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*Cases report*

# ANESTHESIA AND PERIOPERATIVE MANAGEMENT FOLLOWING ERAS PROTOCOL IN KIDNEY TRANSPLANTATION FROM BRAIN-DEAD DONORS AT THONG NHAT HOSPITAL: A CASE SERIES OF SIX PATIENTS

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**ABSTRACT**: Kidney transplantation is one of the most effective treatment options for patients with end-stage renal disease. However, a considerable number of patients die while waiting for transplantation. We conducted a descriptive case series of six kidney transplantations from brain-dead donors in Thong Nhat hospital. The prevalence of end-stage renal disease is steadily increasing, while the disparity between available organ supply and transplantation demand continues to widen. Organs from brain-dead donors represent an effective strategy to address this shortage. Kidney transplantation is a highly complex surgical procedure that necessitates meticulous anesthetic planning to ensure patient safety and optimize graft function. The Enhanced Recovery After Surgery (ERAS) protocol has been recognized as a safe and effective approach in kidney transplantation.

**Keywords**: Kidney transplantation, brain-dead donor, anesthesia and perioperative management, ERAS protocol

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## 1. INTRODUCTION

Organ transplantation is a life-saving intervention for patients with end-stage organ failure; however, it remains dependent on the availability of donated organs. The Global Observatory on Donation and Transplantation (GODT), a collaboration between the World Health Organization (WHO) and the Spanish Organización Nacional de Trasplantes (ONT), reported a total of 146,840 solid organ transplants in 2018, of which only 26.8% were from deceased donors, and approximately 77.3% of these originated from brain-dead donors. In recent years, there has been an upward trend in both the total number of organ transplants and the number of brain-dead donors. Nevertheless, the efficiency of organ utilization from brain-dead donors remains suboptimal.

Global disparities in transplantation are becoming increasingly evident, with the lowest transplant rates per million population observed in low- and middle-income countries—regions that bear the highest burden of disease. In most of these countries, such as India, postmortem organ donation programs are still at an early stage of development, and the conversion rate from brain death diagnosis to organ donation remains extremely low [1].

Between 2003 and 2016, there was a continuous global increase in end-stage kidney disease (ESKD), with an average rise of approximately 43%. In 2016 alone, around 45% of countries reported ESKD prevalence ranging from 600 to 999 cases per million population [2]. Against the backdrop of population aging, coupled with the rising prevalence of diabetes mellitus and hypertension, the global burden of ESKD is projected to escalate substantially in the coming decades.

Kidney transplantation is widely regarded as the optimal treatment strategy for patients with end-stage renal disease. Multiple studies have demonstrated that kidney transplantation is not only more cost-effective but also improves survival compared with long-term dialysis [3].

In recent years, the one-year graft survival rate from deceased donors in the United States, Europe, Canada, Australia, and New Zealand has consistently exceeded 90%. Living-donor kidney transplantation is widely practiced in many African and Asian countries, whereas deceased-donor kidney transplantation is primarily performed in selected European nations. Kidney transplantation is a highly complex surgical procedure that requires meticulous anesthetic planning to ensure patient safety and to optimize graft function [4].

In Vietnam, the Law on Donation, Procurement, and Transplantation of Human Tissues and Organs, as well as the Donation of Cadavers, was enacted in 2006 and took effect on July 1, 2007. This law regulates the processes of organ donation, procurement, and transplantation, along with the organization and operation of tissue banks and the National Coordination Center for Organ Transplantation [5]. The year 2010 marked a turning point for organ transplantation in Vietnam, with the successful implementation of several pioneering studies on kidney transplantation from brain-dead donors. The first successful kidney transplantation from a brain-dead donor was performed at Cho Ray Hospital on February 11, 2010, when two kidneys were transplanted into two recipients. Subsequently, kidney transplantation from brain-dead donors has been continuously performed at other hospitals [6]. By 2018, a total of 2,249 living-donor kidney transplants, 174 brain-dead donor kidney transplants, and 3 kidney transplants from donation after circulatory death (DCD) were reported. Among the 17 kidney transplant centers in Vietnam, three presented their data at the 4th Congress of the Vietnam Society for Organ Transplantation (VSOT) in October 2017, reporting the proportion of unrelated living-donor kidney transplantation as 6.3%, 71.4%, and 85.7% at Cho Ray Hospital and two hospitals in Hanoi [7].

Enhanced Recovery After Surgery (ERAS) protocols are designed to minimize medical complications, shorten hospital stays, and reduce healthcare costs. ERAS has been considered safe and effective for kidney transplantation. Kidney transplant recipients are often frail and present with multiple comorbidities. As these patients undergo a comprehensive preoperative evaluation, ERAS pathways can ideally be initiated during this period. Even minor, incremental modifications along the perioperative course may result in

substantial improvements in outcomes [8].

The anesthetic goals in kidney transplant recipients include maintaining stable renal graft perfusion throughout surgery, optimizing the internal milieu with acid–base and electrolyte balance to mitigate ischemia–reperfusion injury, controlling pain and postoperative nausea and vomiting (PONV), reducing cardiovascular and respiratory complications, and facilitating early recovery within the ERAS framework. Overall, perioperative management must be individualized based on the recipient's comorbid conditions (e.g., hypertension, coronary artery disease, diabetes mellitus, hyperkalemia, anemia) and donor characteristics (e.g., donor quality index, cold ischemia time).

## 2. MATERIALS AND METHODS

### 2.1. Study population

Six kidney tranplants from brain-dead donors were perfomed at Thong Nhat Hospital.

### 2.2. Methods

A descriptive case series of six kidney transplantations from brain-dead donors in Thong Nhat hospital.

All cases were anesthetized according the ERAS protocol:

Pharmacologic preparation: prophylactic antibiotics, protonpump inhibitors or $H_2$ blockers, and antiemetic agents.

Induction of anesthesia: Fentanyl, Propofol, Rocuronium.

Maintenance of anaesthesia: desflurane, with additional rocuronium and fentanyl as needed.

Monitoring: Bispectral index (BIS), trainoffour (TOF) neuromuscular monitoring, endtidal $CO_2$ ($EtCO_2$) and pulsepressure variation (PPV).

Fluid management: goaldirected crystalloid administration and albumin supplementation.

Diuretics: mannitol and furosemide to promote diuresis and reduce reperfusion injury.

Active warming to prevent hypothermia.

Haemodynamic goals: systolic blood pressure maintained above 120 mmHg during graft reperfusion, adjusted to each patient's baseline.

Emergence: reversal of neuromuscular blockade with sugammadex.

Postoperative analgesia: multimodal analgesia (paracetamol, nefopam, local wound infiltration and patientcontrolled analgesia), coupled with antiemetic prophylaxis.

## 3. RESULTS

### 3.1. Preoperative recipient characterics

Table 1 summerizes the demographic and clinical characterics of six kidney recipients. The cohort comprises of four men and two women with a mean age of 38 ± 7.7 years. All patients had hypertension (HTN). Preoperative hemoglobin (Hb) ranged from 10.0 g.dL-1 to 14.0 g.dL-1; five had mild-to-moderate aneamia. Average serum creatinine prior to surgery was 645 $\mu mol.L^{-1}$ (range 442–891 $\mu mol.L^{-1}$). Dialysis methods included peritoneal dialysis (TPPM) and haemodialysis via an arteriovenous fistula (AVF). Duration of pretransplant dialysis ranged from one to sixteen months.

**Table 1.** Recipient characteristics before surgery

| Patient | Age (years) | Sex | Weight (kg) | Height (cm) | Comobidity | Creatinin (µmol.L-1) | Hb (g.dL-1) | Dialysis method | Duration of dialysis (months) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 34 | Male | 50 | 160 | HTN | 442 | 11.8 | TPPM | 3.0 |
| 2 | 27 | Female | 46 | 152 | | 609 | 10.0 | TPPM | 2.5 |
| 3 | 41 | Male | 60 | 165 | | 617 | 12.7 | AVF | 1.0 |
| 4 | 41 | Male | 60 | 160 | | 891 | 14.0 | AVF | 12.0 |
| 5 | 36 | Female | 48 | 155 | | 703 | 11.3 | AVF | 16.0 |
| 6 | 49 | Male | 54 | 158 | | 608 | 10.1 | TPPM | 6.0 |

**Table 2.** Donor and intra-operative characterics

| Patient | Donor age (years) | Donor serum creatinin(μmol/L) | Warm ischemia time (min) | Cold ischemia time (min) | SBP post-reperfusion (mmHg) |
|---|---|---|---|---|---|
| 1 | 19 | 59 | 58 | 200 | 140 |
| 2 | 19 | 59 | 55 | 297 | 130 |
| 3 | 44 | 183 | 26 | 99 | 130 |
| 4 | 44 | 183 | 26 | 99 | 140 |
| 5 | 39 | 120 | 39 | 160 | 145 |
| 6 | 39 | 120 | 105 | 160 | 140 |

**Table 3.** Postoperative results

| Recipent | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Postoperative creatinine (μmol.L-1) | 268 | 333 | 365 | 670 | 290 | 352 |
| PONV | None | None | None | None | None | None |
| Postoperative immidiate VAS | 2-3 | 6-7 | 5-6 | 8 | 4 | 1-2 |
| The following morning VAS | 2 | 4 | 2 | 4 | 4 | 1-2 |
| Delayed kidney function | None | None | None | None | None | None |
| Postoperative urine | 8000ml/6h | 3700ml/8h | 2280ml/7h | 830ml/5h | 5700ml/3h | 4750ml/4h |
| Length of stay (days) | 8 | 20 | 10 | 10 | 8 | 8 |

## 3.2. Donor and surgical characterics

Table 2 details the characteristics of donors and intraoperative parameters. The donor pool comprised three braindead individuals aged 19, 39 and 44 years. Donor serum creatinine values ranged from 59 to 183 μmol.$L^{-1}$. Warm ischemia time (from crossclamp to cold perfusion) varied between 26 and 105 minutes, while cold ischaemia time (from cooling to reperfusion) ranged from 99 to 297 minutes. Systolic blood pressure (SBP) after graft reperfusion was maintained between 130 and 145 mmHg.

## 3.3. Postoperative outcomes

Table 3 summarizes the postoperative course. No recipient experienced nausea or vomiting, and no case of delayed graft function was observed. Visual analogue scale (VAS) pain scores immediately after surgery ranged from 1–2 to 8 out of 10; by the following morning, scores had decreased markedly and were ≤ 4 in all patients. Urine output during the first postoperative hours exceeded 2 mL.$kg^{-1}$.$h^{-1}$ in five cases, indicating good graft perfusion. Serum creatinine levels decreased significantly in all recipients compared with preoperative values. Hospital stay ranged from 8 to 10 days in five patients; one patient required a 20day stay due to a perirenal hematoma and seroma needing monitoring and intervention.

Overall, serum creatinine declined postoperatively, demonstrating early graft function. The fourth patient had the highest pre and postoperative creatinine (891 μmol.$L^{-1}$ and 670 μmol.$L^{-1}$, respectively) and the lowest urine output; however,

this kidney was transplanted with minimal warm and cold ischemia times, and systolic blood pressure was maintained above 140 mmHg during reperfusion, suggesting that optimized perioperative management may compensate for less favorable donor characteristics.

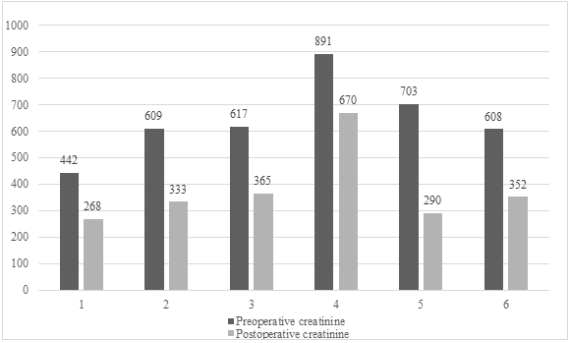


**Figure 1.** Pre- and Post-operative serum creatinine

# 4. DISCUSSION

## 4.1. Optimizing perioperative care

Perioperative management aims to control modifiable risk factors to reduce complications and improve outcomes. Preoperative assessment should address cardiovascular, respiratory and metabolic comorbidities; optimise volume status; and treat anaemia, ideally using erythropoiesisstimulating agents when haemoglobin falls below 9-10 $g.dL^{-1}$. During surgery, continuous haemodynamic monitoring, preferably invasive, helps maintain adequate intravascular volume and renal graft perfusion. Mean arterial pressure should be maintained between 80 and 110 mmHg, and vasopressors (preferably norepinephrine) may be required to prevent hypotension. Neuromuscular blockade must be monitored and reversed appropriately, and anaesthetic agents with minimal nephrotoxic metabolites should be chosen. Glycaemic control, active warming and judicious use of diuretics are essential components of intraoperative care.

Postoperatively, multimodal analgesia and prevention of delirium promote faster recovery. ERAS protocols emphasise early removal of drains, early oral intake and mobilisation, which can shorten hospital stays and improve patient satisfaction. A recent narrative review notes that ERAS protocols improve pain management, enable earlier mobilisation and oral nutrition, shorten hospital stays and reduce costs. [4] Our experience aligns with these findings: five of six patients were discharged within 8-10 days and none experienced delayed graft function or significant nausea.

## 4.2. Evidence from recent studies

Elsabbagh et al. retrospectively compared 20 kidney transplant recipients managed under an ERAS pathway with 20 recipients receiving standard care. The ERAS group had significantly lower postoperative pain scores, earlier ambulation and oral intake, and a shorter average hospital stay (two days) without increased rates of readmission or graft dysfunction. This study demonstrates the feasibility and benefits of ERAS in kidney transplantation.

An analysis of 545 renal transplants found that hypotension after graft reperfusion (mean arterial pressure < 75 mmHg) independently predicted delayed graft function, underscoring the importance of maintaining haemodynamic targets during surgery. Our results similarly support aggressive bloodpressure management during reperfusion.

A multicentre randomised controlled trial (BESTFluids) conducted in Australia and New Zealand showed that balanced crystalloids reduce the incidence of delayed graft function compared with normal saline in deceaseddonor kidney transplantation. This supports the use of balanced crystalloid solutions as the standard intraoperative fluid therapy.

Case series from Nepal on the first six braindead–donor kidney transplants reported variable hospital stays (9-32 days), with delayed graft function, acute rejection and urinary infection occurring in several patients; nonetheless, all grafts and patients survived during 3-4.5 years of followup. In contrast, our patients experienced no delayed graft function or rejection and generally shorter hospitalisations, suggesting that standardised ERASbased protocols may improve early outcomes.

## 5. CONCLUSION

Kidney transplantation exemplifies the achievements of modern medicine, offering improved quality of life and survival for patients with ESRD. Establishing a brain-dead donor programme is essential to bridge the gap between organ supply and demand in Vietnam. Such programmes require comprehensive legal frameworks, coordinated organ procurement systems, trained personnel and public awareness campaigns. Success depends on collaboration among hospitals, government agencies, social organisations and the wider community.

Standardising perioperative care using ERAS principles can enhance surgical quality, shorten recovery and optimise transplant outcomes. Key elements include early and thorough preoperative assessment, goaldirected haemodynamic management (avoiding hypotension after reperfusion), preferential use of balanced crystalloid solutions, strict glycaemic and temperature control, neuromuscular monitoring with appropriate reversal, opioidsparing multimodal analgesia and early oral intake and mobilisation. Implementing these strategies can reduce complications (particularly delayed graft function) and shorten hospital stays, ultimately improving patient and graft survival.

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