



Application of a specialist nurse-led multidisciplinary team model in the perioperative care of patients undergoing simultaneous pancreas and kidney transplantation: randomized controlled trial

Weiting Zhang, Xiuli Feng, Xuanying Deng, Min Jin, Jiali Li, Jiahui Xu, Jiali Fang, Caiqin Pan, Yuhe Guo

Organ Transplantation Department, the Second Affiliated Hospital of Guangzhou Medical University, Guangzhou, China

Contributions: (I) Conception and design: W Zhang; (II) Administrative support: X Feng; (III) Provision of study materials or patients: X Deng, M Jin; (IV) Collection and assembly of data: J Li, J Xu, J Fang; (V) Data analysis and interpretation: C Pan, Y Guo; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Xiuli Feng, BS. Organ Transplantation Department, the Second Affiliated Hospital of Guangzhou Medical University, No. 63, Yayun South Road, Panyu District, Guangzhou 511447, China. Email: 379894875@qq.com.

Background: Simultaneous pancreas and kidney transplantation (SPKT) is an effective treatment option for individuals who suffer from both diabetes mellitus and renal failure. However, experiments exploring nurse-led multidisciplinary team management during the perioperative management of patients undergoing SPKT are currently limited. This study aims to explore the clinical performance of a transplant nurse-led multidisciplinary team (MDT) in the perioperative management of SPKT patients.

Methods: A total of 218 patients who underwent SPKT were randomly assigned to either a control group (n=116) receiving conventional care or an intervention group (n=102) managed through a transplant nurse-led MDT approach. The incidence of postoperative complications, hospital stay, total hospitalization cost, readmission rate, and postoperative nursing quality were compared between these 2 groups.

Results: The intervention and control groups showed no significant differences in age, gender, and body mass index. Compared with the control group, the intervention group had a significantly lower incidence of postoperative pulmonary infection and gastrointestinal (GI) bleeding (27.6% vs. 14.7% and 31.0% vs. 15.7%, respectively, both $P<0.05$). Compared to the control group, the intervention group had significantly lower hospitalization costs, length of hospital stay, and readmission rate 30 days after discharge (32.98 ± 9.10 vs. 36.78 ± 15.36 , 26.47 ± 13.4 vs. 31.03 ± 11.61 and 31.4% vs. 50.0% , respectively, all $P<0.05$). Additionally, the intervention group had significantly better quality of postoperative nursing care than the control group (11.61 ± 0.69 vs. 9.64 ± 1.42 , $P<0.01$), the availability of infection control and prevention measures (11.74 ± 0.61 vs. 10.53 ± 1.11 , $P<0.01$), the effectiveness of health education (11.73 ± 0.61 vs. 10.41 ± 1.06 , $P<0.01$), the effectiveness of rehabilitation training (11.77 ± 0.54 vs. 10.37 ± 0.96 , $P<0.01$), and the patient satisfaction with nursing care (11.83 ± 0.42 vs. 10.81 ± 1.08 , $P<0.01$).

Conclusions: The nurse-led MDT model for transplant patients can reduce complications, shorten hospital stays, and save costs. It also provides clear guidelines for nurses, improving care quality and aiding patient recovery

Trial Registration: Chinese Clinical Trial Registry ChiCTR1900026543.

Keywords: Specialist nurse; multidisciplinary team; simultaneous pancreas and kidney transplantation; perioperative management

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Introduction

Simultaneous pancreas and kidney transplantation (SPKT) is an effective treatment for individuals suffering from both diabetes mellitus and renal failure, helping patients to eliminate dependence on exogenous insulin and renal replacement therapy (1). In 2021, the International Diabetes Federation (IDF) released new epidemiological survey data showing that 537 million adults worldwide between the ages of 20 and 79 were living with diabetes, with a prevalence rate of 10.5%, among which China had 140 million individuals with diabetes, the highest number of individuals with diabetes globally (2). Diabetic kidney disease (DKD) has been the primary cause of end-stage renal disease (ESRD) for a considerable period, and the prevalence of DKD has increased proportionally with the significant rise in the prevalence of diabetes (3).

Since multiple departments are involved during the perioperative management of SPKT, the multidisciplinary team (MDT) approach has become one of the important medical modes globally as it can integrate medical resources and contribute to improved outcome (4). Nurses are essential in all aspects of SPKT management, providing disease-related information, health education, and patient engagement to improve adherence to guidelines and promote positive health outcomes. However, most of the currently available studies on perioperative care of SPKT patients are case reports from single centers, and most of them have focused on the nursing of specific complications and thus were still at the stage of experience accumulation. To date, no systematic and evidence-based mode for nursing

management throughout the spectrum of perioperative care has been available (5). In our current study, a pre-, intra-, and post-operative (PIP) care model for patients undergoing SPKT that was led by specialist nurses for organ donation (hereafter referred as “transplant nurses”) and involved nurses from the anesthesiology department, nutrition department, rehabilitation department, endocrinology department, nephrology department, hemodialysis department, and pharmacy department, as well as follow-up nurses, was developed and applied in clinical settings to integrate multiple resources. We present this article in accordance with the CONSORT reporting checklist (available at <https://gs.amegroups.com/article/view/10.21037/ga-23-116/rc>).

Methods

Participants

In this prospective parallel study, patients who underwent SPKT at our center from September 2016 to December 2021 were enrolled if they met the inclusion (*Figure 1*). To be eligible for inclusion, inclusion criteria for patients were: (I) age between 18 and 80 years; (II) meeting the SPKT criteria stipulated by the indications and contraindications for SPKT in the *Chinese Guidelines on Kidney Transplantation* and *Chinese Guidelines on Pancreatic Transplantation* and having been approved by the ethics committee; (III) being able to tolerate surgery, as assessed by preoperative organ function tests; (IV) having signed informed consent forms. In relation to withdrawal and exclusion, patients were excluded from the investigational treatment: (I) at the request of the investigator himself/herself or his/her legal representative; (II) if in the opinion of the investigator or designee, participation in the study could be detrimental to the patient; (III) upon the death of the patient. The reasons for withdrawal were recorded for all patients who withdrew from the study.

A total of 218 eligible patients were divided into 2 groups using a random number table. Participants were randomly assigned to either the intervention or control group in a 1:1 ratio. There were 102 patients in the intervention group, and 116 in the control group. This parallel study complied with the Declaration of Helsinki (as revised in 2013), and was approved by the Ethics Committee of the Clinical Research Center of the Second Affiliated Hospital of Guangzhou Medical University (No. 2023-hg-ks-11). All the patients signed informed consent forms.

Highlight box

Key findings

- The MDT model facilitates perioperative recovery of patients undergoing simultaneous pancreas and kidney transplantation (SPKT).

What is known and what is new?

- There is a lack of research on multidisciplinary, patient-centered management approaches by specialist nurses during the perioperative care of pancreas-kidney transplant patients.
- This study tested a comprehensive multidisciplinary approach, led by nurses, to manage patients undergoing SPKT.

What is the implication, and what should change now?

- The MDT model saves health care expenditures, and larger sample sizes are needed to better evaluate the model.

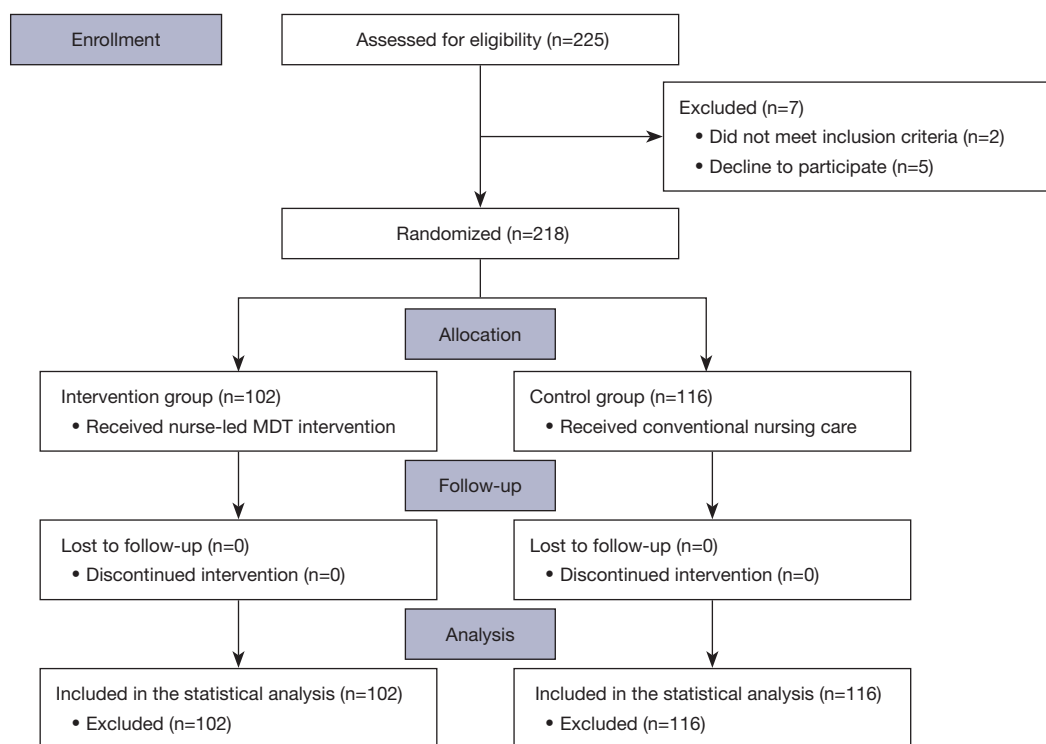


Figure 1 Flow chart of patient grouping and screening. MDT, multidisciplinary team.

Intervention group

During the perioperative management period, the intervention group received both the conventional care described above and a nurse-led MDT approach, while the control group only received conventional care.

Building a transplant nurse-led MDT

With a transplant nurse as the team leader, the MDT comprised a transplant surgeon, anesthesiologist, dialysis physician, nutritionist, pharmacist, rehabilitation physician, hemodialysis nurse, diabetes specialist nurse, and follow-up nurse.

Developing PIP care protocols for patients undergoing SPKT

Based on nursing practice and clinical nursing management experience in China and internationally (6,7), the MDT developed a PIP care model for patients undergoing SPKT, with its main content including preoperative assessment and preparation, intraoperative anesthesia management, postoperative fluid management, blood glucose management, nutrition management, infection control and prevention, identification and observation of complications,

early rehabilitation, psychological care, health education, follow-up management, and specialist nurse-guided nursing management continuum.

Implementation of an MDT approach

The implementation steps included the following: (I) establishment of an SPKT MDT. (II) Assessment of nursing problems: the transplant nurse collected patient data and facilitated the assessment of major nursing problems. (III) Multidisciplinary bedside rounds: members of the MDT were invited to attend morning bedside rounds every Monday, during which the transplant nurse reported the disease conditions and provided reasonable insights from the perspective of nursing. (IV) MDT meetings: during the weekly meetings, the transplant surgeon reported on the disease condition and treatment plan and the transplant nurse reported on early-warning nursing problems; accordingly, the intervention plan was developed. (V) Implementation of the intervention plan: the specialist nurse checked the implementation of the nursing plan daily, so as to identify any possible problem during the implementation of the plan and revise the nursing plan in a timely manner. Specialist nurses were invited to

address the relevant specialist problems encountered in the implementation process. (VI) Evaluation of quality control performance: MDT records of the discharged patients were regularly compiled by follow-up nurses; for patients experiencing special or complex nursing problems, a continuous improvement program was developed.

Control group (conventional nursing care group)

Patients received conventional nursing care after SPKT: after the surgery, the primary nurse closely monitored the disease conditions and offered mental health support, with special attention to the prevention of complications; health education was provided throughout the peri-operative period; nursing problems were promptly assessed, and consultations with other specialists were arranged when needed.

The transplant nurse-led multidisciplinary collaborative nursing protocol is shown in the [Appendix 1](#).

Survey tools

A quality control questionnaire for post-transplantation nursing was developed, which covered 5 domains including the implementation rate of basic nursing care, the availability of infection control and prevention measures, the effectiveness of health education, the effectiveness of rehabilitation training, and the patient satisfaction with nursing care. The questionnaire included 15 items, and the total score of each domain was 12. A higher score indicated better quality control.

Follow up

Baseline data such as age, gender, and BMI were collected. Data were collected at the perioperative period after SPKT, and mainly focused on the postoperative complication incidence, hospital stay, total hospitalization cost and readmission rate, and postoperative nursing quality scores. Two independent researchers who were blinded to the allocation of participants collected and analyzed the aforementioned data. The primary endpoint was gastrointestinal (GI) bleeding during the peri-operative period.

Statistical analysis

Sample size

We performed a conservative sample size calculation based

on the incidence of GI bleeding observed in our study. We determined that 99 patients in both groups would be required to detect an expected decrease from 31% to 15% with a two-tailed alpha of 0.05 and a power of 0.80.

Data analysis

We conducted statistical analysis using SPSS version 22.0 (IBM Corp., Armonk, NY, USA). *T*-tests and analysis of variance (ANOVA) were used to analyze the measurement data, which were reported as mean \pm standard deviation (SD). The qualitative data were compared using chi-square test on rows and columns; for data with an expected frequency of <1 , the Fisher's exact probability test was performed. The Kolmogorov-Smirnov method was used to examine the normality of data distributions, and a *P* value of <0.05 was considered statistically significant. Statistical analysis was performed using SPSS 25.0 software.

Results

Baseline characteristics

A total of 218 patients who underwent SPKT in our center during the period from September 2016 to December 2021 were enrolled (*Figure 1*). The intervention group ($n=102$) and control group ($n=116$) showed no statistical differences in general information including age, gender, and BMI (*Table 1*). Thus, these two groups were comparable.

Post-operative complications

The intervention group had a significantly lower incidence of pulmonary infection compared to the control group in terms of medical complications ($P=0.021$), and a significantly lower incidence of GI bleeding in terms of surgical complications ($P=0.008$), whereas there was no statistical difference in the incidence rates of intestinal obstruction, intestinal fistula, pancreatic fistula, pancreas graft thrombosis, and poor incision healing (*Table 2*).

Total hospitalization cost, length of hospital stay, and readmission within 30 days after discharge

The intervention group had significantly lower hospitalization days, total hospitalization cost, and 30-day post-discharge readmission rate compared to the control group. The number of hospitalization days and total hospitalization cost (direct medical cost) were significantly

Table 1 Baseline data in two groups

| Main measures | Control group (n=116) | Intervention group (n=102) | P value |
|--|-----------------------|----------------------------|---------|
| Age, years | 47.5±10.3 | 50.8±8.8 | 0.082 |
| Gender (males/females) | 94/22 | 91/11 | 0.093 |
| BMI, kg/m ² | 23.5±3.16 | 23.7±2.78 | 0.249 |
| Number of HLA mismatches | 3.6±1.0 | 3.6±1.1 | 0.702 |
| Pre-operative glycosylated hemoglobin, % | 6.5±1.5 | 6.8±1.9 | 0.242 |
| Age of donors, years | 32.7±11.0 | 35.1±12.5 | 0.292 |

Data are presented as either numerical values or mean ± standard deviation. BMI, body mass index; HLA, human leukocyte antigen.

Table 2 Incidence rates of complications in two groups (n=218)

| Item | Control group (n=116) | Intervention group (n=102) | P value |
|----------------------------------|-----------------------|----------------------------|---------|
| Gastrointestinal bleeding, n (%) | 36 (31.0) | 16 (15.7) | 0.008 |
| Intestinal obstruction, n (%) | 4 (3.4) | 1 (0.9) | 0.374 |
| Pulmonary infection, n (%) | 32 (27.6) | 15 (14.7) | 0.021 |
| Intestinal fistula, n (%) | 3 (2.6) | 2 (2.0) | 1.0 |
| Pancreatic fistula, n (%) | 1 (0.9) | 1 (0.9) | 1.0 |
| Pancreas graft thrombosis, n (%) | 4 (3.4) | 5 (4.9) | 0.737 |
| Poor incision healing, n (%) | 20 (17.2) | 16 (15.7) | 0.758 |

Table 3 Total hospitalization cost and length of hospital stay in two groups

| Item | Control group (n=116) | Intervention group (n=102) | P value |
|---|-----------------------|----------------------------|---------|
| Length of hospital stay (days) | 36.78±15.36 | 32.98±9.10 | 0.023 |
| Total hospitalization cost (10,000 yuan) | 31.03±11.61 | 26.47±13.4 | <0.01 |
| Readmission rate within 30 days after discharge | 58 (50.0) | 32 (31.4) | 0.005 |

Data are presented as either numerical values or mean ± standard deviation.

lower in the intervention group than in the control group ($P<0.05$), as shown in *Table 3*.

Quality of postoperative care

According to the survey, the quality of postoperative nursing care was significantly better in the intervention group compared to the control group in all 5 domains including the implementation rate of basic nursing care, the availability of infection control and prevention measures, the effectiveness of health education, the effectiveness of rehabilitation training, and the patient satisfaction with nursing care (all $P<0.01$) (*Table 4*).

Discussion

SPKT is a complex surgical procedure that simultaneously involves 3 organs including pancreas, duodenum, and kidneys. Its perioperative care is extremely challenging, and a variety of complications may occur. The major concerns during PIP care of patients undergoing SPKT include the following: (I) fluid management: excessive fluid intake can easily lead to heart failure, pulmonary edema, and other complications, whereas low fluid intake can cause dehydration and insufficient graft perfusion. (II) Nutrition management: there is limited evidence on the application of early enteral nutrition following SPKT. In fact, early

Table 4 Core competencies of specialist nurses in two groups

| Item | Control group (n=116) | Intervention group (n=102) | P value |
|---|-----------------------|----------------------------|---------|
| Implementation rate of basic nursing care | 9.64±1.42 | 11.61±0.69 | <0.01 |
| Effectiveness of health education | 10.41±1.06 | 11.73±0.61 | <0.01 |
| Effectiveness of rehabilitation training | 10.37±0.96 | 11.77±0.54 | <0.01 |
| Availability of infection control and prevention measures | 10.53±1.11 | 11.74±0.61 | <0.01 |
| Patient satisfaction with nursing care | 10.81±1.08 | 11.83±0.42 | <0.01 |

Data are shown as mean ± standard deviation.

nutritional management often includes 3 phases: TPN, transition from parenteral to enteral nutrition, and enteral nutrition, with daily caloric supply adjusted by nursing staff in an individualized manner. (III) Infection prevention and control: patients undergoing SPKT are predisposed to infections due to the placement of multiple indwelling catheters and the use of high-dose immunosuppressants, and the infections may be aggravated in diabetic patients because these patients are intolerant to it. (IV) Rejection identification: SPKT is a transplant of multiple organs, during which the diagnosis and treatment of rejection is particularly complicated and difficult. Most acute-rejection episodes occur insidiously, and the confirmation of pancreas rejection relies on biopsy. (V) Complication identification and observation: the high incidence of complications after SPKT is an important factor affecting the short-term patient and graft survivals. Reducing the incidence of postoperative complications is the key to improving the short-term survival rates of patients and grafts and preventing graft failure. (VI) Psychological care and health education: multiple catheterizations, long fasting time, and pain and discomfort at the operation site may lead to decreased compliance behavior and anxiety/depression. Timely mental assessment, psychological support, and health education are especially important for the recovery and prognosis of the recipients.

In our current study, the MDT model had the following advantages and thus optimized management, reduced the occurrence of postoperative complications, and promoted the early recovery of patients.

Specialist nurse-led MDT model improves nursing quality and reduces postoperative complications

In the present study, the specialist nurse-led MDT perioperative management model was effective in

lowering the incidence of pulmonary infection, intestinal obstruction, and GI bleeding in patients undergoing SPKT. It has been reported that the incidence of complications after SPKT ranges from 23% to 65.5% (8,9). In our center, pulmonary infection and GI bleeding are the 2 major complications with the highest incidence rates, and their occurrence is closely related to the use of immunosuppressive drugs. Oversuppression of the immune system by immunosuppressive drugs is a risk factor for pulmonary infection after organ transplantation (9), whereas the common causes of GI bleeding after SPKT include anastomotic bleeding, mucosal necrosis/bleeding due to intestinal ischemia, and pancreaticoduodenal graft bleeding due to rejection (10). Therefore, in our specialist nurse-led MDT model, the transplant nurse exerts leadership in patient care and plays a key role in the prevention, identification, and detection of complications. Early pulmonary infection requires refined care by nursing staff, including the addition of early rapid rehabilitation interventions (to encourage patients to exercise in bed and become ambulatory early) and the provision of scientific guidance (to reduce hypostatic pneumonia caused by long-duration bed rest). Our results also showed that the transplant nurse-led MDT increased MDT specialist consultations, which effectively reduced the incidence of pneumonia, highlighting the key role of the transplant nurse in preventing complications. Intestinal bleeding is another major complication, and effective and feasible nursing measures can reduce the trauma caused by GI bleeding. In this study, the incidence of GI bleeding was significantly lower in the intervention group than in the control group ($P=0.008$), suggesting the effectiveness of the transplant nurse-led MDT model in preventing this condition. Intestinal obstruction is a common complication after pancreatic surgeries and is also known to occur after SPKT (11). The occurrence of early intestinal obstruction

after SPKT is associated with the history of preoperative peritoneal dialysis, insufficient postoperative ambulation, and premature consumption of solid foods. The implementation of our specialist nurse-led MDT model, in which the specialist nurse developed the individualized rehabilitation plans and dietary regimens together with the rehabilitation physician and nutritionist, reduced the incidence of intestinal obstruction (0.9% *vs.* 3.4%), although there was no statistical difference between these 2 groups.

Specialist nurse-led MDT model shortens hospital stay and lowers hospital costs

In our current study, perioperative management based on a specialist nurse-led MDT shortened hospital stay, reduced hospital costs, and lowered readmission rates in patients undergoing SPKT. According to a study conducted outside of China (12), the hospitalization costs ranged from \$75,200 to \$87,800 and the laboratory testing costs were \$23,600–\$11,200 for patients undergoing SPKT, and the above expenditures did not include the organ acquisition costs. The high hospitalization expenses pose a huge financial challenge to SPKT patients (13). In addition, bleeding, thrombosis, and infections after SPKT are the main causes of prolonged hospitalization, and the incidence of readmission reached 74.2% in SPKT patients due to various infections (14). In our current study, the specialist nurse-led MDT model reduced the incidence of common complications such as pulmonary infections and GI bleeding, thereby promoting early recovery and improving health outcomes, which ultimately shortened the length of hospital stay and lowered the readmission rate, showing great economic benefits.

The specialty nurse-led MDT model improves nurses' professional competencies and increases patient satisfaction

In the present study, the transplant nurse-led MDT model promoted the increase in the specialist nurses' core competencies and promoted the continuous improvement of nursing quality. Nursing staff participate in the whole course of treatment and rehabilitation and provide direct care for the patients; thus, they play key role in multidisciplinary collaboration (5,15). Among them, specialist nurses participate in MDT as nursing experts. They can act as consultants, educators, and multidisciplinary coordinators for physicians, nurses, and patients, thus playing a pivotal

role in the MDT (16). Some international MDT models have proposed the health problem-oriented professional support (6,7). In our present study, the specialist nurse served as an MDT leader in assessing patients' symptoms and demands and invited professionals from relevant disciplines to provide professional support. This model effectively enhanced the nurse' management skills, critical thinking, professional development skills, and other core competences, which is conducive to the development of core competencies of specialist nurses.

Effective communication and information sharing facilitate MDT management

Multidisciplinary information-sharing platforms and communication channels are important for MDT management. In our center, we have realized real-time communication and information sharing through the hospital's information sharing platform, which will be further used for the performance assessment of various MDTs. In particular, it will be used to optimize the management policies, work processes, and performance incentives of the transplant nurse-led MDT model.

The main limitation of this study was the small number of cases included, in the future, larger sample sizes are needed to better evaluate the model.

Conclusions

In summary, SPKT is a difficult procedure with high incidence of postoperative complications, complex perioperative management, and multiple challenges in postoperative care. In this article, we summarized our experience in offering postoperative clinical nursing for SPKT patients, especially the application of a transplant nurse-led MDT model that has effectively reduced perioperative complications. This new model proposes clear clinical pathways and guidelines for nursing staff and improves the quality of nursing services and therefore warrants further investigations and application in clinical practice.

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Footnote

Reporting Checklist: The authors have completed the CONSORT reporting checklist. Available at <https://gs.amegroups.com/article/view/10.21037/gc-23-116/rc>

Trial Protocol: Available at <https://gs.amegroups.com/article/view/10.21037/gc-23-116/tp>

Data Sharing Statement: Available at <https://gs.amegroups.com/article/view/10.21037/gc-23-116/dss>

Peer Review File: Available at <https://gs.amegroups.com/article/view/10.21037/gc-23-116/prf>

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://gs.amegroups.com/article/view/10.21037/gc-23-116/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study complied with the Declaration of Helsinki (as revised in 2013), and was approved by the Ethics Committee of the Clinical Research Center of the Second Affiliated Hospital of Guangzhou Medical University (No. 2023-hg-ks-11). All the patients signed informed consent forms.

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