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Comparing the effects of intercostal and subcostal flank incision on post-operative pain and incisional hernia or bulge in patients undergoing open kidney surgery: A randomized clinical trial

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Abstract

BACKGROUND: Flank incision, a common approach in kidney surgery, has several types. This study was carried out to examine the effect of using subcostal and intercostal flank incisions on post-operative pain, incisional hernia or bulging, and incision time and wound closure time in patients undergoing open kidney surgery.

MATERIALS AND METHODS: This randomized clinical trial was conducted Iran (2023–2024). Sixty-four patients were randomly divided into two groups of 32 patients, subcostal and intercostal, based on available sampling technique. The Visual Analog Scale was used to assess post-operative pain. The abdominal wall asymmetry (AWA) technique was used for both hernia and bulge, and clinical examination was done by a urology surgeon for diagnosing AWA. Data analysis was done using SPSS-23.

RESULTS: In the subcostal group, a higher incidence of AWA was observed when compared to the intercostal group at 6 months post-operation, and this difference was statistically significant ($P = 0.039$). However, there was no significant difference between the two groups at 3 months post-operation in this regard ($P > 0.05$). The mean pain score of patients at 24 and 72 h post-operation was significantly higher in the intercostal group than in the subcostal group ($P < 0.05$); however, at the first hour and on day 7 post-surgery, no significant difference was found between the two groups in this regard ($P > 0.05$). In addition, no significant differences existed between the two groups regarding incision time and wound closure time ($P > 0.05$).

CONCLUSION: Intercostal incision, when compared to subcostal incision, was associated with lower probability of development of hernia or bulge, in spite of its higher-level post-operative pain.

TRIAL REGISTRATION: This study was registered with the Iranian Clinical Trials Registry under the code IRCT20230208057358N1 on 2023.02.11.

Keywords:

Flank incision, hernia, incisional hernia, intercostal incision, open kidney surgery, subcostal incision

Introduction

Open kidney surgery may be carried out by four principal routes, including extraperitoneal flank approach, dorsal lumbotomy, abdominal incision, or thoracoabdominal incision.[1] Flank extraperitoneal incision is one of the most common approaches for open kidney

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surgery.[2] Considering the precise surgical site, it is divided into three types: transcostal, subcostal, and intercostal.[3]

Subcostal incisions are made obliquely and as small as 2 cm below the 12th rib from the rectus sheath up to the sacrospinalis muscle. Intercostal incision is usually made between ribs 11 and 12, with similar stages to the previous incision. In this approach, the ribs should be held apart by using a retractor for establishing suitable exposure. Sometimes, for complete exposure of kidneys, especially in cases where kidneys are facing upward, the rib should be removed, in which case transcostal incision is employed, where an incision is made on the rib which is to be removed, being typically ribs 11 or 12.[3]

Flank incision offers many advantages and has been used by urologists for several decades, though it results in considerable complications. They include hernia and bulging, long operation time, and pain, which are common indications following open kidney surgery with flank incision. They can result in staggering financial, health, and emotional costs for patients, affecting their quality of life and the outcomes resulting from their treatment.[4,5]

Few studies have been performed on comparing the efficacy of intercostal and subcostal incisions. To our knowledge, no clinical trial study has been performed to examine the effects of these two incisions on hernia and building following surgery and their post-operative pain. The aim of the present study is to compare the effects of flank subcostal and intercostal incisions in open kidney surgeries regarding abdominal wall asymmetry (AWA) and post-operative pain plus incision time and incision closure time. Each of them can affect the patient's life, health, and satisfaction with the treatment.

Materials and Methods

Study design

This is a randomized clinical trial done on open kidney surgery candidate patients, performed from March 2023 to March 2024 at Shahid Beheshti Hospital in Hamedan, Iran. All of the patients were placed in a supine position under general anesthesia with the same method and then positioned laterally. The necessary considerations and observation of safety issues were taken into account for all patients to maintain proper position and safety. After preparation and draping, surgery was initiated with subcostal or intercostal flank incision.

Setting and participants

The patients aged 18–55 years, who underwent open kidney surgery, were recruited in the study through convenience sampling. The patients who did not show up for follow-up or refused to continue their participation for any reason would be excluded from the study.

Validity and confounding factors

The patients who had the following conditions were excluded: incision longer than 25 cm, obese individuals (body mass index [BMI] >30), reoperation with incision on the previous incision, post-operative abdominal ascites, post-operative surgical site infection, existence of comorbid abdominal wall hernia, and also patients with a history of diabetes, peritoneal dialysis, previous hernia, taking immunosuppressive drugs, smoking, and using illicit drugs. Previous studies have already mentioned these factors as risk factors in development of abdominal wall hernia or bulging.[5-13]

Also, some confounding factors of study such as stressful personality type, which can affect post-operative pain and wound healing, as well as the psychological problems of patients which can hinder pain improvement post-operation were controlled using personality and screening tests before surgery.

Ethical considerations

Ethics committee of Hamedan University of Medical Sciences approved this study (Code: IR.UMSHA.REC.1401.937), and this study was also registered in Iran Clinical Trial Registration Center under Code IRCT20230208057358N1. Before initiating the surgery, the goal and general procedure of the research were explained to the patients, and informed consent for inclusion was taken. If the patients no longer wished to continue their participation, they were free to withdraw from it. In addition, the surgical procedures were carried out adhering to the principles of Helsinki Declaration.

Sample size calculation

The required sample size was calculated using the following formula, which is a suitable method for determining the sample size for the hypothesis testing of mean differences between populations.[14] According to the formula, the mean and standard deviation of post-operative pain score criterion (in Visual Analog Scale [VAS] scale on the third day) in the study by Chaywiriyangkool *et al.*[15] in 2016, was used. Thus, at error type I level of α=0.05 and β=0.2 (considering confidence interval 95% and power 80%), the sample size for each group was around 29 subjects; considering possible attrition of 10%, the final sample size in each group was 32.

$$\frac{\left(z1-\alpha/2+Z_1-\beta\right)^2\left(SD_1^{\,2}+SD_2^{\,2}\right)}{\left(\mu_1-\mu_2\right)^2}$$

Randomization and allocation

Randomization of patients was done using the randomized blocks method, with a block size of 4. First,

four cards were prepared; intercostal was written on two cards, while subcostal was written on the other two cards. Next, these cards were placed inside sealed envelopes and mixed with each other and then picked up by the researcher consecutively and without replacement. This was repeated for all eligible patients, where each patient being subcostal or intercostal was noted.

Surgical procedure

Flank subcostal incision was made obliquely and around 2 cm below the 12th rib from the rectus sheath until the sacrospinalis muscle. To gain access to the kidneys, latissimus dorsi, external oblique, internal oblique, and in cases of requiring increasing exposure, the abdominal transverse muscle were also incised. Upon opening the lumbodorsal fascia, the fat around the kidneys, Gerota's fascia, as well as adrenal glands were also exposed. Flank intercostal incisions were made between ribs 11 and 12, with its stages being similar to those of the previous incision. In both approaches, no self-retaining retractor was used.

Once the surgical procedure was completed, musculofascial incision was closed carefully in one layer with interrupted 1 Vicryl sutures, subcutaneous with interrupted 2-0 Vicryl sutures, and skin with a vertical matrix suture using 0.3 nylon. Drains were devised using a separate incision and fixated using 0 silk. Analgesic drugs and antibiotics used in the hospital and home were equalized and matched for both groups. Dressing was removed on the first day post-operation, which was followed by daily cleansing of the wound and re-dressing. Once the secretions decreased to below 30 mL/day, the drains were withdrawn, and on average, on the 10th day post-operation, they were removed. The patients were discharged on the fifth–to seventh day post-operation, and their follow-up was scheduled in months 3 and 6.

Instruments and measures

In addition to a thorough history and physical examination, demographic and clinical data were collected from the patients. The variables of study were measured as follows:

Incision and wound closure time

The incision time was measured using a digital watch from the beginning of skin incision until reaching the Gerota's fascia. Concurrent with initiation of incision, the surgeon ordered "start," while he ordered "end" once he reached the Gerota's fascia. For measuring the incision closure time, with initiation of suturing the first layer of stich, the timer was started, and it was stopped after completion of the last skin suture.

Abdominal wall asymmetry

Differentiation of bulging and hernia in visual examination can be very difficult and even impossible because both cause visible bulging in the flank.[2] As such, to prevent confusion between bulging and hernia, similar to the study by Inkiläinen *et al.*,[2] AWA was used for both of them. The main criterion for presence or absence of AWA was clinical examination by a urologist surgeon who was blinded to the type of flank incision used in the patient's surgery. First, all patients were clinically examined regarding AWA. The subsequent visits were planned in months 3 and 6 post-surgery, whereby the patients were reexamined regarding AWA by a surgeon specialist.

Pain

The severity of pain was measured using the VAS, which is one of the most widely used and credible self-report tools for pain measurement, once the patient's status became status post-operation (h0), 24 h later (h24), 72 h later (h72), and on the 7th day post-operation (Day7).[15] This scale is a 10-cm line, where the range of pain degree variations from the left side of it is represented by "No-pain" until "Worst possible pain" on the right side. The patients estimate their level of pain by marking on this line. Patients were blinded to which flank incision was used for their surgery.

Data collection and statistical analysis

Data analysis was done using SPSS 23 and at significance level of lower than 5%. Normality of quantitative variables was checked using the Kolmogorov–Smirnov test. Homogeneity of the two groups regarding confounding variables was determined using analytical statistics including the chi-square and Fischer exact test (for qualitative variables) and independent *t* test (for quantitative variables with normal distribution). Also, for mean comparison of quantitative variables in the two groups, independent *t* test was applied, while for qualitative variables, the chi-square and Fischer exact tests were used.

Results

In this two-group clinical trial study, 64 subjects completed the study based on the inclusion and exclusion criteria ($n = 32$ in each group).

The results of the independent *t* test indicated that [Table 1] there was no significant difference between the two groups regarding mean age, BMI, length of the incision, and operation duration ($P > 0.05$). Furthermore, use of the chi-square test showed no significant difference between the two groups regarding gender, type of surgery, and side of surgical incision ($P > 0.05$), with its results reported in Table 1.

The results of independent *t* test did not reveal significant differences between the two groups regarding incision time and incision closure time ($P > 0.05$) [Table 2].

Table 1: Patient demographic and baseline characteristics

	Intercostal (n = 32)	Subcostal (n = 32)	P value
Age (years)*	47.34 ± 6.18	46.40 ± 7.45	0.586
BMI (kg/m^2)*	25.14 ± 2.39	25.22 ± 1.88	0.881
Incision length (cm)*	17.65 ± 2.16	17.34 ± 2.17	0.567
Operation time (min)*	92.65 ± 23.55	99.21 ± 26.88	0.303
Sex**			0.617
Male	17 (53.12)	15 (46.87)	
Female	15 (46.87)	17 (53.12)	
Incision side**			0.802
Right	16 (50)	17 (53.12)	
Left	16 (50)	15 (46.87)	
Type of surgery**			0.847
Partial nephrectomy	13(40.62)	14(43.75)	
Total nephrectomy	7(21.87)	8(25)	
Radical nephrectomy	3(9.37)	4(12.5)	
Open kidney stone removal	6(18.75)	4(12.5)	
Pyeloplasty	3(9.37)	2(6.25)	

*Mean ± standard deviation (SD)
**count (%)
BMI indicates body mass index

Table 2: Incision time and wound closure time (minute)

	Intercostal (n = 32) Mean ± SD	Subcostal (n = 32) Mean ± SD	P value
Incision time	15.65 ± 4.45	14.18 ± 3.58	0.151
Wound closure time	21.15 ± 5.80	20.18 ± 5.06	0.479

The mean pain score of patients at 24 and 72 h post-operation was significantly higher in the intercostal group compared to the subcostal group ($P < 0.05$); however, at first hour and on day 7 post-operation, no significant difference was found between the two groups in this regard [Table 3].

At the 3-month follow-up post-operation, overall eight subjects (12.50%) showed AWA. In the intercostal and subcostal groups, three and five subjects developed this problem. Also, at the 6-month follow-up post-operation, overall AWA was found in 10 (15.63%) patients (two in intercostal and eight in subcostal). In the intercostal group, at the 3-month follow-up post-operation, three patients had AWA, with AWA resolving in one patient at the 6-month follow-up post-operation, but the two other patients had still AWA. Thus, overall at the 6-month follow-up post-operation, two patients in the intercostal group had AWA.

In the subcostal group at 3-month follow-up post-operation, AWA was diagnosed in five patients; at

Table 3: Severity of pain at various intervals in the groups

Pain Score by VAS	Intercostal (n = 32) Mean ± SD	Subcostal (n = 32) Mean ± SD	P value
Hour 0	9.85 ± 0.31	9.85 ± 0.29	0.839
Hour 24	8.43 ± 0.75	8.19 ± 0.75	0.009
Hour 72	5.60 ± 1.28	4.98 ± 0.97	0.032
Day 7	3.21 ± 0.87	2.81 ± 1.03	0.096

6-month follow-up post-operation, AWA symptoms were resolved in one patient, but the other four patients who had no signs of AWA at 3-month follow-up post-operation were diagnosed with AWA at the 6-month follow-up post-operation. Ultimately, eight patients developed AWA in the subcostal group at the 6-month follow-up post-operation.

Although we witnessed a higher incidence of AWA in the subcostal group compared to the intercostal counterpart at 3-month follow-up post-operation, the results of Fischer exact test did not show any significant differences between the two groups ($P > 0.05$). However, this difference was more perceptible at the 6-month follow-up post-operation and became significant according to the chi-square test ($P = 0.039$). Indeed, in the subcostal group, eight subjects had developed AWA, while in the intercostal group, two developed AWA [Table 4].

Discussion

The aim of the present study was to compare subcostal and intercostal flank incisions in open kidney surgeries regarding AWA and post-operative pain, incision time, and wound closure time. There was no significant difference between the two groups regarding demographic and underlying characteristics such as BMI, age, gender, incision length, and whole operation duration, which affect the probability of development of hernia and bulging as well as post-operative pain.

So far, there has been limited and controversial information on the extent of flank bulging following retroperitoneal open surgery. The prevalence of flank bulging following flank incision shows high variation, reported between 9% and 57% in different studies.[5] There is less information about the extent of incision hernia following kidney surgery. A Swedish retrospective study[7] has reported 5% as the incisional hernia rate, while a review study[8] reported 15% as the incisional hernia rate. In the present research, the patients were followed-up for development of AWA including hernia and bulging of abdominal wall in the flank region at 3 and 6 months post-operation. At the 3-month follow-up post-operation, out of 64 studied patients, eight had developed AWA (12.5%), while at 6-month follow-up

Table 4: Abdominal wall asymmetry (AWA) at 3 and 6 months post-operation in the groups

AWA	Intercostal (n = 32) Count (%)	Subcostal (n = 32) Count (%)	Overall rate (%) n = 64	P value
3 months post-operation	3 (6.25)	5 (21.88)	12.5%	0.708
6 months post-operation	2 (6.25)	8 (25)	15.62%	0.039

post-operation, 10 (15.63%) out of 64 studied patients had developed this condition, which is similar to the observations in the previous studies in this regard. Furthermore, these results concur with the findings of a prospective study by Osman *et al.*, reporting incidence of flank bulging as 14% at 6 months post-operation.[11] In the retrospective study by Kranz *et al.* (2020), the flank bulging following retroperitoneal operation was confirmed for 20.8% (25 out of 120 patients).[5] Also, Inkiläinen *et al.*[16] in a retrospective study reported that out of 165 patients, bulging and hernia were diagnosed for 38 (23%) patients and one (0.6%) patient, which were statistically similar to our study findings. Also, in another study by Inkiläinen *et al.*,[2] 31% of patients (45 out of 146) reported AWA post-operation, showing a higher rate compared to our study regarding AWA. This can be due to the retrospective nature of these studies compared to our clinical trial, whereby those with the risk of developing this complication have been largely excluded based on inclusion and exclusion criteria.

According to our extensive research in medical literature, there has been no clinical trial study that has precisely compared these two incisions regarding the development of hernia or bulging post-operation. In the prospective study by Osman *et al.*,[11] performed to evaluate the incidence and risk factors of development of hernia or bulging of flank incision following kidney surgery, 100 adult patients underwent different kidney surgeries through flank approaches including access through the rib 11 (n = 3), through rib 12 (n = 69), and through subcostal incision (n = 28), where two, 18 (26.1%), and four (14.3%) had developed hernia or bulging, but this difference was not statistically significant. Also, in the retrospective study by Kranz *et al.*[5], out of 43 patients who had developed flank bulging following open retroperitoneal surgery, for 12 patients, retroperitoneal access had been used through the intercostal space 10, while for 31 patients, intercostal 11 and lower had been used, and again this difference was not statistically significant. The difference of these two studies with ours lies in the fact that it had no clinical trial nature, in which comparison has been made between results of accesses through ribs 10, 11, or 12 with subcostal incision. However, in our study, subcostal and intercostal incision access (between ribs 11 and 12) have been compared with each other. Based on the present study results, the likelihood of the incidence of hernia or bulging is lower following intercostal incision as compared to subcostal, which can be due to the placement of ribs 11 and 12 in the flank region as well as the relative resistance to the bulging of more internal organs.

The present study showed that the mean pain score of patients at 24 and 72 h post-operation was significantly lower than in the intercostal group. However, this difference was not significant once they became stable post-operation in the recovery and on the 7th day post-surgery [Table 3]. In this regard, Shamim and Iqbal[1] in a controlled randomized trial compared subcostal and transcostal incisions (by removing rib 12) for benign kidney disease. They found that the extent of pain was significantly higher in the transcostal group (P = 0.001). The difference of this study with the present one is that it compared subcostal incision with transcostal incision, and due to the higher aggressiveness of transcostal access and removal of ribs, it is justified that a greater level of pain would be induced compared to subcostal access. However, the present study tried to compare the level of subcostal and intercostal incisions. Also, in the prospective randomized study by Aguiar *et al.*[17] comparing mini subcostal incision (n = 30) and lumbotomy incision (n = 30) in alive kidney donors, no significant difference was found in the extent of tramadol consumption or pain perception between the groups. Again, the study, unlike ours, has compared the subcostal method with the lumbotomy method.

Overall, the patients who undergo surgery with flank intercostal incision have a higher probability of developing hernia or bulging following surgery compared to the subcostal method. However, the level of pain reported by patients undergoing surgery with subcostal flank incision is lower than those undergoing intercostal incision. There was no difference regarding the time of incision and time of wound closure in the flank intercostal and subcostal incision approaches. There is no clinical trial study that has precisely compared these two incision methods regarding development of hernia or bulging post-operation, and the present study is novel in this regard. Use of precise and complete inclusion and exclusion criteria for selection of patients to mitigate the confounding factors that affect the results has been one of the major strengths of this study. Nevertheless, our study had some limitations. Limited sample size was a limitation, and it is suggested to conduct similar studies with larger sample size and with longer follow-up periods in other healthcare centers. Furthermore, through medical imaging, more precise differentiation can be done between hernia and bulging post-operation.

Conclusion

No difference was found between flank intercostal and subcostal approaches regarding time of incision and wound closure time. Intercostal incision as compared to subcostal incision in spite of being associated with higher post-operative pain showed a lower probability of developing hernia or bulging post-operation. Thus, these results can be of interest in clinical planning for the surgery team in applying the best access with the minimum probability of development of hernia or bulging of the abdominal wall in those undergoing open kidney surgery, especially those who have the risk factors of developing hernia or bulging.

Author contributions

Clinical studies and experimental studies: AA, BI, SHM and SBJ; Data acquisition: AA, SHM and SBJ; Data analysis: AA, BI, SHM and SK; Statistical analysis: SK; Manuscript preparation: AA, BI, SK and SBJ. All authors contributed to concepts, design, definition of intellectual content, literature search, manuscript editing, manuscript review and guarantor.

Ethical policy and institutional review board statement

The Ethics committee of Hamedan University of Medical Sciences approved this study under the code IR.UMSHA. REC.1401.937 on 2023.01.27, and the principles of Helsinki Declaration were also observed in this study.

Declaration of patient consent

The informed consent form for participation in the study, which was approved by the Ethics Committee of Hamadan University of Medical Sciences, was completed by all patients before the surgery.

Data availability statement

All data generated and/or analyzed during this study are included in this published article.

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Conflicts of interest

There are no conflicts of interest.

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References

1. Shamim M, Iqbal SA. Open renal approach: comparative analysis of sub-costal incision versus trans-costal incision with excision of 12th rib. Pakistan J Med Sci 2009;25:557-62.
2. Inkiläinen A, Blomqvist L, Ljungberg B, Strigård K. Patient-reported outcome measures of abdominal wall morbidity after flank incision for open partial nephrectomy. BJU Int 2021;128:497-503.
3. Frey KB, Association of Surgical Technologists. Surgical technology for the surgical technologist: A positive care approach. Cengage Learning; 7. Technologists AoS. Surgical Technology for the Surgical Technologist4; 2018.
4. Al-Kaabneh A, Qamar AA, Al-Hammouri F, Al-Majali A, Alasmar A, Al-Sayedeh N, *et al*. The effect of anaesthesia on flank incisional pain: Infiltration versus intercostal nerve block, a comparative study. Pan Afr Med J 2020;36:356.
5. Kranz J, Grundl S, Wußow F, Steffens J, Anheuser P, Schneidewind L. Permanent flank bulge after flank incision: Patient-and physician-reported outcome. Urol Int 2022;106:387-96.
6. Knighton BJ, Ngaage LM, Calvert C, Niederhaus SV, Scalea JR, Rasko YM. Post-abdominal transplant hernia: Can we predict size and onset? Transplant Proc 2021;53:730-736. Elsevier.
7. Hermann M, Gustafsson O, Sundqvist P, Sandblom G. Rate of incisional hernia after minimally invasive and open surgery for renal cell carcinoma: A nationwide population-based study. Scand J Urol 2021;55:372-6.
8. Zhou D, Carlson MA. Incidence, etiology, management, and outcomes of flank hernia: Review of published data. Hernia 2018;22:353-61.
9. Yildız I, Koca YS. What kind of incision should be made to reduce the risk of incisional hernia in kidney transplantation? Ann Transplant 2017;22:689-93.
10. Simson N, Samuel P, Stonier T, Halligan S, Windsor A. Incisional hernia in renal transplant recipients: a systematic review. Am Surg 2018;84:930-6.
11. Osman T, Emam A, Farouk A, ElSaeed K, Tawfeek AM, AbuHalima A. Risk factors for the development of flank hernias and bulges following surgical flank approaches to the kidney in adults. Arab J Urol 2018;16:453-9.
12. Moris D, Bokos J, Vailas M, Kakavia K, Spartalis E, Athanasiou A, *et al*. Renal paratransplant hernia revealed: A review of the literature. Hernia 2017;21:363-7.
13. Marchand C, Renard Y, Avisse C, Palot JP, Larre S. Éventrations lombaires symptomatiques après néphrectomies par lombotomie: Quels sont les facteurs de risque? Progrès En Urologie 2016;26:304-9.
14. Hajilo P, Imani B, Zandi S, Mehrafshan A. Comparing the intraoperative and postoperative complications of the scalpel and electrocautery techniques for severing the inner layers of the lumbar disc during discectomy surgery. Front Surg 2023;10:1264519.
15. Chaywiriyangkool C, Manusook S, Pongrojpaw D, Somprasit C, Suwannarurk K. Comparative study of postoperative pain between Maylard incision and pfannenstiel incision in gynecologic surgery: A randomized controlled trial. J Med Assoc Thai 2016;99:S16-22.
16. Inkiläinen A, Styrke J, Ljungberg B, Strigård K. Occurrence of abdominal bulging and hernia after open partial nephrectomy: A retrospective cohort study. Scand J Urol 2018;52:54-8.
17. Aguiar WF, Passerotti CC, Claro JF, Almeida CJ, Gattas N, Cedenho AP, *et al*. Mini-incisions by lombotomy or subcostal access in living kidney donors: A randomized trial comparing pain, safety, and quality of life. Clin Transplant 2007;21:269-76.