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CASE REPORT

Implementation of the Brain Death Protocol in an Adult Patient with Severe Traumatic Brain Injury

Maria Yasmim Alves Rodrigues[1,*], Marina Brito Pontes[1], Thaís Dias Uchôa de Moura[1], Thiago Joanes Brandão Sales[1], André Henrique Albuquerque Silva[1], Victor de Paula Fonseca[1], Arturo de La Vega de Matos Vieira[1]

1.Universidade de Pernambuco – Faculdade de Ciências Médicas – Recife (PE) – Brazil.

*Corresponding author: mariayasmim2403@gmail.com

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ABSTRACT

This report describes a case of implementation of the Brain Death Protocol in an adult donor, culminating in the procurement of solid organs (liver and kidneys) for transplantation. The patient was a 63-year-old male, a victim of severe traumatic brain injury after falling down stairs. The objective of this report is to describe the conduct of this important protocol, which is one of the eligibility criteria for organ donation in Brazil, and to highlight and discuss barriers to the process.

Descriptors: Post-Traumatic Brain Injury Coma; Brain Death; Tissue and Organ Procurement.

Aplicação do Protocolo de Morte Encefálica em Paciente Adulto Vítima de Traumatismo Cranioencefálico

RESUMO

Neste relato, descreve-se um caso de aplicação do Protocolo de Morte Encefálica em doador adulto que culmina na captação de órgãos sólidos (fígado e rins) para transplante. Trata-se de um paciente do sexo masculino, de 63 anos de idade, vítima de traumatismo cranioencefálico grave após queda de escada. O objetivo deste relato é apresentar a condução do importante protocolo que permite uma das formas de elegibilidade para doação de órgãos no Brasil, demonstrando e discutindo entraves relacionados ao processo.

Descritores: Coma Pós-Traumatismo da Cabeça; Morte Encefálica; Obtenção de Tecidos e Órgãos.

INTRODUCTION

Organ donation for transplantation in Brazil began in 1964, when the country's first kidney transplant was performed in Rio de Janeiro[1]. The first attempts at liver transplantation, in turn, began in the late 1960s, but it was only in 1985 that the first successful long-term liver transplant was performed, at the Hospital das Clínicas of the University of São Paulo[2]. During this period, transplants still represented a relatively new therapeutic strategy, and their results demonstrated high associated mortality rates[2].

In the following decades, the surgical replacement of solid organs became established as a powerful therapeutic tool for the treatment of several diseases, thanks to technical improvements in organ procurement and transplantation, as well as in postoperative management. A progressive increase in the number of transplants performed in Brazil was observed. In 2025, the National Transplant System (*Sistema Nacional de Transplantes*) registered 9,940 solid organ transplants: approximately 6,700 kidney transplants and 2,573 liver transplants[3].

With patients diagnosed with brain death (BD) representing the largest fraction of organ donors in the country (90.9% of donations from January to September 2025 came from deceased donors), the Brain Death Protocol (BDP) was mandated by federal law and instituted by the Federal Council of Medicine in 1997, and updated in 2017, to guide the medical team and protect the patient[4,5]. This protocol systematizes the establishment of a BD diagnosis in stages, with a time interval to be respected during execution.

Given the imbalance between the number of organ donations carried out and the number of people on transplant waiting lists (3,215 effective donors from January to September 2025, compared to 72,626 active patients on the waiting list during the same period), as well as the severity of the clinical condition of patients requiring transplantation, there is a need to ensure timely and effective execution of the protocol for patients who are candidates for donation[4].

However, technical obstacles, such as the availability of qualified professionals or necessary equipment, can delay protocol implementation, a situation that is not uncommon in Brazilian health services.

In this context, this work aims to present a clinical case of the application of the BDP in an adult patient, from the identification of the patient as a potential candidate for organ donation to the establishment of the diagnosis and the performance of the procurement surgery, bringing to light discussions about the technical obstacles faced during this process.

Case Report

A 63-year-old man was admitted to the emergency department on March 11, 2025, after falling down a flight of stairs at home approximately 20 hours prior. A companion reported loss of consciousness and an episode of vomiting with bloody content.

On initial physical examination, the patient presented with poor general condition, being eupneic, with patent airways, well perfused, acyanotic, and disoriented. The heart rate (HR) was 86 beats per minute (bpm), and the blood pressure (BP) was 135/90 mmHg. Pulmonary and cardiac auscultation, as well as the abdominal examination, were normal.

The patient scored 8 points on the Glasgow Coma Scale (GCS): 2 points for eye opening, 2 points for verbal response, and 4 points for motor response. A diagnosis of severe traumatic brain injury was then established. In this context, the patient underwent orotracheal intubation and remained sedated, with a Richmond Agitation-Sedation Scale (RASS) score of -5.

A non-contrast head CT scan revealed a large intraparenchymal hematoma in the right frontal lobe (Fig. 1). In addition, a CT scan of the cervical spine showed no abnormalities. Initially, the patient remained stable, under sedation (RASS-5), without complications.

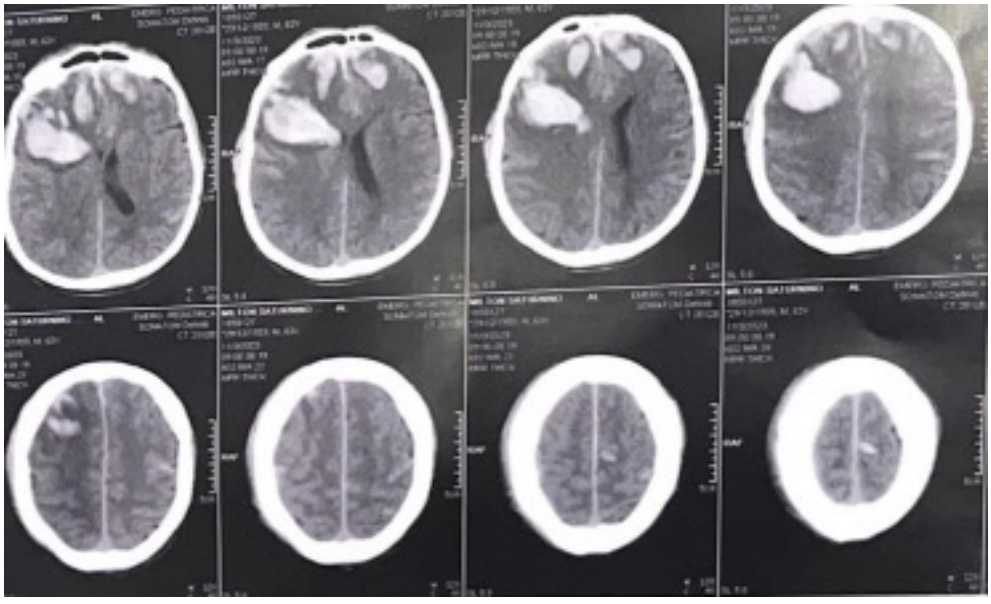


Figure 1. Cranial tomography performed on March 11, 2025. A hyperdense area, consistent with an intraparenchymal hematoma, is visualized in the right frontal region.

Given this scenario, surgical intervention was performed to drain the intracranial hematoma on March 12, 2025. A successful right frontal craniotomy was performed without complications. In the immediate postoperative period, the patient remained in a critical condition, intubated and sedated, hemodynamically stable, and without vasoactive drugs. The physical examination remained unchanged from the admission standard.

The patient's blood pressure increased progressively, reaching 220/140 mmHg, at which point intravenous antihypertensive therapy was initiated. Subsequently, the patient developed hemodynamic instability, requiring vasopressor therapy.

When sedation was first discontinued after surgery, an absence of motor and verbal response was observed, with bilateral mydriasis, consistent with unresponsive coma (GCS 3). The neurological deterioration observed post-operatively, compared to admission to the service (a 5-point drop in GCS), despite the successful completion of the proposed surgical procedure, can be justified by the progression of the brain lesion during the intracerebral hemorrhage in the pre- and intraoperative period, the clinical impact of which was not accompanied by serial estimates of GCS scores due to the sedation administered.

At this time, the patient was placed under hemodynamic monitoring for transfer to the intensive care unit, with follow-up by neurosurgery and the Intra-Hospital Commission for Organ and Tissue Donation for Transplants (*Comissão Intra-Hospitalar para Doação de Órgãos e Tecidos para Transplantes*).

Respiratory physical therapy identified impaired spontaneous ventilation due to compromised airway protective mechanisms and reduced functional capacity. Consequently, controlled mechanical ventilation parameters were maintained, and bronchial hygiene therapy, lung expansion maneuvers, and bedside positioning adjustments were implemented.

Throughout the night of March 12, 2025, the patient's clinical status remained critical. The patient was intubated and off sedation, yet hemodynamically stable under vasopressor support (norepinephrine at 4 mL/h), with a Glasgow Coma Scale (GCS) score of 3. Physical examination revealed no significant abnormalities. Vital signs at the time were as follows: HR 71 bpm, BP 166/102 mmHg, RR 17 rpm, and oxygen saturation (SatO2) 98%.

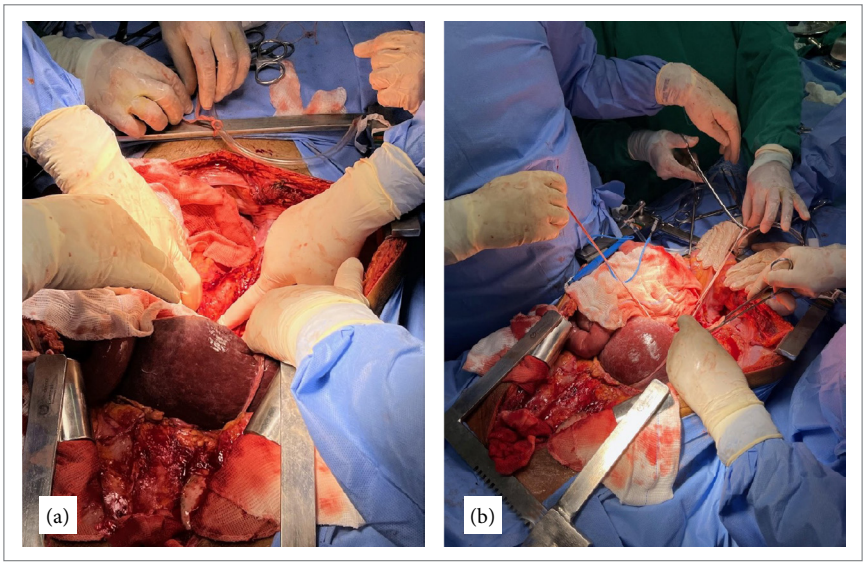
Given the clinical and neurological picture, the BDP was initiated, with the first assessment at 8:40 PM on March 12, 2025. The patient presented with fixed and unresponsive pupils, absent corneal-palpebral, oculocephalic, and vestibulo-caloric reflexes, and a cough. Blood pressure: 166 / 102 mmHg; axillary temperature: 36.4 °C.

Over the following days, the patient was monitored and assisted with hemodynamic maintenance and continuous monitoring. On March 15, 2025, at 12:12 PM, the second clinical evaluation of the BDP was performed, maintaining the previous findings. The apnea test, performed on the same day, confirmed the absence of respiratory movements with $PaCO_2 > 55$ mmHg. Transcranial Doppler showed cerebral circulatory collapse. The protocol was completed at 6:30 PM on the same day, with family authorization for organ donation. Hemodynamic support was maintained until the time of surgery.

In the early hours of March 16, 2025, organ procurement of the liver and kidneys for transplantation was performed. A midline sternopubic laparotomy and thoracotomy were carried out, as shown in Fig. 2. The liver was retrieved en bloc, along with the gastrohepatic ligament, the head and body of the pancreas, a segment of the vena cava, a segment of the aorta, and adjacent tissues. Figures 3a, 3b, 4, and 5 demonstrate the stages of the described surgical procedure.

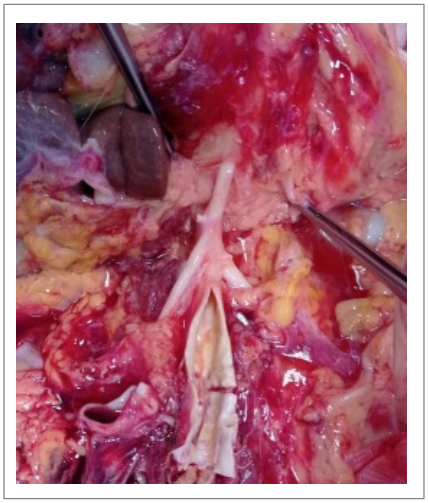
Source: Elaborated by the authors.

Figure 2. Thoracotomy and laparotomy during procurement surgery.



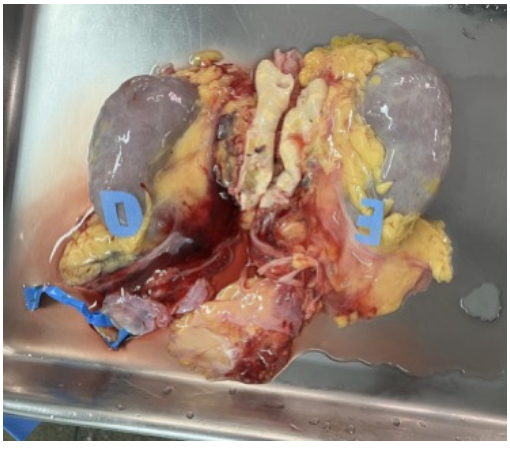
Source: Elaborated by the authors.

Figure 3. a) Identification and isolation of the hepatic vascular bed for harvesting. b) Vascular bed identified.



Source: Elaborated by the authors.

Figure 4. Anatomical variation: renal arteries originating from the aorta in a more proximal position than usual.



Source: Elaborated by the authors.

Figure 5. Right (D) and left (E) kidneys after being retrieved.

Bilateral nephrectomy was performed, including the renal arteries, renal veins, and ureters. During the procedure, anatomical variation of the renal arteries was observed, with their origin from the aorta at a higher (proximal) position than the usual pattern. Unlike the common inferior location near the iliac arteries, the renal arteries arise in a superior position, near the celiac trunk.

The surgery was completed with closure of the thoracic and abdominal walls. The liver underwent *ex situ* perfusion via the aortic and portal routes, using a preservation solution, as shown in Fig. 6.

Source: Elaborated by the authors.

Figure 6. Preparation of the liver after harvesting, with ex situ perfusion.

The liver showed signs of aging, without evidence of steatosis or fibrosis, and was classified as medium-sized. The kidneys were in good condition and considered suitable for transplantation.

DISCUSSION

The BDP establishes that procedures for diagnosing BD should be initiated in all patients in an unresponsive coma who also present with supraspinal unresponsiveness and persistent apnea[5]. In the case described, it is clear that as soon as the patient was diagnosed with a coma, and sedation was withdrawn post-operatively, he was considered a potential candidate for the protocol and, consequently, for organ donation. Therefore, within a few hours, the physiotherapy service was activated to assist with the apnea test, and a qualified medical professional arrived the same day for a clinical examination to confirm the absence of reactivity.

Timely implementation of the protocol is essential to its success, as it is applied to critically ill patients who are susceptible to complications and may develop cardiorespiratory arrest before the steps are completed if the process is delayed. Between January and September 2025, 6.63% (780/11,753) of the reasons for non-completion of organ donation among potential donors notified in Brazil were cardiac arrest[4].

Our service, fortunately, had the infrastructure to allow for the diagnostic steps of the protocol, namely: conducting two neurological clinical examinations, each performed by a different qualified medical professional, as well as performing an apnea test and a complementary examination confirming the absence of cerebral activity or perfusion.

Given the minimum time between clinical examinations (1 hour for adult patients), it is important to avoid delays in conducting the protocol so the donor remains viable. In the case presented, there is a time interval of 63 hours and 32 minutes between the first and second evaluation, which is justified by the difficulty in finding a qualified professional for the examination, a common problem in several services across the country.

Two distinct physicians are required, neither of whom shall be members of the transplant team; each must have training or specialization in neurology, neurosurgery, intensive care medicine, or emergency medicine, or possess formal training recognized by the hospital or the transplant system[4]. This professional requirement, while very important for the proper execution of the protocol from a technical and ethical standpoint, considerably limits the available team resources for the examination. This limitation, in a context of enormous demand for medical work in Brazilian healthcare services, particularly in the public sector, can delay the clinical examination stage, as was the case with the patient presented.

Besides limited professional resources, another limiting factor makes the protocol unfeasible in many health services across the country: the scarcity of complementary exams to confirm the absence of cerebral activity/perfusion. High-cost techniques, such as cerebral scintigraphy and cerebral arteriography, are employed, or low- to moderate-cost techniques that require trained professionals for performance and interpretation, such as transcranial Doppler and electroencephalography.

This entire panorama of limitations, which is still a reality of Brazilian health services, culminates in an alarming statistic: another 6.80% (800/11,753) of the reasons for the non-realization of organ donation from potential donors, from January to September 2025, were due to the inability to confirm the diagnosis of suspected BD[4].

Despite technical and structural limitations, refusal to donate during the interview with family members remains the main reason why donations do not go through (45% of cases)4. Overcoming this obstacle does not depend on cutting-edge diagnostic equipment or specific specialization titles, but rather on the humanization of the approach by the professionals involved in communicating with the family, since, at this sensitive moment, many doubts and preconceptions can generate resistance to donation. In the reported case, fortunately, the responsible team's capabilities enabled the donation to be successful.

The result of all the difficulties described is a huge disproportion between potential donors, actual donations, and the number of patients waiting for transplants in the country. In 2025, a registry published by the Brazilian Association of Organ Transplants (*Associação Brasileira de Transplantes de Órgãos*) showed that, in the first 9 months of the year, among the 11,753 potential donors notified, only 3,215 became actual donors, while 72,626 patients were active on the waiting list for solid organ transplants during the same period[4].

CONCLUSION

Organ procurement for transplantation from brain-dead donors is a process that requires meticulous attention and rigorous procedures by the healthcare professional team involved. The BDP is extremely important in the organ procurement process, as it provides guidelines and procedures to confirm the patient's death and guide medical practice. In this context, the team, as in the reported case, must remain vigilant to identify potential donors early and ensure that organ procurement is carried out quickly and ethically.

Healthcare professionals must be prepared from the early stages of the BDP through organ procurement, ensuring that the patient receives the best possible care while their organs remain viable. Challenges related to the shortage of technical and professional resources in Brazilian healthcare services, especially in the public sector, can compromise the feasibility and speed of implementing the BDP.

Furthermore, the patient's family members must receive clear and accurate information so that they can make informed decisions about organ donation. It is a challenging process, but one that can bring hope and new opportunities to those awaiting a transplant.

CONFLICT OF INTEREST

Nothing to declare.

AUTHOR'S CONTRIBUTION

Substantive scientific and intellectual contributions to the study: Rodrigues MYA, Pontes MB, Moura TDU, Sales TJB, Silva AHA, Fonseca VP; **Conception and design:** Rodrigues MYA, Vieira AVM; **Data analysis and interpretation:** Rodrigues MYA, Pontes MB, Fonseca VP, Vieira AV; **Article writing:** Rodrigues MYA, Pontes MB, Moura TDU, Sales TJB, Silva AHA, Fonseca VP; **Critical revision:** Rodrigues MYA, Vieira AVM; **Final approval:** Rodrigues MYA.

DATA AVAILABILITY STATEMENT

All datasets were generated or analyzed in the current study.

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DECLARATION OF USE OF ARTIFICIAL INTELLIGENCE TOOLS

The authors declare that no artificial intelligence tools were used in the preparation, writing, data analysis, or review of this manuscript.

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