ± 1.84	4.45 ± 1.84	4.25 ± 1.88	0.737
16 hours after surgery	3.95 ± 1.58	4.25 ± 1.71	3.65 ± 1.42	0.236
20 hours after surgery	3.75 ± 1.56	4.05 ± 1.83	3.45 ± 1.23	0.230
24 hours after surgery	3.35 ± 1.49	3.60 ± 1.63	3.10 ± 1.33	0.296

tion group, though this difference was not significant (P = 0.575). Furthermore, the total dose of analgesics consumption in the intervention group was lower than the control group, however, this difference was not also statistically significant (P = 0.107). Sandeman et al. reported that the performance of TAP block in laparoscopic appendectomy is not clinically premier in children in comparison with local infiltration methods; however, the pain was significantly decreased during the recovery in children (P = 0.03) (17). In our study, all patients in both groups were pain-free during the recovery, based on the WBFP score.

Wu et al. compared the TAP block with intravenous administration of an opioid analgesic and thoracic epidural (with continuous infusion of Ropivacaine 0.375%) in radical gastrectomy. Consequently, TAP block was more effective than intravenous opioid for pain control; additionally, the continuous infusion of epidural ropivacaine between T8 and T9 vertebrae was much more effective than the single TAP block (18).

Carney et al. reported that TAP block is effective in pain control after hysterectomy (19). Also, in the study of Ra et al. in 2010, TAP block with levobupivacaine solution and ultrasound-guided in Laparoscopic Cholecystectomy in patients aged from 20 to 65 years, significantly reduced postoperative pain (20). This study, unlike the present study, was performed on adult patients; therefore, the difference in age could be a factor in the response of the patients to TAP block.

In the present study, none of the two groups had postoperative complications and the duration of hospitalization in the two groups was similar. Also, complications of TAP block was not seen in the intervention group. The side effects reported about the TAP block in the studies mostly are related to the skill of the person and it seems that if the operator has the skill and experience to do it, it is almost safe and without risk. However, common side effects of TAP block reported in the studies are nervous ischemia, intravascular injection, paralysis of the femoral nerve, infection and damage to adjacent, perforation of the peritoneum, and also liver damage after TAP block (21, 22). Johns et al. reported that 2 TAP blocks reduced the need for analgesics after surgery. Moreover, in this review, which included nine studies, no side effects have been reported after TAP block (23).

One review study by Charlton et al. in 2010, showed that TAP block reduced the need for analgesics after surgery. This study also revealed that there were few studies about the use of TAP block for pain relief after surgery (24). Several new studies have reported that TAP block is a safe and effective method for anesthesia in various surgeries such as cholecystectomy, laparoscopic inguinal surgery, and cesarean section; however, in order to obtain more definitive results, further investigation is needed in this area of research (11, 25). Finally, there is controversy in this field because of the complexity of the relationship between pain and analgesia induced by the TAP block. The difference in the sample size, parameters defined, the difference in age, and type of surgery in these studies could explain these conflicting results.

TAP block is an effective method for pain relief after surgery and in reducing the use of narcotic analgesics, which can reduce the length of hospital stay, nosocomial infection, and health care costs (26, 27).

The present study shows that the TAP block reduces the intensity and frequency of post appendectomy pain in children; however, there was no statistically significant difference between the two groups. The first time to request pain medication in the control group was earlier than the intervention group; however, this difference was not also statistically significant.

The total dose of analgesics consumption in the control group was lower than the intervention group24 hours after surgery, however, this difference was not also statistically significant.

Limitation of this study is the small sample size.

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Footnotes

Clinical Trial Registration: IRCT201503024041N11.

Conflict of Interests: The authors declared that they had no conflict of interest.

Ethical Considerations: This study has been approved by the Ethics Committee of Tabriz University of Medical Sciences (https://en.irct.ir/trial/4225).

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Patient Consent: The written informed consent was taken from parents.

References

1. Kehlet H, Dahl JB. Anaesthesia, surgery, and challenges in postoperative recovery. *Lancet*. 2003;**362**(9399):1921–8. doi: 10.1016/S0140-6736(03)14966-5. [PubMed: 14667752].
2. Chung F, Ritchie E, Su J. Postoperative pain in ambulatory surgery. *Anesth Analg*. 1997;**85**(4):808–16. [PubMed: 9322460].
3. White PF. The role of non-opioid analgesic techniques in the management of pain after ambulatory surgery. *Anesth Analg*. 2002;**94**(3):577–85. [PubMed: 11867379].
4. Silvasti M, Svartling N, Pitkanen M, Rosenberg PH. Comparison of intravenous patient-controlled analgesia with tramadol versus morphine after microvascular breast reconstruction. *Eur J Anaesthesiol*. 2000;**17**(7):448–55. [PubMed: 10964147].
5. Immer FF, Immer-Bansi AS, Trachsel N, Berdat PA, Eigenmann V, Curatolo M, et al. Pain treatment with a COX-2 inhibitor after coronary artery bypass operation: A randomized trial. *Ann Thorac Surg*. 2003;**75**(2):490–5. [PubMed: 12607659].
6. Markar SR, Blackburn S, Cobb R, Karthikesalingam A, Evans J, Kinross J, et al. Laparoscopic versus open appendectomy for complicated and uncomplicated appendicitis in children. *J Gastrointest Surg*. 2012;**16**(10):1993–2004. doi: 10.1007/s11605-012-1962-y. [PubMed: 22810297].
7. Hale DA, Molloy M, Pearl RH, Schutt DC, Jaques DP. Appendectomy: A contemporary appraisal. *Ann Surg*. 1997;**225**(3):252–61. [PubMed: 9060580]. [PubMed Central: PMC1190674].
8. Shafer A, White PF, Urquhart ML, Doze VA. Outpatient premedication: Use of midazolam and opioid analgesics. *Anesthesiology*. 1989;**71**(4):495–501. [PubMed: 2478048].
9. Petersen PL, Mathiesen O, Torup H, Dahl JB. The transversus abdominis plane block: A valuable option for postoperative analgesia? A topical review. *Acta Anaesthesiol Scand*. 2010;**54**(5):529–35. doi: 10.1111/j.1399-6576.2010.02215.x. [PubMed: 20175754].
10. Siddiqui MR, Sajid MS, Uncles DR, Cheek L, Baig MK. A meta-analysis on the clinical effectiveness of transversus abdominis plane block. *J Clin Anesth*. 2011;**23**(1):7–14. doi: 10.1016/j.jclinane.2010.05.008. [PubMed: 21296242].
11. Kahl C, Cleland JA. Visual analogue scale, numeric pain rating scale and the McGill pain Questionnaire: An overview of psychometric properties. *Phys Therap Rev*. 2013;**10**(2):123–8. doi: 10.1179/108331905x55776.
12. Reid SA. The transversus abdominis plane block. *Anesth Analg*. 2007;**105**(1):282. author reply 282-3. doi: 10.1213/01.ane.0000261295.16250.4c. [PubMed: 17578993].
13. Seyedhejazi M, Moghadam A, Sharabiani BA, Golzari SE, Taghizadieh N. Success rates and complications of awake caudal versus spinal block in preterm infants undergoing inguinal hernia repair: A prospective study. *Saudi J Anaesth*. 2015;**9**(4):348–52. doi: 10.4103/1658-354X.154704. [PubMed: 26543447]. [PubMed Central: PMC4610074].
14. Carney J, Finnerty O, Rauf J, Curley G, McDonnell JG, Laffey JG. Ipsilateral transversus abdominis plane block provides effective analgesia after appendectomy in children: A randomized controlled trial. *Anesth Analg*. 2010;**111**(4):998–1003. doi: 10.1213/ANE.0b013e3181ee7bba. [PubMed: 20802056].
15. Findlay JM, Ashraf SQ, Congahan P. Transversus abdominis plane (TAP) blocks-A review. *Surgeon*. 2012;**10**(6):361–7. doi: 10.1016/j.surge.2012.07.005. [PubMed: 22975402].
16. Seyedhejazi M, Sheikhzadeh D, Adrang Z, Rashed FK. Comparing the analgesic effect of caudal and ilioinguinal iliohypogastric nerve blockade using bupivacaine-clonidine in inguinal surgeries in children 2-7 years old. *Afr J Paediatr Surg*. 2014;**11**(2):166–9. doi: 10.4103/0189-6725.132821. [PubMed: 24841020].
17. Sandeman DJ, Bennett M, Dilley AV, Perczuk A, Lim S, Kelly KJ. Ultrasound-guided transversus abdominis plane blocks for laparoscopic appendicectomy in children: A prospective randomized trial. *Br J Anaesth*. 2011;**106**(6):882–6. doi: 10.1093/bja/aer069. [PubMed: 21504934].
18. Wu Y, Liu F, Tang H, Wang Q, Chen L, Wu H, et al. The analgesic efficacy of subcostal transversus abdominis plane block compared with thoracic epidural analgesia and intravenous opioid analgesia after radical gastrectomy. *Anesth Analg*. 2013;**117**(2):507–13. doi: 10.1213/ANE.0b013e318297fcee. [PubMed: 23744953].
19. Carney J, McDonnell JG, Ochana A, Bhinder R, Laffey JG. The transversus abdominis plane block provides effective postoperative analgesia in patients undergoing total abdominal hysterectomy. *Anesth Analg*. 2008;**107**(6):2056–60. doi: 10.1213/ane.0b013e3181871313. [PubMed: 19020158].
20. Ra YS, Kim CH, Lee GY, Han JI. The analgesic effect of the ultrasound-guided transverse abdominis plane block after laparoscopic cholecystectomy. *Korean J Anesthesiol*. 2010;**58**(4):362–8. doi: 10.4097/kjae.2010.58.4.362. [PubMed: 20508793]. [PubMed Central: PMC2876857].
21. Taylor RJ, Pergolizzi JV, Sinclair A, Raffa RB, Aldington D, Plavin S, et al. Transversus abdominis block: Clinical uses, side effects, and future perspectives. *Pain Pract*. 2013;**13**(4):332–44. doi: 10.1111/j.1533-2500.2012.00595.x. [PubMed: 22967210].
22. Heil JW, Ilfeld BM, Loland VJ, Sandhu NS, Mariano ER. Ultrasound-guided transversus abdominis plane catheters and ambulatory perineural infusions for outpatient inguinal hernia repair. *Reg Anesth Pain Med*. 2010;**35**(6):556–8. doi: 10.1097/AAP.0b013e3181fa69e9. [PubMed: 20975474].
23. Johns N, O'Neill S, Ventham NT, Barron F, Brady RR, Daniel T. Clinical effectiveness of transversus abdominis plane (TAP) block in abdominal surgery: A systematic review and meta-analysis. *Colorectal Dis*. 2012;**14**(10):e635–42. doi: 10.1111/j.1463-1318.2012.03104.x. [PubMed: 22632762].
24. Charlton S, Cyna AM, Middleton P, Griffiths JD. Perioperative transversus abdominis plane (TAP) blocks for analgesia after abdominal surgery. *Cochrane Database Syst Rev*. 2010;(12). CD007705. doi: 10.1002/14651858.CD007705.pub2. [PubMed: 21154380].
25. Mirza F, Carvalho B. Transversus abdominis plane blocks for rescue analgesia following Cesarean delivery: A case series. *Can J Anaesth*. 2013;**60**(3):299–303. doi: 10.1007/s12630-012-9866-6. [PubMed: 23263981].
26. Faiz SHR, Alebouyeh MR, Derakhshan P, Imani F, Rahimzadeh P, Ghaderi Ashtiani M. Comparison of ultrasound-guided posterior transversus abdominis plane block and lateral transversus abdominis plane block for postoperative pain management in patients undergoing cesarean section: A randomized double-blind clinical trial study. *J Pain Res*. 2018;**11**:5–9. doi: 10.2147/JPR.S146970. [PubMed: 29296094]. [PubMed Central: PMC5741073].
27. Imani F, Rahimzadeh P, Faiz HR, Abdullahzadeh-Baghaei A. An evaluation of the adding magnesium sulfate to ropivacaine on ultrasound-guided transverse abdominis plane block after abdominal hysterectomy. *Anesth Pain Med*. 2018;**8**(4). e74124. doi: 10.5812/aapm.74124. [PubMed: 30250819]. [PubMed Central: PMC6139531].