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Efficacy of Ultrasound Guided Rhomboid Intercostal Subserratus Plane Block in Open Nephrectomy: Randomized Controlled Study.

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Abstract

Background: Renal cell carcinoma (RCC) accounts for 2% to 3% of all cancers and is the third most common malignancy of the genitourinary tract.
Aim: To assess the efficacy and safety of ultrasound guided Rhomboid Intercostal Subserratus Plane Block (RISS) in open nephrectomy surgeries.
Patients and methods: This single blinded randomized controlled trial was conducted on 50 patients age (18-65) Years and physical status ASA II, III, scheduled for open nephrectomy. They were randomly assigned into 2 equal groups (25 patients each). **Group 1**: Thoracic Epidural Block (TEB) group, **Group 2:** RISS group, the study was done at National Cancer Institute Cairo University from December 2022 to march 2024.
Results: Time of 1st rescue analgesia was significantly prolonged in RISS group (5.5 ± 2.29 hrs.) compared to TEB group (3.2 ± 3.08 hrs.) (P value<0.001), however, TEB group (165.9 ± 33.44 mic) was associated with statistically insignificant reduction of intraoperative fentanyl consumption than RISS groups (182.1 ± 43.24 mic) (p value 0.165), As for the NRS score at rest was insignificantly different among the two groups, except at PACU and after 2 hrs,8 hrs. and 10 hrs. was significantly lower in RISS group than TEB group (P value<0.001) and NRS with cough was insignificantly different among the two groups.
Conclusion: RISS are effective and safe to perform in open nephrectomy surgery. As it increases the time of 1st rescue of analgesia, provide lower pain score with superiority to ESB compared to TEB.
Key words: Open Nephrectomy, TEA, RISS.

Introduction

Open surgery is still utilized for patients needing partial or radical nephrectomy, leading to high rates of severe postoperative pain and chronic pain in the months after the procedure. (1,2)

Regional anesthesia methods are often suggested for pain control during open nephrectomy because they reduce the need for injectable opioids and enhance patient contentment. (1)

Epidural analgesia is considered the best option for managing pain before, during, and after open surgeries. Anesthesiologists are looking for other ways to manage pain that provide strong pain relief but with a lower risk of serious complications, such as epidural hematoma, postoperative nerve damage, and headaches after dural puncture. (3)

The innovative Rhomboid intercostal subserratus plane block (RISS) was first introduced by Elsharkawy et al. (4) in 2016 for effective chest wall and upper abdominal pain relief. (5) In a cadaveric investigation, the injected

substance dispersed among the intercostal muscles, reaching the rhomboids and serratus anterior muscles, and coloring the lateral cutaneous branches of intercostal nerves from T4 to T9 and extending medially to the erector spinae muscle. [6-8]

Patients and methods:

This study involved 50 ASA II, III patients who were scheduled for Open Nephrectomy under general anesthesia in a single blinded randomized controlled trial. Patients were grouped randomly into two equal and similar groups using random numbers generated by a computer in sealed envelopes that could not be seen through. In the first group, 25 patients were given a thoracic epidural block with 5-10 ml of bupivacaine 0.25% before surgery, while in the second group, also consisting of 25 patients, a rhomboid intercostal subserratus plane block was administered with 30 ml of bupivacaine 0.25% under ultrasound guidance before surgery. The research took place at National Cancer Institute Cairo University between December 2022 and March 2024, Patients provided informed written consent. Individuals were ineligible if they showed signs of infection at the injection site or had coagulopathy, such as hereditary disorders or acquired conditions. Other criteria for exclusion were unstable heart conditions, psychiatric or cognitive impairments, and allergies to prescribed drugs. Patients were subjected to a comprehensive history-taking, physical assessment, and standard laboratory investigations. Individuals over the age of 40 underwent electrocardiograms (ECGs).

In the preoperative holding area, patients were continuously monitored for their vital signs. IV cannulas were inserted, and midazolam was given at a dosage of 0.02 mg/kg.

In TEB group: Following strict aseptic procedures, 2 ml of lidocaine 1% was injected into the skin. A Tuohy needle with an 18-gauge was placed through the T7-T8 vertebral interspace, with the epidural space identified through the use of the loss of resistance method. A small amount of 3 ml lidocaine 1% with epinephrine at a concentration of 1:200,000 was administered as a test to detect any accidental intrathecal or IV injections. Next, a dose of 5-10 ml of 0.25% bupivacaine was administered via epidural injection.

In the RISS group, a linear ultrasound probe is placed next to the C7 spinous process in a cephalocaudal orientation under rigorous aseptic measures. Next, we located the 5th thoracic spine (87), positioned the ultrasound probe in a sagittal plane next to the scapula's inner edge, and then turned it to create a slanted sagittal image around 1 to 2 cm inward from the scapula's inner border. The boundary between the rhomboid major and intercostal muscles was located. 2 ml of lidocaine 1% was injected subcutaneously into the skin, followed by the insertion of an 18-gauge needle moving from a superomedial to an inferolateral direction through the trapezius and rhomboid major muscles. Subsequently, 15 ml of bupivacaine 0.25% was delivered, with the rhomboid intercostal block being carried out as a single-shot injection at the T5 level. Next, the probe was shifted downwards and to the side in order to locate the tissue layer between the serratus anterior and external intercostal muscles for the T8 subserratus block. The needle was placed in the skin at the same spot where the rhomboid intercostal injection was given, but it was aimed downwards and to the side past the bottom corner of the shoulder blade. A dose of 15 ml of 0.25% bupivacaine was given, targeting the layer above the intercostal muscles. [9] Sensory block level was evaluated with a pinprick test every 20 minutes along the anterior axillary line from T5 to T10 dermatomes after each block. If the pinprick was identified as a touch from a dull object or not identified at all, it was deemed a successful block; if not, the patient was not included in the study.

Anesthesia was initiated by administering IV propofol at a dosage of 2-3 mg/kg, fentanyl at 2 μg/kg, and rocuronium at 0.5-0.8 mg/kg. Anaesthetic maintenance was attained using a 50% air-oxygen mixture with isoflurane (1-2%). The patients underwent intubation and mechanical ventilation with volume-controlled positive pressure ventilation, delivering a tidal volume of 6-8 mL/kg and an inspiratory to expiratory (I: E) ratio of 1:2, to keep the end-tidal carbon dioxide tension at approximately 35 mmHg.

Heart rate (HR) and mean arterial blood pressure (MAP) were checked following the administration of LA and subsequently every 15 minutes during the surgical procedure.

Hypotension (decrease exceeding 20% of initial value) was managed by administering 0.9% normal saline and/or 5mg ephedrine in gradual amounts to uphold mean blood pressure above 70 mmHg.

At the completion of the surgical procedure, any remaining neuromuscular blockade was counteracted with neostigmine (0.05 mg/kg) and atropine (0.02 mg/kg), and the patient's airway reflexes were fully restored before extubation took place.

The first time the patient receives pain relief (if NRS ≥ 4) will be noted, and then they will be given 3 mg of IV morphine as pain relief, followed by a continuous infusion of morphine through Patient Controlled Analgesia (PCA) device (20 mg morphine and 1 mg granisetron diluted in 100 ml of saline solution). Moreover, patients were given 1 g of paracetamol every 8 hours as scheduled.

Outcomes: Time of first request of analgesia. (calculated from the time of complete injection of local anesthetics till the numerical rating scale (NRS) is ≥4), Total amount of intraoperative fentanyl was recorded, change in hemodynamics ((heart rate and mean arterial blood pressure) and Numeric Pain Rating Scale both at rest and during cough.

Ethical considerations: Consent required from patients after obtaining approval from the Ethical committee at National Cancer Institute - Cairo University. Sufficient measures are in place to uphold the privacy of participants and the confidentiality of the data.

Sample Size: The sample size was calculated using G*power software version 3.1.9.2 based on an expected large effect size of opioid consumption (d = 0.907) between ESP and epidural blocks **Abdelgalil et al,** [10]. The total sample size was 38 patients (19 for each group). The sample size was increased to 50 patients (25 in each group) to compensate for the possible failures. Alpha and power were adjusted at 0.05 and 0.95, respectively.

Statistical analysis:

SPSS software (IBM, located in Armonk, New York, United States) was utilized for data management and statistical analysis. Quantitative data was evaluated for its normal distribution prior to analysis. As per standard practice, quantitative data was summarized using means and standard deviations or medians and ranges. Numerical and percentage summaries were produced for categorical data. Quantitative data from the studied groups was analyzed using either one-way ANOVA or Kruskal Wallis test for normally and non-normally distributed quantitative data, respectively. Categorical data was examined by conducting the Chi-square or Fisher's exact test. After the significant overall effect was found, post hoc analyses were conducted and were corrected with Bonferroni's method. All tests of statistical significance were conducted with results considered from both directions. A significance level was set at less than 0.05 for P values.

Results: There were insignificant differences among the two groups as regard to sex, age, weight, ASA physical status, and duration of surgery p value > 0.05. (Table 1).

		TEB group (No=25)	RISS group (No=25)	P value
Age (years)	Mean ± SD	51.3 ± 10.27	50 ± 11.13	0.814
	Range	27 – 68	27 – 69	
Sex	Male	15 (42.86%)	13 (37.14%)	0.760
	Female	20 (57.14%)	22 (62.86%)	
Weight (Kg)	Mean ± SD	79.7 ± 9.38	79 ± 10.69	0.676
	Range	60 – 92	60 – 95	
	II	31 (88.57%)	32 (91.43%)	0.903

ASA physical status	**III**	4 (11.43%)	3 (8.57%)	
Side	**Right**	16 (45.71%)	16 (45.71%)	0.962
	Left	19 (54.29%)	19 (54.29%)	
Duration of Surgery (min)	**Mean ± SD**	155.1 ± 30.43	162.9 ± 36.59	0.674
	Range	90 – 210	90 – 240	

Table 1: Patients' characteristics and duration of surgery of the studied groups

Time of 1st rescue analgesia was significantly prolonged in RISS group (5.5 ± 2.29 hrs.) compared to TEB group (3.2 ± 3.08 hrs.) (P value<0.001).

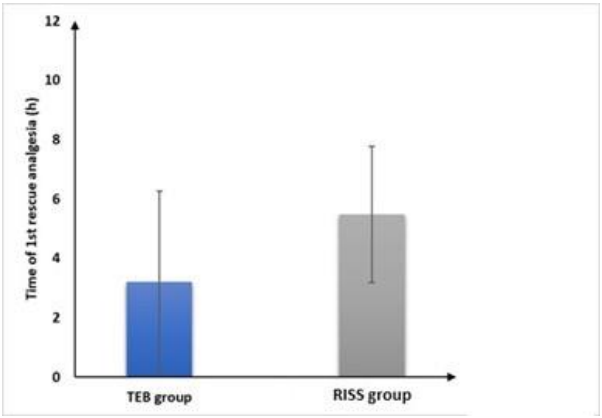

Figure 1: Time of 1st rescue analgesia of the studied groups

Intraoperative fentanyl consumption for RISS groups weas (182.1 ± 43.24) compared to (165.9 ± 33.44) for TEB group which was insignificantly different among the three groups (p value >0.05).

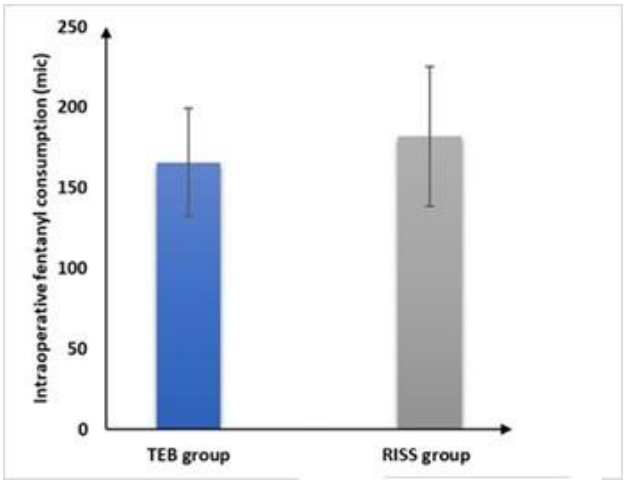

Figure 2: Intraoperative fentanyl consumption of the studied groups

The NRS score at rest was insignificantly different among the two groups, except at PACU and after 2 hrs,8 hrs. and 10 hrs. were significantly lower in RISS group than TEB group (P value<0.001) and NRS with cough was insignificantly different among the two groups.

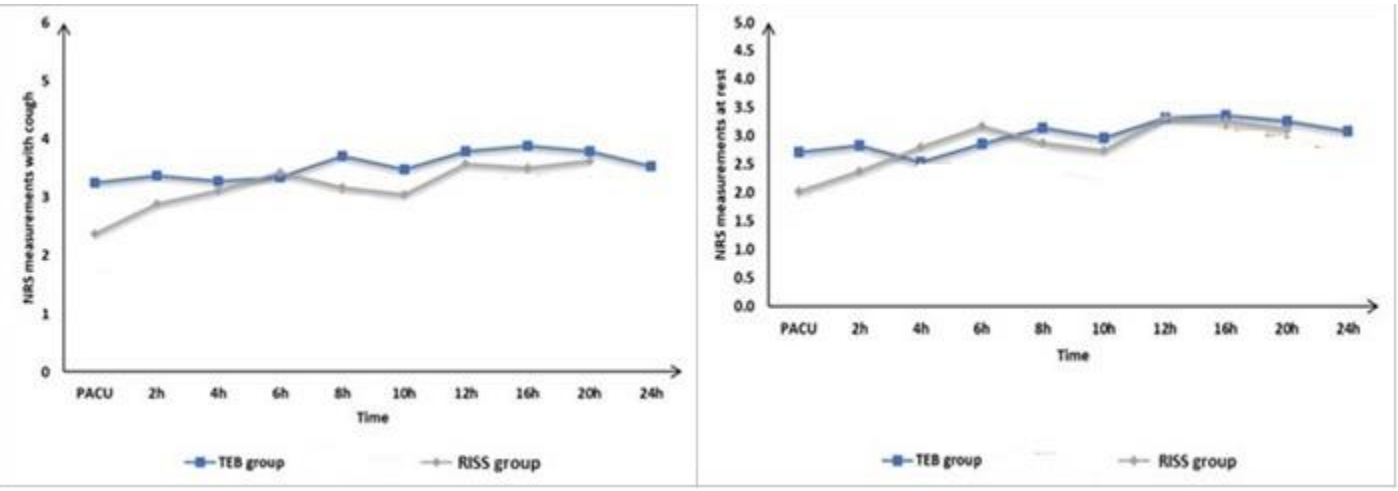

Figure 3: NRS measurements at rest and with cough of the studied groups

Discussion:

Nephrectomy, specifically the open method as opposed to laparoscopic, is known for being an especially painful surgery. [11]. Inadequate management of postoperative pain hinders movement, increases risks of pneumonia, thromboembolism, wound opening, chronic pain, and lengthens the healing process. [12].

Optimal dynamic analgesia is crucial for improved recovery post open abdominal surgeries. Over the past ten years, there has been a significant move away from thoracic epidural analgesia, previously considered the best technique, because of issues like difficulty walking, low blood pressure, too much intravenous fluid, and complications with neuraxial techniques. [13].

The rhomboid intercostal block has been used before for controlling pain in surgeries that involve the thoracic wall. However, Elsharkawy et al. subsequently made alterations to it. [7,9] and combined with the subserratus plane block for managing post-abdominal surgery pain, the merged blocks were later called the "RISS block". It offers pain relief from T4 to T9 dermatomes and is utilized in postoperative pain control for thoracic and upper abdominal surgeries [13,9].

Furthermore**, Deng et al. (2021)** [15] performed a prospective, randomized-controlled study at a single center, involving 90 patients aged 18-80 years with ASA I and II, who were set to undergo elective unilateral video-assisted thoracoscopic surgery (VATS). The patients were split into three equally sized groups: one receiving RISS, another receiving rhomboid intercostal block (RIB), and a control group. They demonstrated that the RISS group exhibited extended analgesic effects and had a longer duration until the first postoperative analgesic request. There was no significant difference in opioid usage after surgery between the three groups.

Consistent with our findings, **Ökmen et al. (2022)** [13] carried out aquasi-experimental research on 50 individuals aged 20 to 65 years classified as ASA I and II, and who underwent laparoscopic cholecystectomy (LC). These patients were split into two even groups: RISS group and control group. They demonstrated that there was an equal intraoperative opioid requirement in both RISS and control groups.

Additionally, **Kozanhan et al, (2022)** [16] carried out a study at a single center, prospective, and randomized controlled on 40 patients over the age of 18 with ASA I-III who had posterolateral thoracotomy. The patients were split into two groups of equal size: group R (IVPCA + ongoing RISS block) and group C (IVPCA only). They demonstrated that the Numeric Rating Scale (NRS) at rest was consistently lower in the IVPCA plus RISS group compared to the IVPCA group at all postoperative time points analyzed.

Conclusion: RISS are effective and safe to perform in open nephrectomy surgery. As it increases the time of 1st rescue of analgesia, provide lower pain score, with superiority to ESB compared to TEB.

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Conflict of Interest: Nil

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