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## Eligibility for organ donation following end-of-life decisions: a study performed in 43 French intensive care units

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On the behalf of the EPILAT study group.

**Take-home message:** A substantial number of patients who died in French ICUs following the decision to withhold or withdraw life-sustaining treatment would have been eligible to donate organs according to Maastricht III. Severely brain-injured patients were more likely to die after the withdrawal of life-sustaining therapy under conditions which may satisfy the requirements for organ retrieval and graft viability.

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**Abstract Purpose:** A persistent shortage of available organs for transplantation has driven French medical authorities to focus on organ retrieval from patients who die following the withdrawal of life-sustaining therapy. This study was designed to assess the theoretical eligibility of patients who have died in French intensive care units (ICUs) after a decision to withhold or withdraw life-sustaining therapy to organ donation. **Methods:** This was an observational multi-center study in which data were collected on all consecutive patients admitted to any of the 43 participating ICUs during the study period who qualified for a withholding/withdrawal procedure according to French law. The theoretical organ donor eligibility of the patients once deceased was determined a posteriori according to current medical criteria for graft selection, as well as according to the withholding/withdrawal measures implemented and their impact on the time of death. **Results:** A total of 5,589 patients were admitted to the ICU during the study period, of whom 777 (14 %) underwent withholding/withdrawal measures. Of the 557 patients who died following a

foreseeable circulatory arrest, 278 (50 %) presented a contraindication ruling out organ retrieval. Of the 279 patients who would have been eligible as organ donors regardless of measures implemented, cardiopulmonary support was withdrawn in only 154 of these patients, 70 of whom died within 120 min of the withdrawal of life-sustaining treatment. Brain-injured patients accounted for 29 % of all patients who qualified for the withholding/withdrawal of treatment, and 57 % of those died within 120 min of the withdrawal/withholding of treatment. **Conclusion:** A significant number of patients who died during the study period in French ICUs under withholding/withdrawal conditions would have been eligible for organ donation. Brain-injured patients were more likely to die in circumstances which would have been compatible with such practice.

### Keywords

Tissue and organ procurement · Withholding treatment · Life support care · Medical futility · Fatal outcome · Terminal care

### Introduction

Organ transplantation brings sustainably improved quality of life to patients with end-stage organ failure. Given the

worldwide shortage of suitable organs for transplantation and the ever-increasing gap between organ demand and donor graft supply, there is a need for rethinking of the practical and ethical issues concerning organ

transplantation [1–3]. French policy on organ retrieval essentially hinges on brain-dead donors, while a number of other countries have based part of their transplantation policy on donation from donors with a circulatory determination of death (CDD) [4–7]. The Maastricht classification distinguishes four categories of circulatory death: unforeseeable (uncontrolled) irreversible circulatory arrest without (category I) or with (category II) immediate cardiopulmonary resuscitation, foreseeable circulatory arrest occurring after a decision to withhold/withdraw treatment (category III, controlled) and circulatory arrest occurring after brain death (category IV) [8]. Donations after unforeseeable circulatory arrest have been legally possible in France since 2005. As the procedure is restricted to a small number of suitably equipped centers, to date few organs have been retrieved under these clinical settings. Organ retrieval according to Maastricht III does not yet fall within the French legal framework. Academic and scholarly institutions have previously expressed concerns on such a procedure, arguing that it could be viewed as a form of utilitarian end-of-life practice [9–12]. In 2013, a regulatory framework making this type of organ retrieval possible was debated in the French parliament. A dedicated steering committee drafted a protocol establishing the mandatory conditions to retrieve organs under the Maastricht III classification in France [13].

To our knowledge, recent epidemiologic data describing French withholding/withdrawal practices and questioning whether such practices would be compatible with organ retrieval are not yet available. The experiences of other countries have clearly shown that the length of time between the withdrawal of life-sustaining therapy and death is a major determinant of organ donation and the quality of the organs retrieved [14]. This period may range from few minutes to several days, depending on the level of life support engaged at the time of decision-making and how the treatments are withdrawn. As clinical guidelines and rules in this area mainly focus on general principles rather than practical details, there is as yet no consensus on the best airway management during the withdrawal period (cessation/decrease of ventilation with/without removal of the endotracheal tube). However, a long withdrawal period often results in severe ischemic damage, thereby compromising organ usability for transplantation [14, 15].

We therefore designed an observational multicenter study (named “EPILAT”) to describe the epidemiological characteristics of patients who died in French intensive care units (ICUs) following a formal decision to withhold/withdraw treatment, as well as to assess the theoretical eligibility of these patients as organ donors, integrating the measures implemented and the possible impact of the duration of the withdrawal period on organ viability.

## Methods

This study was performed in 43 French ICUs (15 units in university-affiliated centers, 28 in general hospitals). The institutional review board (CPP Paris Ile-de-France II) approved the protocol. The study took place during the first half of 2013, and the study period consisted of 60 or 90 consecutive days under normal operating conditions. All consecutive patients admitted to any one of the participating ICUs who underwent a withholding/withdrawal procedure in compliance with the terms of the French law of April 22, 2005 (Leonetti’s law) were prospectively enrolled in the survey [16]. The epidemiological data recorded during the ICU stay included age, gender, medical history, circumstances surrounding admission, Simplified Acute Physiology Score (SAPS) II index on ICU admission, relevant clinical and biological characteristics, Sequential Organ Failure Assessment (SOFA) score at the time of the decision-making, reasons for limiting treatment, implemented measures and patient’s outcome (deceased or discharged alive). By convention, a SOFA organ subscore of  $\geq 3$  was considered to be organ failure.

The withdrawal/withholding of treatment consisted of therapies such as cardiopulmonary resuscitation, ventilatory support, renal replacement therapy, catecholamine infusion, urgent surgery, antimicrobial therapy, transfusions, nutrition and hydration. “Withhold” was defined as the decision not to start or increase a treatment beyond a specified threshold. “Withdraw” was defined as the decision to stop a treatment already in place. Limitations were classified as “withholding” if withholding was the single limitation and as “withdrawal” if treatments were both withheld and withdrawn. “Withdrawal of life-sustaining treatments” was defined as the withdrawal of all provided ventilatory support and/or catecholamine infusion over a short period of time (10–15 min), with or without extubation (i.e. removal of the endotracheal tube), while ensuring patient comfort.

For patients who died under withholding/withdrawal conditions, their theoretical eligibility as organ donors was determined a posteriori based on medical criteria and length of time from withholding/withdrawal to death. Individual and organ-specific (kidney, liver and lung) acceptability for donation regardless of measures implemented was retrospectively assessed by the attending physician [13]. Because hemodynamic parameters were not widely available within the withdrawal period, an interval of 2 h from treatment discontinuation to cessation of cardiac activity was considered the maximum time compatible with organ viability [14].

Continuous variables are reported as the mean  $\pm$  standard deviation (SD), or as the median with interquartile ranges (IQR), where appropriate. Qualitative variables are expressed as absolute values with

percentages. We used univariate and multivariate logistic regression analyses with death within 120 min of withdrawal/withholding as a binary outcome variable (death within vs. after 120 min) to assess associations with categorical variables. Continuous measurements were converted into binary variables, according to a cut-point value allowing a reasonable number of observations in each group. For each variable, we give adjusted odds ratios (OR) and the 95 % confidence interval (CI). All univariate indices with a  $p$  value of  $<0.25$  were included in the multivariate logistic regression model. Descriptive statistics and univariate and multivariate regressions were performed using Epi Info<sup>TM</sup> (Centers for Disease Control and Prevention, Atlanta, GA) and the R statistical package<sup>®</sup> (Core Team, R Foundation for Statistical Computing, Vienna, Austria).

## Results

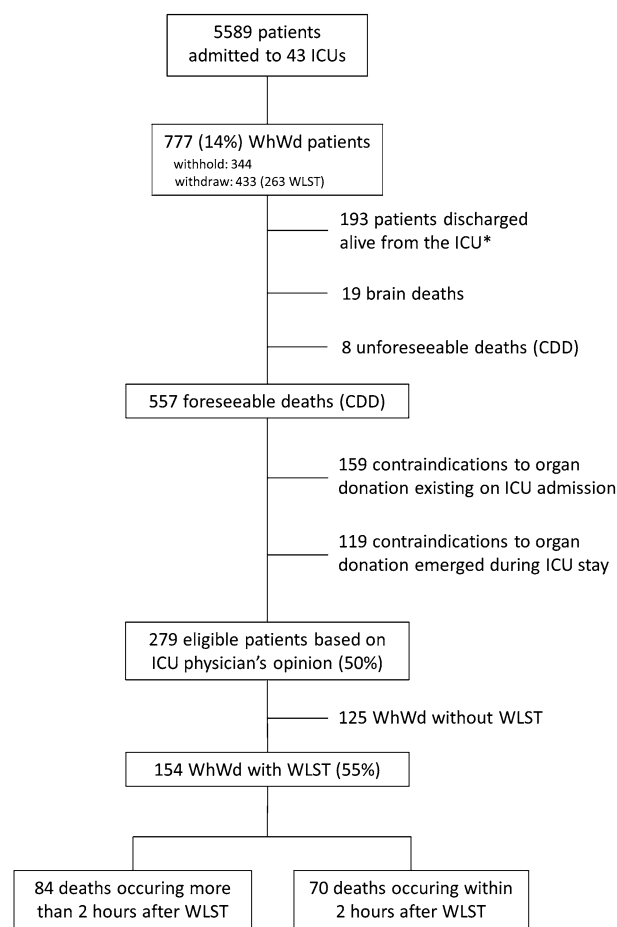
During the study period, 5,589 patients were admitted to 43 ICUs. Of these, 4,457 patients (80 %) were discharged alive onto the ward, and 1,132 (20 %) died in the ICU, with 117 (10 %) registered with brain death and 1,015 (90 %) registered with a CCD.

Of the 5,589 patients admitted to the ICUs, 777 (14 %) underwent withholding/withdrawal measures in 31 mixed surgical/medical (577 patients), six medical (135 patients), four surgical (41 patients) and two neurosurgical (24 patients) ICUs (Fig. 1). The reasons for admitting these 777 patients to the ICU are given in Table 1.

The rationales put forward to justify withholding/withdrawal decisions were: limited subsequent functional autonomy (581 patients), absence of curative strategy (559 patients), advanced or terminal stage of a severe and incurable disease (474 patients), limited subsequent relational quality-of-life (442 patients), older age (210 patients), perception of non-beneficial treatment voiced by patient's relatives (172 patients) and patient's wish to limit treatment (110 patients).

Median time from ICU admission to the decision to withhold/withdraw treatment was 4 (IQR 1–13) days. Withholding and withdrawal involved 344 and 433 patients, respectively (Table 1). For 263 patients (a subgroup of withdrawal), ongoing life-sustaining treatments (catecholamine infusion, invasive ventilation) were withdrawn with or without extubation (138 and 125 patients, respectively).

Of the 777 patients undergoing withholding/withdrawal measures, 193 (25 %) were discharged alive from the ICU, whereas 584 died (Fig. 1). Of the 584 who died, 19 were declared deceased of brain death, and eight died under limitations which did not preclude resuscitation measures in the case of cardiac arrest.



\* 133 left the hospital alive (126 after withholding and 7 after withdrawal, none after WLST)

**Fig. 1** Flowchart of the 5,589 patients admitted to 43 intensive care units (ICUs) in terms of outcome and theoretical eligibility for organ donation. *WhWd* withhold or withdraw therapy, *WLST* withdrawal of life-sustaining treatments (invasive ventilation and inotropic drugs), *CDD* circulatory determination of death

These latter eight patients ultimately died despite full resuscitation efforts and, therefore, their death was considered unforeseeable. The remaining 557 patients died of foreseeable circulatory arrest without any attempt of resuscitation.

The reasons for admitting the 557 patients who ultimately died of a foreseeable cause are shown in Table 1. On the day of the withholding/withdrawal decision, 498 of these 557 patients suffered from at least one organ failure involving the neurological (327 patients), respiratory (257), circulatory (244), renal (152), hematological (60) and hepatic (42) systems, respectively. The median time from withholding/withdrawal completion to death was 2 (IQR 1–6) days after withholding (158 patients), and 1 (0–3) day after withdrawal (399 patients). The number of patients who died on day 1, 2 and 3 was 114 (26 %), 107 (24 %) and 60 (14 %) from withdrawal (433

**Table 1** Characteristics of the 777 patients with withholding/withdrawal measures according to the measures implemented, outcome and eligibility for organ donation

Patient characteristics	Patients with WhWd measures	Discharged alive from the ICU	Deceased due to foreseeable cause (CDD)	Eligible for at least one organ donation	Eligible, CDD >2 h following WLST	Eligible, CDD <2 h following WLST
<i>N</i>	777	193	557	279	84	70
Age (years)	68 ± 14	70 ± 14	68 ± 14	68 ± 14	68 ± 14	67 ± 13
Age ≤60 years	193	42	139	77	21	21
Age ≤70 years	398	97	283	136	44	37
Sex ratio male/female	1.8	1.7	1.9	1.9	3	2.3
SAPS II	60 ± 20	52 ± 17	63 ± 20	61 ± 18	61 ± 18	62 ± 17
SAPS II >60	355	54	281	123	41	36
LOS, median (IQR)	8 (3–20)	9 (4–25)	8 (3–19)	9 (4–20)	9.5 (5–21)	7 (4–11)
LOS >8 days	365	103	258	142	45	26
Reasons for admission						
Respiratory failure	259 (33)	85 (44)	171 (31)	90 (32)	27 (32)	15 (21)
Brain injury	223 (29)	26 (13)	179 (32)	117 (42)	42 (50)	40 (57)
Post cardiac arrest	150	16	124	74	26	24
Stroke	49	6	37	29	11	9
Head trauma	24	4	18	14	5	7
Shock and MOF	215 (28)	47 (24)	167 (30)	53 (19)	9 (11)	11 (16)
Other reasons <sup>a</sup>	80 (10) <sup>a</sup>	35 (18)	40 (7)	19 (7)	6 (7)	4 (6)
Patient characteristics on WhWd day						
SOFA >8	317	24	278	101	29	31
SOFA >12	138	1	130	35	9	12
Neurologic SOFA ≥3	385	35	327	185	62	60
Inotrope use	320 (41)	47 (24)	259 (46)	97 (35)	26 (31)	26 (37)
Invasive ventilation	595 (77)	93 (48)	477 (86)	237 (85)	76 (90)	65 (93)
With FiO <sub>2</sub> >50 %	252	26	215	81	15	22
With FiO <sub>2</sub> >70 %	145	9	129	39	4	12
WhWd implemented						
Withholding	344 (44)	172 (89)	158 (28)	79 (28)	0	0
Withdrawal	433 (56)	21 (11)	399 (72)	200 (72)	84	70
WLST	263	0	263	154	84	70
with extubation	138	0	138	95	50	45

Values are presented as the number with or without the percentage in parenthesis, or as the mean ± standard deviation (SD), unless stated otherwise

WhWd withhold or withdraw therapy, WLST withdrawal of life-sustaining treatments (invasive ventilation and inotropic drugs), SAPS Simplified Acute Physiology Score, LOS length of stay, IQR interquartile range, MOF multiple organ failure, SOFA Sequential

Organ Failure Assessment, CDD circulatory determination of death, FiO<sub>2</sub> fraction of inspired oxygen

<sup>a</sup> Other reasons include major surgery (32 patients), status epilepticus (14), metabolic disorder (8), central nervous system infection (4), acute kidney injury (4) and less common miscellaneous causes (18)

patients), and 33 (10 %), 38 (11 %) and 14 (4 %) from withholding (344 patients), respectively.

Of the 557 patients who died of foreseeable circulatory arrest, 159 already presented a contraindication to organ donation (based on the opinion of the attending physician) either before or upon admission to the ICU (hematological or metastatic malignancies, viral hepatitis, AIDS, systemic diseases, older age). A total of 119 patients developed organ dysfunction during their ICU stay, thereby ruling out any possibility of organ retrieval (uncontrolled sepsis, multiple organ failure, shock). Therefore, 279 deceased patients would ultimately have been eligible for donation of one or more organs based on the opinion of the attending physician (regardless of withholding/withdrawal measures implemented and age). Of these 279 eligible patients, 154 underwent a withdrawal of life-sustaining treatments with (95 patients) or

without extubation (59 patients). Only 70 of these 154 patients died less than 2 h after withdrawal, the timeframe considered compatible with organ viability in our study. Table 2 gives the individual and organ-specific eligibility of patients aged less than 70 and 60 years, respectively, according to the duration of the withdrawal period.

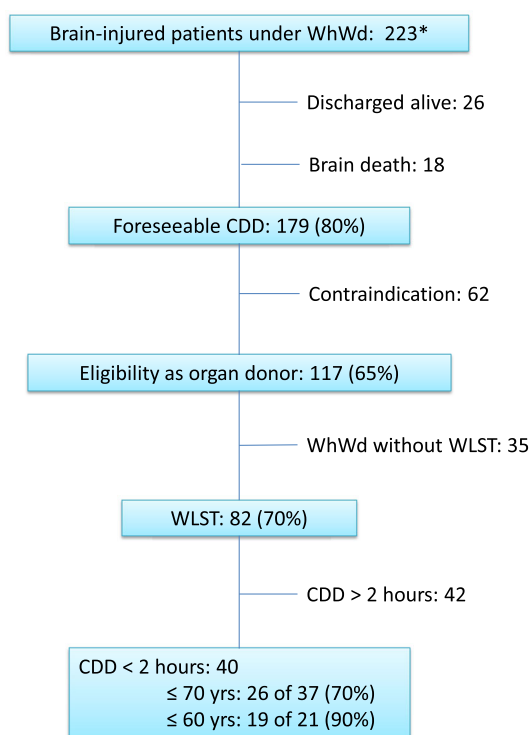
Patients with brain injury (post-cardiac arrest coma, stroke, head trauma) accounted for 32 % (179/557) of patients deceased under withholding/withdrawal conditions, 42 % (117/279) of deceased patients eligible for organ donation and 57 % (40/70) of patients deceased within 2 h after the withdrawal of life-sustaining treatments who were eligible for organ donation (Table 1). Of the 70 patients deceased within a short timeframe, 21 were aged <60 years, the maximum age selected by the French steering committee for organ donation according to Maastricht III; 19 of 21 patients (90 %) had severe

**Table 2** Individual and organ-specific eligibility for donation of patients deceased under withholding/withdrawal settings

Individual and organ-specific eligibility for donation	Eligible for organ donation			Deceased <2 h of WLST		
	All (n = 279)	Age ≤ 70 years (n = 136)	Age ≤ 60 years (n = 77)	All (n = 70)	Age ≤ 70 years (n = 37)	Age ≤ 60 years (n = 21)
Eligible for kidney donation	158 (57)	86 (63)	55 (71)	46 (66)	24 (65)	16 (76)
Eligible for liver donation	163 (58)	83 (61)	46 (60)	53 (76)	28 (76)	15 (71)
Eligible for lung donation	63 (23)	36 (26)	31 (40)	20 (29)	9 (24)	8 (38)
No obvious contraindication but organ-specific eligibility not stated	71 (25)	27 (20)	13 (17)	13 (19)	7 (19)	4 (19)

Values are presented as the number with the percentage in parenthesis

WLST withdrawal of life-sustaining treatments (invasive ventilation and inotropic drugs)



\*29% of the 777 patients under WhWd

**Fig. 2** Flow chart showing brain-injured patients under WhWd with regards to the outcome and theoretical eligibility for organ donation. Brain injury includes post-cardiac arrest coma, stroke and head trauma. *WhWd* withhold or withdraw therapy, *CDD* circulatory determination of death, *WLST* withdrawal of life-sustaining treatments (invasive ventilation and inotropic drugs)

brain injuries on admission. With an age limit of 70 years, 37 patients would have fulfilled the conditions for organ donation, of whom 26 (70 %) suffered from brain injury on admission (Fig. 2).

Univariate and multivariate regression analyses (Fig. 3) were used to determine factors associated with death within 120 min following withholding/withdrawal implementation in the 154 patients eligible for organ

donation who were withdrawn from life-sustaining treatments before death. The single factor associated with death within 120 min was ventilation with fraction of inspired oxygen ( $\text{FiO}_2$ ) >70 % before withdrawal. In the entire group of 263 patients withdrawn from life-sustaining treatments (regardless of organ donation acceptability), ventilation with  $\text{FiO}_2$  >50 % before withdrawal (OR 2.44; 95 % CI 1.40–4.27) and extubation (OR 1.80; 95 % CI 1.07–3.01) were associated with death within 120 min.

## Discussion

To our knowledge, this study is the first assessment of potential “Maastricht III” donors performed in France prior to the launching of the program. We designed our study to obtain the largest overview of both withholding/withdrawal practices (not influenced by any other objective) and patients affected by such procedures. In this survey, 14 % of the 5,589 patients enrolled in the study underwent withholding/withdrawal measures. Among the 557 patients who died of foreseeable circulatory arrest, we identified a subgroup of 279 patients with no obvious contraindication to organ donation based on the opinion of the attending physician (regardless of withholding/withdrawal measures implemented). Life-sustaining treatments were withdrawn for 154 of these patients, 70 of whom died less than 2 h after withdrawal (the maximum delay compatible with a hypothetical organ harvesting [14]). Only 77 of the 279 eligible patients and 21 of the 70 patients deceased within 2 h from withdrawal were aged <60 years, the maximum age for a donor (according to Maastricht III) selected by the French steering committee [13]. With an age limit of 70 years, 59 additional patients would have been eligible, of whom 16 died within 2 h from withdrawal.

In our survey we made no distinction between conscious and unconscious patients under withholding/withdrawal conditions. In the UK, where the rate of organ



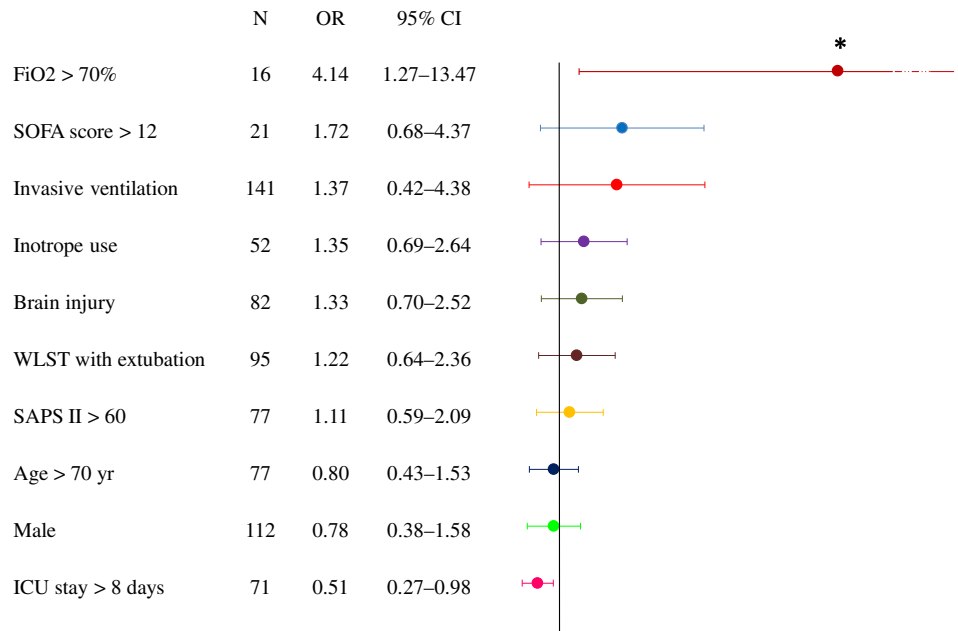
retrieval under Maastricht III is one of the highest in the world, the most common disease affecting donors is severe and irreversible brain injury [17]. However, conscious patients suffering from irreversible severe diseases with no hope for improvement (for example end-stage respiratory disease, locked-in syndrome, atrophic lateral sclerosis) may request both withdrawal of life-sustaining treatments (i.e. turn off mechanical ventilation) and subsequent organ donation if not contraindicated [17–19]. In France, Leonetti’s law applies to both conscious and unconscious patients in an end-of-life situation or with irreversible and severely-disabling diseases [16]. As donation under Maastricht III does not yet fall with the legal framework of France, in this survey we deliberately considered every possible scenario encountered in other public healthcare systems. Albeit questionable from a pathophysiological point-of-view, we also regarded patients who recovered from shock or multiple organ failure. Finally, brain-injured patients (29 % of patients undergoing limitations) accounted for over one-half (57 %) of patients eligible as organ donors and who died within a timeframe compatible with graft viability. However, as our group only involved two units highly expert in the field of neurocritical care, we probably underestimate the proportion of brain-injured patients dying in French ICUs under withholding/withdrawal conditions.

In a previous single-center study, we reported a significant rate of patients dying under withholding/withdrawal conditions who theoretically were eligible for organ donation based on medical criteria [20]. However,

the withholding/withdrawal measures implemented in this pilot unit (progressive removal of life-support devices) would have been incompatible with organ transplantation due to an extended withdrawal period. Because circulatory arrest must occur after a short period, only the withdrawal of life-sustaining treatments for highly-dependent patients (high FiO<sub>2</sub>, non-triggered modes of ventilation, inotrope/vasoactive drug use) is compatible with organ donation [14, 15, 21–23]. There is a significant variability in how withholding/withdrawal are implemented in ICUs, particularly in terms of airway management [24–27]. Once the ventilator is switched off, it is possible to remove the endotracheal tube that secures the airway. Rather than remove both the ventilator and tube within a short period of time, many ICU teams prefer a progressive withdrawal of mechanical ventilation. Indeed, they believe the symptoms of airway obstruction may harm the patient and be distressing to relatives and caregivers [28]. However, other intensivists consider this progressive weaning to be an unnecessarily prolonged agony if death is the most likely outcome [29], especially as these distressing symptoms may be reliably anticipated [30]. Moreover, a formal policy on the maintenance of patient comfort throughout the entire withdrawal period is essential for the acceptance of organ donation according to Maastricht III.

Although not expressly prohibited under current French law, organ retrieval after controlled death is still not practiced “so as to rule out any potential tension between the decision to withdraw treatment and the intention to harvest organs” [9]. In other countries, teams

**Fig. 3** Factors associated with death within 120 min in the 154 deceased patients eligible for organ donation who underwent WLST before death. Brain injury includes post-cardiac arrest coma, stroke and head trauma. WLST withdrawal of life-sustaining treatments (invasive ventilation and inotropic drugs), OR odds ratio, CI confidence interval, FiO<sub>2</sub> Fraction of inspired oxygen, SAPS Simplified Acute Physiology Score, SOFA Sequential Organ Failure Assessment



\* Independent risk factor in multivariate analysis

involved in organ procurement after controlled death consider organ donation as a routine part of end-of-life care once it is established that the patient wishes to be a donor [17, 31, 32]. Our study provides an assessment of French practices, with physicians responsible for decision-making being free from any moral dilemma between the individual interest of the dying patient and the collective benefit to potential graft recipients. Of the 777 patients in our survey with limitations, 25 % left the ICU alive, thereby confirming the intention of withholding/withdrawal measures in some circumstances, which is to let nature take its course without trying to hasten death. When death is the most likely outcome, the withdrawal of life-sustaining treatments usually involves the disconnection of mechanical ventilation (with or without removal of the endotracheal tube) and cessation of vasoactive drugs. The length of time to death following withdrawal is highly variable, ranging from minutes to days. However, extubation is more often associated with progression to organ donation than terminal weaning without extubation [17]. Death within 1 or 2 h of withdrawal usually correlates with severe brain injuries (low Glasgow Coma Scale, absence of brainstem reflexes) [22, 23, 33–36], high dependence on mechanical ventilation (non-triggered mode, high FiO<sub>2</sub>, high positive expiratory pressure) [15, 21–23, 34, 36, 37], use of inotrope drugs [21, 22, 33, 37], young age [15, 33, 38], underlying diseases [35, 37] and physiological anomalies (high severity index scores, low blood pressure, low pH on arterial blood gas analysis) [35, 36, 38, 39]. In our study, the factors associated with a short withdrawal period were high FiO<sub>2</sub> and extubation.

Our study has several limitations. First, as French transplant coordinators are still not involved in organ retrieval under Maastricht III, the theoretical eligibility for organ donation was evaluated solely by the physician in charge of the patient. In some cases, patients were declared dead without any obvious contraindication to donation, but the first-line physician would have entrusted the transplant organization with the task of evaluating organ-specific acceptability. Also, this study does not address the question of patient/family consent. The largest impediment to organ procurement after controlled circulatory arrest is relatives' refusal. Thus, it is important to keep in mind that the rate of refusal would significantly impact the number of potential donors proceeding to donation [40].

Second, while it is not the duration per se but the hemodynamic profile during the withdrawal period which determines the consequences of warm ischemia on organ viability [14], hemodynamic parameters during this period were rarely available due to the observational nature of our study (not influenced by any other purpose than patient's comfort). Moreover, troublesome monitoring might have been switched off to allow the patient and relatives peace. We arbitrarily considered that an interval

of 2 h from treatment withdrawal to cessation of cardiac electrical activity was the maximum timeframe compatible with a hypothetical organ retrieval [14, 15].

Lastly, this study does not address the question of how and when physicians declared death after withdrawal. Theoretical eligibility as organ donors was assessed after death by physicians free of any temporal constraints. Under actual Maastricht III criteria, the removal of organs must be scheduled before withholding/withdrawal is implemented and must start as soon as death is certified. As the removal of organs should not precede the donor's death, defining the precise moment of death after withdrawal requires the determination of very explicit criteria, even though biological evidence is lacking to support this accuracy [41]. Several organizations state that "if the patient or surrogate understands the circumstances of the determination of death", physicians are legally authorized to declare death after 2 min of absent circulation [5].

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## Conclusion

In this observational study, a significant number of patients who died in French ICUs under withholding/withdrawal settings would have been eligible for organ donation based on the assessment of the attending physician. Severely brain-injured patients were more likely to die after the withdrawal of life-sustaining treatments in circumstances which may fulfill the requirements for organ retrieval according to Maastricht III.

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**Conflicts of interest** None.

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