

# Intraoperative Management of Brain-dead Organ Donors by Anesthesiologists during an Organ Procurement Procedure: Results from a French survey

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## Research Article

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# Abstract

**Background:** There is no specific guidelines concerning intraoperative management of brain-dead donors (BDD) during organ procurement (OP). This study aimed at describing usual anesthetic practices for BDD during an OP procedure and to assess the knowledge and self-confidence of French anesthesiologists with this practice.

**Methods:** An electronic, national and anonymous survey with closed-questions about anesthetic management of BDD was distributed to French anesthesiologists via the mailing list of the French Society of Anesthesiology and Intensive Care. The questionnaire included questions concerning monitoring, intraoperative resuscitation, anesthetic drugs use and confidence of the respondents.

**Results:** 458 responses were analyzed. Respondents were mainly attending physicians with more than 10 years of professional experience, equally distributed between university and non-university centers. Seventy-eight percent of them declared knowledge about guidelines regarding ICU management of BDD. Advanced hemodynamic monitoring and endocrine substitution were poorly considered by respondents (31% and 35% of respondents, respectively). 98% of the respondents used crystalloids for fluid resuscitation. During the procedure, use of neuromuscular blockers, opioids and sedative agents were considered by respectively 84%, 61% and 27% of the respondents. A very high level of agreement (10 [8-10], on a ten-points Likert-style scale) was reported concerning the expected impact of intraoperative anesthetic management on the primary function of grafts.

**Conclusions:** Declared anesthetic practice appeared in accordance with guidelines concerning ICU management of organ donors. Further studies are needed to evaluate the specific impact of intraoperative management during this procedure and thus the need for specific anesthetic guidelines.

## Background

Brain-dead donors (BDD) currently remain the primary source of grafts for solid organ transplantation over the world [1, 2]. In this context, appropriate management of organ donors from the diagnosis of brain death to the end of the organ procurement (OP) procedure is of paramount importance to ensure the functionality of potential grafts. Intensive care unit (ICU) management of BDD is well-codified. This is an active research field [3] and many guidelines are published and regularly updated over the last years [4–7]. Conversely, perioperative and anesthetic management of the donor during the OP procedure is far less codified [2, 8]. French guidelines mainly specify to follow the same organ resuscitation strategy initiated in the ICU and only specify that the use of neuromuscular blocking (NMB) agents and analgesics are justified [5]. Because of the lack of specific recommendations on the anesthetic management of organ procurement procedure, we hypothesize that the usual practices are disparate.

In this context, we performed a French national survey on perioperative management of BDD by anesthesiologists. The aims of the study were to describe usual anesthetic practices for BDD during an OP procedure and to assess the knowledge and the feeling of the French anesthesiologists with this practice.

## Methods

### Questionnaire

We conducted a French national survey on anesthetic management of BDD during the OP procedure. The questionnaire included 33 closed-questions and one open-ended question (see the Additional file 1). The questionnaire was anonymous and subdivided into seven sections taking into account the domains covered by the guidelines [4–7]: general and demographic data, per-operative monitoring, hemodynamic management, metabolic management, respiratory management, anesthetic drugs employment and personal feeling about the procedure. Intraoperative use of donor management goals (DMGs) was also evaluated. For questions on usual practice, a five-point Likert-style scale was provided (ranging from *never* to *always*); for questions covering provider's perception of the OP procedure, a ten-points Likert-style scale ranging from 1 (*certainly not agree*) to 10 (*absolutely agree*) was used. Before broadcasting, the questionnaire was tested and approved by the anesthesiologists of our tertiary teaching hospital (European Georges Pompidou hospital, AP-HP, Paris, France).

According to the French law, no ethic committee approval was required for this anonymous survey intended to health professionals.

## Survey processing

The questionnaire was meant to target all the French anesthesiologists. Expected time to complete the questionnaire was inferior to 10 min. An electronic form of the survey was compiled using SurveyMonkey® (<https://www.surveymonkey.com>). In early September 2017, French anesthesiologists were invited to respond to the survey via an email, sent through the mailing-list of the French Society of Anesthesia and Intensive Care (*Société Française d'Anesthésie-Réanimation*, SFAR). The survey was available *on-line* during a 4-month period (until end of December 2017). A follow-up email was sent 2 months after the first e-mail, during November 2017.

## Data analysis

Results are reported as count (%) for categorical variables and median (25th-75th percentiles) for continuous variables. For questions pertaining to practice, in order to simplify the interpretation of the results, the answers "never" and "seldom" were grouped, as well as the answers "always", "often" and "regularly". Analyses were performed using Microsoft® Excel software (2017).

# Results

## Respondent characteristics

Four hundred and fifty-eight anesthesiologists responded the survey during the study period. General characteristics of the respondents are described in Table 1. Among the respondents, 359 (78%) declared to have knowledge about the recommendations on BDD management in the ICU.

## Per-operative monitoring

Almost all respondents (98%) declared always use the standard intraoperative monitoring required by the SFAR (i.e., electrocardiogram, blood pressure, SpO2 and end-tidal CO2) during the OP procedure. Detailed answers concerning other optional monitoring are presented in the Figure 1. Invasive blood pressure and invasive temperature monitoring is reported to be frequent (97% and 89%, respectively). Blood lactate or hemoglobin monitoring during the procedure is less frequent. Most of the respondents (69%) does not reported use of advanced hemodynamic monitoring in this context. When an advanced hemodynamic monitoring is used, pulse contour analysis seems to be the most commonly used device in this setting (63%).

## Donor management during organ procurement

*DMGs:* 358 (78%) respondents reported to use pre-specified DMGs during the OP procedure. This included: targeted mean arterial pressure range of 60-70 mmHg for 305 (67%) respondents and temperature > 35°C for 96% of the respondents.

*Hemodynamic management:* usual reported practices concerning fluid resuscitation are presented in the Figure S1 (see Additional file 1). Briefly, 95% of the responding anesthesiologists did not used starches for fluid resuscitation and 98% of them reported using crystalloids in this context. Most commonly used crystalloids were ringer lactate (45%) and 0.9% saline solution (38%). A hemoglobin threshold of 7 g.dL<sup>-1</sup> was considered for transfusion for 298 (65%) respondents whereas 21 (5%) of them considered that blood transfusion was not indicated in this setting.

*Pulmonary management:* most anesthesiologists (93%) reported implementing a protective ventilation in the operating room (OR) and 92% of them declared realizing recruitment maneuvers during the procedure (routinely in 55% of cases).

*Endocrine substitution:* during the OP procedure, hormonal resuscitation was not considered by 65% of the respondents. When hormonal replacement therapy was considered, hormone substitution protocol varied substantially across practitioners except for triiodothyronine that was not used by 93% of the respondents (Figure S2, Additional file 1).

## Anesthetic management during organ procurement

Responses concerning anesthetic drugs utilization are reported in the Figure 2. Use of NMB, opioids and hypnotic agents was considered by respectively 84%, 61% and 27% of the respondents. Among anesthesiologists who declared using a hypnotic agent for the procedure, the most popular agents were volatile anesthetics (65%). For 76% of the respondents, administration of unfractionned heparin is only done when asked by surgeons or the OP coordinator.

## Provider's perceptions

Provider's perception concerning the anesthetic management of BDD was evaluated using a numeric scale ranging from 1 to 10. The necessity of the presence in the OR of a senior anesthesiologist was assessed with an agreement of 8 (7-10). The question of feeling enough prepared for OP procedure was rated with a score of 6 (5-8). Consistently, responding anesthesiologists considered that further specific recommendations on anesthetic management of BDD would be useful (score of agreement: 9 (8-10)). A very high level of agreement (10 (8-10)) was also reported concerning the expected impact of intraoperative anesthetic management on the primary function of grafts.

## Discussion

Our study aimed at describing current practices and perceptions of a large panel of anesthesiologists on the intraoperative management of BDD. The few existing recommendations on the subject are essentially based on expert opinions or extrapolated from ICU guidelines for brain dead donor management [1, 2]. Briefly, our survey suggests that anesthetic practices concerning monitoring, DMGs, fluid resuscitation and ventilatory management are in agreement with current guidelines [4–7]. Recent findings concerning the use of mild hypothermia (34-35°C) to improve renal grafts recovery does not seem integrated in current practices [3]. The low reported use of hormone substitution may be surprising. However, this is in agreement with the French guidelines which do not support systematic endocrine substitution (except for vasopressin analogs in case of diabetes insipidus) [5]. This point differs with north-American guidelines [6, 7]. However, the level of evidence concerning the benefit of hormonal substitution (such as corticosteroids supplementation) remains relatively limited in this context [9].

Use of anesthetic drugs during the OP procedure remains matter of debate [10]. In the context of brain death, the goal of anesthetic medications is essentially to control any possible hemodynamic and/or motor response resulting from spinal cord reflexes, thereby justifying the use of neuromuscular blocking and analgesic agents during the OP procedure [5]. Opioids alone may be insufficient to control catecholamine release induced by surgical stimulation [11]. The use of volatile anesthetic, as “vasodilator agents”, may thus be justified [2, 8]. In addition, a potential beneficial effect of volatile anesthetic agents on ischemia-reperfusion injuries has been suggested and could further justify their use in this context [2, 4, 8]. However, the level of scientific evidence remains relatively limited and further investigations are needed before recommending systemic use of volatile agents for OP procedures.

Finally, the most interesting finding of our study is maybe the high-perceived impact of intraoperative management on the primary function of the grafts reported by the providers. Consistently the responders reported high expectations in specific guidelines on anesthetic management of BDD. Further research in the area is needed to give consistency to future evidence-based guidelines.

This declarative study carries some limitations. The survey was sent to an unselected panel of French anesthesiologists, members of the French Society of Anesthesia and Intensive Care Medicine. Although this panel is supposed to be representative of the overall population of practicing anesthesiologists, we cannot rule out some degree of responder bias and thus the results could not be fully representative of the actual current practices. Furthermore, our results might not reflect the practices outside France, especially since there are some known discrepancies between guidelines [5–7].

## Conclusions

Declared anesthetic practices concerning intraoperative management of BDD during organ procurement procedures are in accordance with national French guidelines on organ donor management. Further studies are needed to investigate this specific area of donor management, especially concerning the use of anesthetic agents and hormone substitution during the procedure.

## Declarations

**Ethics approval and consent to participate:** According to French national regulations, ethic approval is deemed unnecessary for this anonymous survey intended to health professionals. (<https://www.legifrance.gouv.fr/affichCode.do?idArticle=LEGIARTI000032722870&idSectionTA=LEGISCTA000032722874&cidTexte=LEGITEXT000006072665&dateTexte=20170614>).

**Consent for publication:** Not applicable.

**Availability of data and materials:** The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

**Competing interests:** The authors declare that they have no competing interests.

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**Authors' contributions:** BC, RP, AN, GF and JJ designed the study, collected, analyzed, and interpreted the data, and wrote the manuscript. RB, BL and OB contributed to design the study and to review the manuscript. BC and RP performed the statistical analysis. BC takes the full responsibility for the integrity of the work. All authors read and approved the final version of the manuscript.

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## Tables

**Table 1: Characteristics of the respondents.**

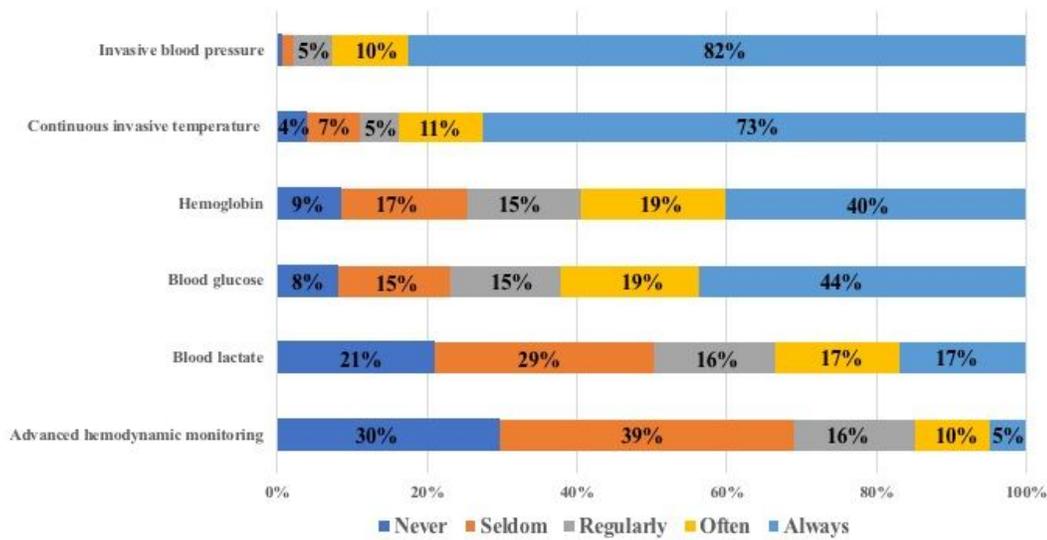
	Respondents ( <i>n</i> =458)
Type of institution	
University hospital	267 (58%)
Non-university hospital	191 (42%)
Function of the respondent	
Resident	48 (10%)
Fellow	53 (12%)
Attending physician	335 (73%)
Professor	22 (5%)
Field of activity <sup>a</sup>	
Full-time anaesthesiology	188 (46%)
Full-time ICU	42 (10%)
Shared activity (both anaesthesiology and ICU)	180 (44%)
Professional experience > 10 years <sup>a</sup>	209 (51%)
Numbers of OP procedures occurred last year per establishment	
< 5 procedures	
5-10 procedures	55 (12%)
10-20 procedures	95 (21%)
>20 procedures	132 (29%)
Numbers of BDD personally managed in the OR by respondent during last year	176 (38%)
None	
1-4	
≥ 5	71 (16%)
	307 (67%)
	80 (17%)
Existence of a written protocol for anaesthetic management of BDD	197 (76%)

Data are expressed as *n* (%).

<sup>a</sup> excluding residents.

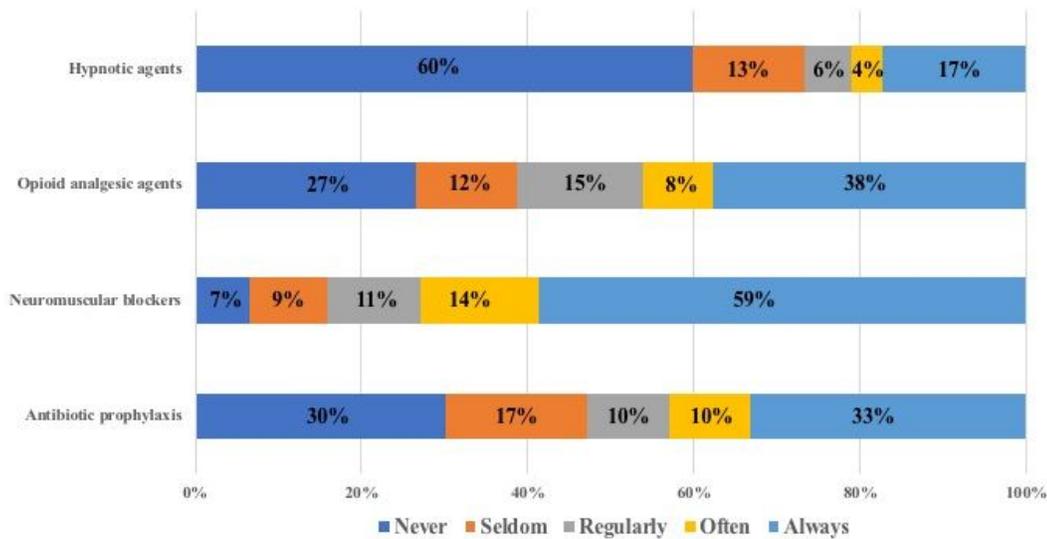
ICU, intensive care unit; BDD, brain dead donor; OP, organ procurement; OR, operating room.

## Figures



**Figure 1**

Detailed answers concerning the use of complementary monitoring during the organ procurement procedure.



**Figure 2**

Declared practices concerning anesthetic drugs utilization during the organ procurement procedure.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [supplement1.docx](#)