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Analysis of risk factors for impaired wound healing after kidney transplantation

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Abstract

To analyse risk factors for impaired wound healing after kidney transplantation to guide clinical decision-making. A retrospective analysis was performed on patients who received kidney transplantation from January 1, 2019, to May 1, 2021, at Kidney Transplantation Center in Renji Hospital Affiliated to Shanghai Jiaotong University School of Medicine. A case-control study was used to identify a cohort of patients with similar baseline characteristics according to 1:4 ratio. Patients were divided into two groups according to whether there was impaired wound healing after surgery. The basic data and clinical examinations between the two groups were compared, and the risk factors for impaired wound healing after kidney transplantation were analysed using univariate and multivariate analyses. According to the data type, independent samples *t*-test or Chi-squared test was used for comparison between groups. Furthermore, multivariate logistic regression analysis was used to analyse different risk factors and calculate the odds ratio (OR) and 95% confidence interval (CI) of each factor. A total of 18 patients showed impaired wound healing after kidney transplantation. And we conducted 72 statically matched controls. Age, diabetes, transplant types, body mass index (BMI), albumin, haemoglobin, and wound infection were statistically different between the two groups. The factors with statistically significant differences in univariate analysis were included in multivariate logistic regression analysis. The results showed that BMI > 25, fasting blood glucose level, albumin level, and prealbumin level were independent risk factors for impaired wound healing after kidney transplantation. Risk factors for impaired wound healing after kidney transplantation can be detected after surgery. Strengthening postoperative monitoring and early intervention of recipients with such factors may effectively prevent impaired wound healing after kidney transplantation.

KEYWORDS

kidney transplantation, risk factors, wound healing

Key Message

- to analyse risk factors for impaired wound healing after kidney transplantation to guide clinical decision-making
- risk factors for impaired wound healing after kidney transplantation can be detected after surgery. Strengthening postoperative monitoring and early intervention of recipients with such factors may effectively prevent impaired wound healing after kidney transplantation

1 | INTRODUCTION

Impaired wound healing is a common surgical complication, including wound dehiscence exudation, fat liquefaction, delayed healing, and wound infection; the incidence of impaired wound healing, an early complication after kidney transplantation, is about 7.7% to 21%.[1,2] Impaired wound healing results in prolonged hospital stays and burdens patients' quality of life.[3] Therefore, early identification of such high-risk groups is significant to reduce the risk of impaired wound healing. Kidney transplant recipients have been in a state of end-stage renal disease for a long time before surgery, leading to a long-term accumulation of toxins, severe protein loss, renal anaemia, edema, and electrolyte disorders.[4,5] As a result, they are more likely to be susceptible to impaired wound healing than other surgical patients. In addition, the use of high-dose corticosteroids and immunosuppressive agents after kidney transplantation increases the risk of impaired wound healing.[6-8] Impaired wound healing in kidney transplantation may cause wound infection and even graft infection, which will burden patients.[9]

This study retrospectively analysed the clinical data of kidney transplant patients in Renji Hospital Affiliated to Shanghai Jiaotong University School of Medicine, aiming to analyse the risk factors related to wound healing in patients and provide guidance for early diagnosing and intervening such patients.

2 | MATERIALS AND METHODS

2.1 | Collection of clinical data

Patients who underwent allogeneic kidney transplantation from January 1, 2019, to May 1, 2021, at Kidney Transplant Center in Renji Hospital Shanghai Jiaotong University School of Medicine were enrolled in this study. A case-control study was used to identify a cohort of patients with similar baseline characteristics according to 1:4 ratio. The clinical data were sorted and collected from the single-disease database of kidney transplantation in the hospital, including sex, age, body mass index(BMI), transplant types, examination in the perioperative period (creatinine, urea nitrogen, alanine aminotransferase, aspartate aminotransferase, direct bilirubin, albumin, urine protein, haemoglobin, platelets, fasting blood glucose, and immunosuppressant concentrations), postoperative wound healing.

2.2 | Definition of impaired wound healing

After standard care, a non-healing full-thickness skin defect is developed at the wound site of kidney transplantation when the wound sutures are removed.

2.3 | Statistical methods

The data were analysed using R (programming language) and Empower Stats statistical software. Continuous variables were expressed as ($x \pm s$), and categorical variables were expressed as percentages (%). According to data types, continuous variables were compared using independent samples *t*-test, while categorical variables were compared using Chi-squared test between the two groups. Furthermore, multivariate logistic regression analysis was applied to analyse different risk factors and calculate the odds ratio (OR) and 95% confidence interval (CI) of each factor. $P < .05$ is considered statistically different.

3 | RESULTS

Baseline comparison and impaired wound healing of patients after kidney transplantation in the two groups are given in Table 1.

A total of 18 patients with impaired wound healing matched 72 patients in the other group at a ratio of 1:4 according to patient age, sex, and operation time. These 72 patients were taken as a control group. In addition, impaired wound healing occurred in the 18 patients in a mean time of 13 days after kidney transplantation (11-15d).

TABLE 1 Baseline comparison after kidney transplantation in the two groups

Characteristic	Case group (N = 18)	Control group (N = 72)
Male gender, n (%)	11 (61.1)	47 (65.3)
Age, year, mean (SD)	49.8 (13.9)	49.6 (11.5)
ABO-compatible, n (%)	18 (100)	72 (100)
BMI, mean (SD)	25.96 (3.44)	22.26 (2.73)
Donor		
Deceased, n (%)	18 (100)	65 (90.2)
Living related, n (%)	0	7 (9.8)
HLA mismatch		
0-3, n (%)	10 (55.6)	47 (65.2)
4-6, n (%)	8 (44.4)	25 (34.8)
Type of dialysis		
Haemodialysis, n (%)	16 (88.9)	58 (80.6)
Peritoneal dialysis, n (%)	2 (11.1)	11 (15.2)
Non-dialysis, n (%)	0	3(4.2)
Primary induction therapy		
Antithymocyte antibodies, n (%)	14 (77.8)	51 (71.0)
Anti-IL-2 receptor antibodies, n (%)	4 (22.2)	21 (29.0)
Maintenance immunosuppressive treatment		
Tacrolimus, n (%)	18 (100)	62 (86.1)
Cyclosporine, n (%)	0	10 (13.9)
mTOR inhibitors, n (%)	0	0
MPA, n (%)	18 (100)	72 (100)
PRED, n (%)	18 (100)	72 (100)

Note: Case group: The patient's wound did not heal well. Control group: The patient's wound heals well. ABO-compatible: Patients who received ABO-matched kidney transplantation.
Abbreviations: BMI, body mass index; MPA, mycophenolic acid; PRED, prednisolone.

Univariate analysis of risk factors affecting impaired wound healing after kidney transplantation is given in Table 2.

Univariate analysis showed that wound infection, overweight, diabetes mellitus, high fasting blood glucose level, and hypoalbuminemia were risk factors for impaired wound healing after kidney transplantation with a statistical difference ($P < .05$).

Multivariate analysis of risk factors affecting impaired wound healing after kidney transplantation is given in Table 3.

BMI > 25, fasting blood glucose level, albumin level, and prealbumin were statistically different in the univariate analysis with $P < .05$. These factors were analysed using multivariate Cox regression, showing that BMI > 25, fasting blood glucose level, albumin level, and prealbumin were the risk factors for impaired wound healing after kidney transplantation.

4 | DISCUSSION

In this retrospective, observational, single-centre study, risk factors for poor wound healing after renal transplantation were analysed. BMI, hypopotassemia and diabetes were significantly more frequently documented in patients with poor healing of the wound. Therefore, the risk factors can be detected and receive effective timely intervention in these patients.

Impaired wound healing often occurs about 10 days after kidney transplantation, manifested as a full-thickness skin defect that cannot heal at the wound site when the wound sutures are removed. Impaired wound healing after kidney transplantation mainly includes wound infection, wound dehiscence exudation, fat liquefaction, and wound bleeding and oozing.[10]

Previous studies have reported infection is a common reason for poor wound healing after kidney transplantation and reported that the incidence of wound infection in kidney transplantation is about 2% to 10%. If the procedure is aseptic before, during, and after surgery, the incidence can be reduced to less than 0.5%.[11] Wound infection after kidney transplantation manifests as redness, swelling, and pain at the wound site, which may threaten the function of the transplanted kidney and even lead to severe bacteraemia and systemic infection. Therefore, preventing wound infection is extremely important.[12] The most fundamental measures to prevent wound infection are intraoperative and postoperative aseptic operation and adequate postoperative wound drainage.[13] After surgery, the wound should be washed promptly and covered with dressings, which will prevent wound infection and promote wound healing.

Wound dehiscence exudation is a common wound complication after kidney transplantation. Kidney transplant recipients have been in a state of uraemia, anaemia, and hypoproteinemia for a long time before surgery, resulting in the long-term accumulation of toxins in the body. Therefore, the wound of kidney transplant patients is prone to discharge, resulting in subcutaneous exudation and impaired wound healing. In addition, the application of high-dose corticosteroids[7] and immunosuppressive agents after kidney transplantation is also not conducive to wound healing.[14,15] Therefore, protein should be

TABLE 2 Univariate analysis of risk factors

Characteristic	OR	95% CI	*P*-value
Infection			
N			
Y	>999.999	<0.001, >999.999	-
BMI			
<=25			
>25	28	8.02, 120	<.001
Diabetic			
N	1.00 (ref)		
Y	3.57	1.24, 10.9	.02
Glucose level	1.08	1.04, 1.13	<.001
Prealbumin	0.98	0.96, 0.99	<.001
Albumin	0.69	0.56, 0.81	<.001
WBC	1.13	0.99, 1.30	.065
TB	0.96	0.82, 1.11	.62
DB	1.24	0.88, 1.75	.21

Abbreviation: BMI, body mass index.

TABLE 3 Multivariate analysis of risk factors

Characteristic	OR	95% CI	*P*-value
BMI			
<=25			
>25	173	8.92, 55 383	.009
Glucose level	1.13	1.02, 1.33	.043
Prealbumin	0.97	0.92, 0.99	.078
Albumin	0.63	0.32, 0.86	.028

Abbreviation: BMI, body mass index.

supplemented to such patients during the perioperative period to correct the hypoalbuminemia state and increase the haemoglobin level as much as possible.[16] The significance of avoiding heavily exudative on the wound is to remove the wound secretions at the wound surface and keep the wound dry.

Fat liquefaction is a common cause of impaired wound healing in obese patients. The large tension of the wound in obese patients and the insufficient blood supply in the fat easily cause liquefaction of the adipose tissue, thus impeding the wound healing.[17] Therefore, the wound after kidney transplantation should be sutured tightly in layers to eliminate dead space as much as possible. The fat layer should be closed with absorbable sutures. Furthermore, doctors should apply tension-relieving sutures, pressure bandages, and delayed suture removal for wounds under high tension.

The major strength of this study is that we provide a reference for early identification of risk factors in poor wound healing after kidney transplantation. But the study also has some limitations. First, this study is an observational study, so baseline factors cannot be fully balanced; second, there were some absent values in this study. Although we imputed the absent values, we could not guarantee 100% that there is no difference between the data and the true measurement. Therefore, further large multicentre prospective studies should be conducted.

In conclusion, impaired wound healing is an early complication after kidney transplantation, which will bring a great burden to patients. Therefore, the risk factors for impaired wound healing after kidney transplantation should be identified early and intervened to reduce wound complications.

DATA AVAILABILITY STATEMENT

The datas will be published alongside your manuscript, if it is accepted for publication.

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