

The degree of certainty in brain death: probability in clinical and Islamic legal discourse

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Abstract The University of Michigan conference “Where Religion, Policy, and Bioethics Meet: An Interdisciplinary Conference on Islamic Bioethics and End-of-Life Care” in April 2011 addressed the issue of brain death as the prototype for a discourse that would reflect the emergence of Islamic bioethics as a formal field of study. In considering the issue of brain death, various Muslim legal experts have raised concerns over the lack of certainty in the scientific criteria as applied to the definition and diagnosis of brain death by the medical community. In contrast, the medical community at large has not required absolute certainty in its process, but has sought to eliminate doubt through cumulative diagnostic modalities and supportive scientific evidence. This has recently become a principal model, with increased interest in data analysis and evidence-based medicine with the intent to analyze and ultimately improve outcomes. Islamic law has also long employed a systematic methodology with the goal of eliminating doubt from rulings regarding the question of certainty. While ample criticism of the scientific criteria of brain death (Harvard criteria) by traditional legal sources now exists, an analysis of the legal process in assessing brain death, geared toward informing the clinician’s perspective on the issue, is lacking. In this article, we explore the role of certainty in the diagnostic modalities used to establish diagnoses of brain death in current medical practice. We further examine the Islamic jurisprudential approach vis-à-vis

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the concept of certainty (*yaqīn*). Finally, we contrast the two at times divergent philosophies and consider what each perspective may contribute to the global discourse on brain death, understanding that the interdependence that exists between the theological, juridical, ethical, and medical/scientific fields necessitates an open discussion and active collaboration between all parties. We hope that this article serves to continue the discourse that was successfully begun by this initial interdisciplinary endeavor at the University of Michigan.

Keywords Brain death · Personhood · Apnea test · Fiqh · Zann · Ijtihad

Introduction

As a medically and scientifically oriented community, our understanding of personhood as a physical phenomenon continues to evolve parallel to our understanding of physiological science. A clinical understanding of personhood, however, is nowhere more controversial than in the topic of brain death. Given the extent of medical knowledge and experience that is required to formally evaluate a patient suspected of having succumbed to brain death, a physician is required to make the ultimate diagnosis. Essentially, the role of the physician is to provide a clinical evaluation that takes into account all environmental and medical factors that have led to the patient's current state, and to determine that established criteria have been sufficiently met to categorically state that the patient has suffered an irreversible loss of personhood. Confounding the issue are numerous factors, not the least of which is the absence of international or even national consensuses on the very definition of brain death. This is not to say that medical knowledge has not progressed to adequately consider this subject, but rather, that the conversation continues to escalate at the level of information available. Perhaps most importantly, the conversation continues not in spite of what we know about personhood and the brain but because of what we have come to know through medical and scientific progress. While these contributions remain key factors in the clinician's approach to the issue of brain death, of equal importance is the consideration of the ethical and religious perspectives of both the clinician and the patient.

In this paper, we intend to address the issue of brain death from the perspective of the clinician providing care for a Muslim population in a predominately non-Muslim society. Herein, we will examine the current practices and trends in the medical diagnosis of brain death, giving consideration to the sources of error that may arise in the process as evidence of the role that probabilities and certainty play in clinical diagnosis. We will further discuss current trends in Islamic legal thought on brain death, again giving consideration to the role of probabilities and uncertainty in the development of Islamic legal discourse on the subject. It is our intent to join the two conversations on brain death and motivate a weighted consideration of both scientific and religious perspectives, with the hope of moving toward a clinically, scientifically, ethically, and religiously sound approach to this complex issue.

Defining brain death

To understand what is meant by the term “brain death,” it may be of value to clarify what is not meant. Brain death is a social construct of clinical criteria that has been defined more recently as a means of distinguishing irreversible loss of personhood from human organismal death, while maintaining that the two are functionally but not physiologically equal [1, 2]. The need for this ad hoc label has become increasingly apparent, as modern medicine is now able to intervene in the process of dying by artificially keeping the body alive, despite a clinically verifiable “irreversible” insult to the brain. It is thus essential to the discourse at hand to give consideration to the idea that biological death, which involves cellular death, may be a separate and distinct occurrence from what has been deemed as functional brain death.

Given the above mentioned understanding of brain death, it could be postulated that an irreversible loss of personhood as a gross physiological phenomenon must be distinguished from a strict tissue definition of death of central nervous system cells, i.e., the process of apoptotic or necrotic cellular death leading to organ failure. Such a distinction is not foreign to clinical science. For example, there is inadequate correlation between histopathological classification in Alzheimer’s disease with clinical staging. The pathological biomarkers for Alzheimer’s disease, such as the degenerative elements found in the brain tissue (tangles, plaques, protein markers), have been variably present in dementia and non-dementia patients and no definitive correlation has been made with clinical severity of the disease process itself. Although multiple formats have been proposed, this remains a work in progress [3, 4]. While there may be a role for the utilization of histopathological changes in the brain as a criterion for brain death, we feel that currently, such tests would be unlikely to remove any legal doubts regarding the certainty of brain death. In any case, the burden of proof remains with the scientific community to develop more specific and nuanced criteria if this modality should play a role in future diagnoses. However, we doubt that a neuropathological tissue death criterion will ever be satisfactory as a primary test if the demand is made for an absolutely certain diagnosis of death.

In the original article by the ad hoc committee of the Harvard Medical School, “A Definition of Irreversible Coma,” the following criteria were proposed as clinical signs, which together portend a diagnosis of brain death: (1) unresponsivity and unresponsivity, (2) no movements or breathing, (3) no reflexes, and (4) a flat encephalogram, i.e., no detectable cerebral rhythm in terms of brain activity [5]. These became the first and most widely accepted criteria for brain death. This report eventuated in a discussion at the Third International Conference of Islamic Jurists, where a consensus was reached accepting brain death as equally definitive as respiratory-circulatory death (cessation of cardiovascular functions with a consequential loss of respiration) [6]. Of note, here in the United States in 1980, the National Conference of Commissioners on Uniform State Laws drafted a bill, the *Uniform Determination of Death Act* (UDDA), which recommended that death be defined as “(1) irreversible loss of circulatory and respiratory functions, or (2) irreversible cessation of all functions of the entire brain, including the brainstem” [7]. This bill has been accepted widely, and revised by individual states.

Subsequent discussions focused on sharper distinctions of brain death, including supratentorial (brain hemispheres), infratentorial (brainstem), and global or “whole” brain death. The criterion for diagnosing these causes of brain death now varies remarkably from the original Harvard criteria. In 1995, the American Academy of Neurology (AAN) published clinical practice criteria to establish a clinical diagnosis of brain death. The AAN defined brain death as “absence of clinical brain function when the proximate cause is known and demonstrably irreversible,” emphasizing three clinical criteria: (1) coma or unresponsiveness, (2) absence of brainstem reflexes, and (3) apnea [8]. In the AAN’s recent report, “Evidenced-Based Guideline Update: Determining Brain Death in Adults,” a review of the efficacy of the original 1995 publication on the same topic is provided along with evidence-based recommendations on subsequent data. Of note, the report found “no published reports of recovery of neurologic function after a diagnosis of brain death using the criteria reviewed in the 1995 American Academy of Neurology practice parameter” [9].

In terms of how this may relate to personhood, if one is to compare Warren’s five proposed traits (i.e., consciousness, reasoning, self-motivated activity, capacity to communicate, and presence of self-concept/self-awareness) with the current understanding of brain death, which is based on the demise of consciousness and the related failure of the body’s integrative functions, could a physiological-philosophical correlation be made with some consistency vis-à-vis loss of personhood? This issue remains an area of much debate and disagreement [10, 11].

While the clinical criteria for brain death have advanced the process of diagnosis, several opponents have advocated suspension of brain death as the legal basis for physical death, citing concerns of clinical uncertainty in diagnosis. Still others have suggested that the term brain death be retired, and in its place, a simple diagnosis of death be used in order to mitigate obfuscation [12, 13]. While those who oppose the idea of brain death have had little impact on clinical practice today, they allude to a valid concern regarding the possibility of error in medical diagnosis. Lending support to this concern are the recent functional Magnetic Resonance Imaging (fMRI) studies, which have brought to light new evidence of functioning brain regions in persistently vegetative patients (Persistent Vegetative State or PVS), raising concern that similar findings might be observed in previously diagnosed brain dead individuals [14, 15]. The fMRI is a highly sophisticated test that indicates cellular function. While PVS is a distinct diagnosis as compared to brain death (and will not be discussed here), the rationale that a brain devoid of basal cellular function has undergone some form of tissue death should then be verifiable using a fMRI test, for example (no conclusive fMRI research studies on brain dead patients are available as of yet).

Such an assessment of the actual cellular function in brain dead patients was analyzed by Verheijde et al., who found a “lack of clinical certainty” in the diagnosis of brain death based on inadequate tissue pathological correlation, while suggesting that tissue death should be a required characteristic of brain death [16]. As we mentioned above, while we see the need for further development in the tissue-based definition of brain death, as opposed to one based on the representation of a gross physiological phenomenon, such as the absence of blood flow to the brain, we foresee a great deal of variability in the degree of tissue damage and its

correlation to disease severity (brain death), as in the other conditions such as Alzheimer's dementia discussed above. This is not to say that molecular level dysfunction does not exist in a malfunctioning brain, but the challenge is to develop clinical correlates for tissue substrates that would be sufficient to develop broad consensus on the issue.

Diagnostic modalities and statistical probabilities in the medical literature

A high degree of variability in institutional policies and procedures in determining brain death has raised concerns of diagnostic uncertainties in terms of the validity of brain death criteria. One survey noted that larger hospitals (>500 beds) more often required a neurologist or neurosurgeon to participate in the certification process than smaller hospitals (<300 beds). Additionally, hospitals with 300–500 beds appeared more likely to recommend a confirmatory test, but this was not statistically significant ($p = 0.53$). About 12 % of the hospitals reviewed did not identify any precautionary factors to avoid invalid testing. Two physicians were required to certify brain death by 46 % of institutions, one physician was required by 44 %, and the rest did not specify. Only 38 % of the hospitals surveyed required either a neurologist or a neurosurgeon to make the diagnosis. The apnea confirmatory test was required by 96 % of institutions, but only 52 % listed a specification that the test be positive if there are no spontaneous respirations with a carbon dioxide measurement of >60 mmHg, as per the American Academy of Neurology (AAN) recommendations [17].

Electroencephalograms (EEG) that detect the underlying cerebral rhythm are frequently used to assess the brain's rhythm, but there are several limiting factors regarding their use in conditions such as coma and brain death. One study noted that 37 out of 125 patients with initially no detectable cortical (brain hemispheric) activity subsequently regained consciousness [18]. Another study found that 20 % of EEGs performed on 56 brain dead patients showed residual activity that lasted 168 h [19]. The factors that limit EEG reliability include the equipment sensitivity to electrical noise, which is common in an emergency room or intensive care unit. Likewise, sedative drugs cause EEG abnormalities and make interpretation difficult, particularly for prognosis [20].

Cerebral angiography had been utilized to evaluate blood flow to the brain by direct injection into the aorta. This technique was considered the method of choice for establishing the diagnosis of brain death (total brain infarction) as early as 1973 [21]. In a study by Greitz, 42 patients with clinical signs of brain death or total brain infarction were examined by cerebral angiography—either unilateral carotid angiography (22 cases), aortocranial angiography (20 cases), or combined (19 cases). The intracranial circulation was arrested in all but one patient, in whom a “global luxury perfusion” was present [21]. It was assumed that this latter finding represented an early stage in the development of a total brain infarction (stroke). The absence of blood flow was therefore considered a positive finding toward a diagnosis; however, persistent cerebral blood flow had been noted in some who were diagnosed brain dead. For example, one study showed a 2.6 % incidence of

arterial blood flow in such patients [22]. Similarly, another study found that 9 out of 140 (6 %) patients with clinically established brain death had persistent blood flow within the posterior fossa as assessed by intravenous angiography [23]. Thus, while presence of arterial blood flow did not exclude brain death, its absence was considered a positive finding.

Computed tomographic angiography (CTA) is another diagnostic modality that has been used to assess cerebral blood flow in brain dead patients. One study looked at 29 clinically brain dead patients from 2007 to 2010 to determine brain death using CTA. Seven patients (~25 %) had residual contrast enhancement in segments of the middle cerebral artery and internal cerebral veins. CTA in this case achieved a sensitivity of 75.9 % [24].

The apnea test remains the main confirmatory test recommended by the AAN in the diagnosis of brain death, although not without controversy. According to the AAN, the test is positive when there is no respiratory response resulting from an increase in the concentration of carbon dioxide, as determined by a $\text{PaCO}_2 \geq 60$ or 20 mmHg above baseline values. In other words, a significant rise in carbon dioxide levels without triggering spontaneous respirations would be consistent with lack of oxygen exchange in lungs [8].

In an 11-year follow-up study by Wijdick et al., 228 patients pronounced brain dead were studied. Having followed the AAN's preconditions for use of the apnea test, they found it to be a safe methodology. In addition, they reported that acute hypotension (low blood pressure) was present in all patients, prompting intervention with vasopressors; this was believed to be a defining characteristic in the transition to brain death. The study also found that 1 in 10 patients did not meet the preconditions for apnea testing and thus required alternative methods of diagnosis [25]. Another recent publication reviewed the prerequisites for use of the apnea test, finding that "all cases in which the [apnea] test had to be aborted due to progressive hypotension (low BP) or hypoxemia (reduced oxygenation), there had been a nonsatisfactory preoxygenation technique" [26].

However, others have raised concerns about the safety of the test, suggesting that the test itself may induce irreversible brain damage by causing catastrophic hypotension and arrhythmias (irregular heart rhythms), as well as inducing a transient increase in intracranial pressure that leads to a no-reflow phenomenon where normal blood flow to the brain is not restored after prolonged initial ischemia (lack of oxygen delivery to the tissue due to poor or blocked blood flow). In addition, where organ donation is concerned, there are also concerns of other organs being damaged [27–29]. Others argue that the test lacks a philosophical rationale for using the lack of spontaneous breathing as a criterion for brain death [29].

Another concern raised is related to equipment failure. One study looked at apnea tests in 83 ventilator dependent patients in a neurologic-neurosurgical intensive care unit to consider brain death. False triggering of the ventilator was noted in 5 % of these patients, suggesting possible spontaneous respiratory effort and a conflict with the apnea test results. The observed phenomenon is known as ventilator self-cycling and may be caused by leaks, which cause pressure changes, highlighting the importance of a clinician's familiarity with equipment failure and the need to use alternative means of confirmatory testing in questionable cases [30].

In making a clinical diagnosis, the clinician's aim is to prove the diagnosis and not simply pronounce it. Often, this includes utilizing numerous criteria and modalities, which on their own would not present a convincing picture but together provide strong cumulative evidence toward an accurate conclusion. In the diagnostic modalities discussed above, each demonstrated clinical utility as well as potential pitfalls in its use. It is ultimately the role of the clinician to use his or her scientific acumen both in the decision of what tests ought to be used in a given scenario as well as the interpretation of those results. This is perhaps the final source of potential error in the clinical diagnosis of brain death—the clinician, who must reliably and accurately utilize the tools at their disposal.

Variation in Islamic legal discourse

Until recently, there was no widely accepted Islamic doctrine on the phenomenon of brain death, in the legal sense. However, within a few decades of the medical community's consideration of the issue, the discussion entered the Islamic ethical and legal arena [31]. As the religious community joined the medical discussion, this unique scholarly perspective quickly became a formidable voice in the debate on brain death. Islamic jurists have dedicated much time to an extensive consideration of the topic of brain death from ethical and legal perspectives [32]. The details of these deliberations, which have taken place over the last forty or more years, are beyond the scope of this paper, but their presence illustrates an invaluable fact—that the Islamic ethical-legal discourse is a *progressive* one, that is to say, that it is not solely retrospective but prospective in its analysis. In other words, while Muslim legal scholars have accounted for the Harvard criteria of the past, they have also looked to potential new developments in the field of neuroscience that could alter the clinical definitions around disorders of consciousness and tried to ensure that any critique of the original criteria is not dismissive of novel developments.

Central to the discussion of Islamic traditional and legal discourse on brain death is the question of certainty. Clearly, the clinician's aim is to provide a *diagnosis* that approximates reality, utilizing the tools available to minimize clinical uncertainty. Equally, it has been the role of Islamic jurists and ethicists to deduce a *ruling* that approximates the divine intent with as little uncertainty as possible. Generally speaking, in any deductive process, there may be numerous sources of uncertainty. To avoid or minimize them in concluding legal opinions, Muslim jurists developed over time an elaborate system of legal maxims and principles as well as a rigorous methodology of deliberation utilized to reach a specific judgment. The formation of four formally recognized schools of thought (*madhāhib*), namely, Maliki, Hanafi, Shafi, and Hanbali, within Sunni Islam, and additionally the Shii' legal traditions, each with its own principles and methods, is an indication of the diversity within Islamic law but also of its legal prowess. In this section we examine the concept of certainty (*yaqīn*) in Islamic law as may be required in establishing brain death.

One issue that has distinguished clinical medicine from legal thought in general has been the consideration of death as a process versus an event [10]. Clinically, the physician will observe the progression of a patient through an eventual irreversible

loss of brain function. The clinician does not look for a single factor that deems brain death a positive finding, but rather, notes a syndrome of clinical signs and test results that together indicate that an irreversible loss of personhood has occurred. In contrast, the law (Islamic or not) views death as an event with a definitive time and place as opposed to a process, hence the requirement for a physician to establish a “time of death” [33]. While the use of death as an event has conventional social value, it is also an attempt to approximate the detachment of the soul from the body that retains broad consensus as the key indicator of death amongst Islamic scholars. The physician’s role would be to observe the process of death, and categorically state when the process has become irreversible as determined by the scientific method. While one might be tempted to see this as an event by the very nature of the pronouncement, in reality, it is the pronouncement of death that is the event, and not the death itself. What then could theologially be considered the exact time of death? Sachedina, in *Islamic Biomedical Ethics*, distinguishes between two different aspects of the soul, i.e., the spirit (*rūh*) that separates from the body at the time of death, and *nafs*, which could be viewed as “self” or even “personhood,” where “death occurs when the *nafs* leaves the body, depriving it of its vital functions.” He used the term “soul” interchangeably with *rūh* (spirit) and *nafs* (self), as they are used in various Qur’anic verses, but concludes that the “soul” could not be adequately defined in terms of *nafs* alone. The *nafs* (self-being) in fact could relate better to the concept of personhood. The nature of soul in Islam is widely discussed in the tradition and is considered a matter of the unseen realm (*ghayb*), the true reality of which is elusive to humans [34]. Nevertheless, cessation of cardiopulmonary function is what is warranted from a traditional perspective to establish actual death and is considered to signal the separation of spirit (*rūh*) from the body [35].

The idea that a human is regarded as dead when the brain or brain stem ceases to function has numerous social implications within Islam. In a customary sense, one must consider burial procedures, inheritance, and specific medical concerns such as organ transplantation. Therefore, a clear definition of death is warranted. Despite extensive deliberations by Islamic theologians over a span of centuries, however, the exact timing and nature of death is considered metaphysical and one that lacks certainty (*yaqīn*) [36]. At the same time, medical indicators, such as pulse rate, etc., have inevitably been important considerations that have been readily espoused by Islamic jurists.

Kraweitz, in her analysis, identifies some of the key challenges within the Islamic legal paradigm to accepting newly discovered scientific parameters, particularly in the idea of brain death. She surmises that one of the major roadblocks has been the “reluctance to give up customary signs, be they part of Islamic legal tradition or not” [36]. Bedir and Aksoy, for example, note that the traditional Islamic notions of death are incompatible with the scientific notion of brain death. They contend that brain death is not complete death according to Islamic teachings because these patients still have a soul within their bodies, “just as the aliment of the body is water, so the nourishment of the soul is air” [37]. In this view, cessation of respiration is the only valid evidence of a departed soul. Therefore, according to them, as long as the patient is still breathing, even if on an artificial respirator, he or she is considered alive as per Islamic jurisprudential criteria. While Kraweitz’s

argument might be representative of some Muslim communities, an observation by Sherman Jackson (in an unrelated paper) may provide an alternative explanation. He emphasizes that because Islam is first and foremost a legal tradition, its participants seek the “authority” of the law and not merely “wisdom” from the law. He suggests that “inasmuch as authority rather than substance is the force that backs law, all legal traditions tend to be backward looking and to privilege provenance over content” [38]. Therefore, it may not be reluctance to adopt changes so much as an emphasis on a systematic approach where, by means of legal deduction, Muslim societies seek to determine a normative assertion on the subject. The function of the jurists therefore is most prominent.

There are four established principle sources of legal deduction to determine “laws and values that regulate [human] conduct...” (*ḥukm*, plural, *aḥkām*). These include the Qur’an and the Sunnah as the key authoritative sources, consensus (*ijmā’*) and precedence-based analogy, a formal source (*uṣūl*) of Islamic law (*qiyās*) to arrive at a certain ruling, judgment, or decree (*ḥukm*). The Qur’an is the divine word (of God) and as the Sunnah constitutes the sayings, actions, and tacit approvals of the Prophet (Muhammad, peace be upon him) as recorded [39].

A legal opinion (*fatwā*) is therefore arrived at through a complex methodology called *ijtihād*, which includes the interpretation and application of the sources (*naṣṣ*), specifically the Qur’an and the Sunnah as it relates to a particular issue or circumstance [40].

There are then two key roles of the Islamic jurist: (1) to determine the meanings of the words of the passage from the authoritative sources (Qur’an and Sunnah), and (2) to analyze based on established rules of legal deduction and reach an opinion (*fatwā*) on a novel case. There are many challenges in this interpretative process, not the least of which include textual ambiguity and proper use of figurative language that are elements accounted for in legal proceedings [41]. And thus Islamic jurists have formalized the process of law development (*fiqh*) to discover the best approximation of the meanings of the authoritative sources, i.e., the Qur’an (word of God) and the Sunnah (prophetic model of practice).

The theory of *ijtihād* (juristic effort) assumes that formulating legal opinions (*fatāwā*) involves extracting that which is present but not self-evident. Thus, Muslim jurists do not invent rules, but instead, attempt to discover rulings (*aḥkām*), which God has already ordained and which are laden in the authoritative sources. As such, the jurists do not rely on human intuition but seek objectivity (by virtue of a text centered method) to approximate the ideal Law of God. And if the authoritative sources do not delineate a clear value (*ḥukm*) on an issue, then the scholars use the tool of analogical reasoning (*qiyās*). According to Kamali, *qiyās* is a rational process predicated on textual sources (*naṣṣ*), i.e., based on transmitted proofs from the Qur’an and the Sunnah for those cases in which a legal value is not found within the texts (*naṣṣ*). In order to be valid, it must be founded on an already established rule (*ḥukm*) of the Qur’an and Sunnah. Kamali further states, “each of these sources may contain speculative rules which are open to interpretation” [39].

Muslim jurisprudence contends that the laws derived from *ijtihād* are classified as *zannī*, or an approximation, and that *zannī* is clearly differentiated from definitive (*qaṭ’ī*) knowledge [39]. The idea of approximation suggests that errors may be

possible, and Sunni theorists contemplate these errors as being inevitable in the legal field. However, opinion in this sense is still regarded as objective in the sense that it is arrived at via a transparent process. Therefore, with every opinion, the scholars usually consider the possibility of error [40].

In the Islamic tradition, the mode of analyzing ethical questions lies within the set structure of legal deduction, i.e., the discipline of legal theory (*uṣūl al-fiqh*) and *ijtihād*. Islamic law has therefore extensively engaged in deliberating on contemporary issues from brain death to organ transplantation, albeit mostly within the confines of legal theory, whereas the role of ethical theory as a distinct discipline is less clear. An obvious limitation pertaining to the case at hand that cannot be overlooked when studying this pattern is the lack of an exchange between religion and science that once used to be part of the historical continuum but has eroded over time [42]. Moosa noted, “the jurists, of the sciences of jurisprudence (*uṣūl al-fiqh*) and the science of positive law (*fiqh*), accepted the working assumptions adopted in the field of science as a reality and there were rarely any major misfits between the two” [42, p. 330]. Moosa suggests that in the modern period this coherence is no longer evident. It is our opinion that this could be an additional factor as to why, in many contemporary discussions on the subject, one can readily see unease with medical assertions in the religious discussions on death when challenged with proposals to depart from the long held customary methods of determining death.¹ We note that although a significant number of Muslim experts have leaned towards accepting brain death as death, the historical trajectory of these debates and differing positions may be illustrative of this sense of discomfort (brain death vs. death details).

Padela et al. provide an overview of the variability in the understanding of various Islamic juridical councils that have opined on this issue, ultimately mostly with skepticism regarding the tendency to equate death with brain death without featuring notable differences [31]. For example, in 1981, the Religious Rulings Committee of Kuwait endorsed that brain death is not legal death, whereas the Majlis al-Shura al-Islami in South Africa considered brain death a legal death in 1994. Also in 1994, Majlis al-Ulama in South Africa claimed that a brain dead person is, in fact, alive. Differences also exist with regard to whole-brain versus brain-stem death in the various juridical bodies [31]. It seems to us that embedded in these critiques of brain death lie anxieties and concerns regarding the rapidly growing organ transplantation industry. Similarly, different countries in the Islamic world determined their own views on brain death. In 1993, the United Arab Emirates stated that there are no specific criteria for brain death, and therefore, it is necessary to have three physicians come to a collaborative final decision about a patient regarding this matter. In contrast, in 1993, Egyptian officials stated that they would not accept brain death as the official death of a person, effectively rejecting the concept of brain death [31].

These marked differences between ruling Islamic bodies continue to inform the present debate on the subject, creating intrigue about differences in the methods of deliberation used to reach a level of certainty (*yaqīn*) in legal terms on this issue.

¹ For a further mention of this, see Kraweitz [36].

This observation prompts us to ask, does an opinion against the notion of brain death carry a greater weight of certainty (*yaqīn*) than one that accepts the idea of brain death? Certainty, or lack thereof, is perhaps the greatest hurdle in accepting brain death as a viable definition of death within the Muslim legal framework. The notion of certainty (*yaqīn*) in Islam is well established in the legal maxim, “certainty is not eroded by doubt,” meaning doubts are not sufficient to render a reality null [32, 43]. So the question of how certain a brain death diagnosis is becomes the focal point for further discourse.

The following explanations by two different experts highlight the differences in approach with regards to the above: one is a jurist while the other is a physician. These contrasting views suggest a sense of disconnect in the conversation on brain death between experts of various backgrounds. Sheikh Hâni al-Jubayr, a presiding judge at the Mecca Courthouse, elaborated on the concept of brain death in a 2008 opinion that included the role of clinical specialists:

It is unlawful to declare someone dead (actual death which brings about legal consequences) merely by a doctor’s statement that the patient is brain-dead. It is necessary to establish death without an ambiguity. The heart must stop beating, breathing must cease, and the other typical signs of certain death must be observed. This is because the default assumption about a living person is that he or she is still alive, so the contrary must be established with absolute certainty. At the same time, it is permissible to take the patient off of life support if all brain function has ceased and a panel of specialists determined that there is no chance for it to resume. [43]

Dr. Ahmed Abdel Aziz Yacoub, a London based cardiothoracic surgeon who also holds a Masters in Law, is able to provide a unique insight from the perspective of both the clinician and one who is learned in Islamic law. In his 2001 book, *Fiqh of Medicine*, he explored the various opinions of each of the four Sunni schools of thought on topics ranging from informed consent to organ transplantation. Although a detailed analysis of brain death was not provided, in his discussion of involuntary euthanasia, he categorically states,

modern methods of technology come into play at that particular moment, when the brainstem has died, but the heart has not yet “shut off,” as it takes a few more moments for it to do so (and even more time for the nails and hair to stop growing), the heart is supplied by oxygen by establishing mechanical breathing. In its turn the heart continues its innate function of just contracting and relaxing thus maintaining the circulation to the lungs and the body. This theoretically, can last as long as the machines last. When the machines are stopped, the lungs do not move and do not ventilate, the heart stops after a time lapse for it to use up the oxygen that was pumped in it. I have tried to explain that brain death is real death.... [44, p. 269]

Keeping the above statements in mind, it becomes crucial to understand as to when scholarly knowledge may be considered approximate (*zannī*), that is to say, derived from the best assessment of the definitive sources (Qur’an and Sunnah) while relying on a significant degree of human agency (process of *ijtihād*).

Therefore, when the authoritative sources do not clearly state a rule (*hukm*), legal conclusions ultimately become a matter of probability (*zann*). Hallaq notes, “depending on the quality and strength of evidence, the probability may be moderately increased, in which case it is termed *ghalabat al-zann*, or it may be increased to such a great extent that it may ‘border on certainty,’ in which event it is known as *al zann al-mutakhim lil-yaqīn*. Other intermediate degrees of probability are also distinguished” [45].

Sheikh Yasin, a renowned Jordanian jurist who was one of the early ethicists commenting on the issue at hand, acknowledges that both juridical and medical findings are not based on incontrovertible certainty, but are in the realm of the “dominant probability of rectitude” (*ghalabat al-zann*). Legal theorists have also acknowledged that the rules governing human conduct are often based on knowledge arrived at on the grounds of such dominant probability [32, 46]. In these issues, a legal probability can set precedence for subsequent rulings. Yasin argues that a great part of the realities of life are only known by strong probability and not by certainty [36]. As Padela et al. illustrated, while the preferences of jurists vary in terms of requiring certainty without doubt (as opposed to dominant probability) on issues of grave importance, it is ultimately the reliance of jurists on experts that allows them to reach sound conclusions. As the scholars work hand-in-hand with clinical experts, the endeavor inevitably becomes more “probabilistic than deterministic,” and this was likely the impetus for the position adopted by Organization of Islamic Conferences’ Islamic Fiqh Academy (OIC-IFA) in favor of equating brain death with death in the 1980s [31].

Conclusion

In considering the relevance of certainty in defining and diagnosing brain death, we find that the human condition predisposes a level of uncertainty, regardless of the perspective. While some have pointed to uncertainty as a fatal error of the process, we see it not as a weakness that slows down the course of action, but as a cautionary reminder of the necessity to further inform action with a body of evidence. It is the very need for a complete and holistic synthesis of the information regarding brain death that requires multidisciplinary discussions between the clinical and legal disciplines on the topic. Yasin argues that “the responsibility to determine when life ends rests squarely on the shoulders of ‘specialists’” [36]. That is to say, those most learned in matters of brain physiology are most equipped to dictate the discussion of brain death and its place in the broader discussion of death in Islam. And as Moosa suggests, “scholars learned in religious law should work side-by-side with medical specialists and provide the ethical principles and moral guidance and context for such practices” [32].

While some have raised concerns regarding diagnostic errors and increases in the rate of organ harvesting as an objection to current trends in diagnosing brain death, these concerns, while important, do not invalidate the substantiation of brain death as a phenomenon equivalent to respiratory-cardiovascular death. Additionally, the emphasis on a tissue definition of brain death, while an important ongoing research

endeavor, is only likely to raise more questions (within the medical field), vis-à-vis the types of tissue pathology and their ultimate correlation with clinical severity in brain injury. Although many cases of brain death may not show any obvious signs of specific brain damage on imaging studies like MRI brain or CT head scans, the authors have experience in evaluating patients with large-scale cerebral ischemia involving bi-hemispheric strokes or diffuse intracerebral hemorrhages that have subsequently resulted in brain death. This prompts us to wonder if this degree of tissue damage would meet the demand for certainty (*yaqīn*) from critics that find clinical criteria insufficient and the tissue definition of brain damage inadequate. Nevertheless, the social construct of personhood in the Islamic legal realm warrants determining the indicators that suggest a presence or absence of *rūḥ* (spirit) from the body at the time of death; this discussion, as elaborate and extensive as it has been amongst Muslim scholars, is likely to continue parallel to the debates in the neurological scientific realm.

This discussion also raises many practical ethical questions that face the clinician currently practicing without a widely accepted Islamic imperative. We believe that the discourse on brain death warrants consideration of the following questions as well: what would long-term clinical care look like for patients in a state of irreversible loss of consciousness and what emotional cost to their families and financial burdens are then acceptable to a community as a result of long-term use of artificial ventilation for such patients? Are most Muslim majority countries even financially strong enough to maintain patients on such expensive long-term artificial ventilators? What happens when the most affluent find a way to obtain such expensive modalities, as in chronic ventilation after their loved ones are declared brain dead, while the less privileged have fewer options? Does that mean that life as maintained on artificial breathing is a matter of financial privilege and transactional in nature?

An obvious remaining question given our own analysis in this article is whether certainty in the diagnosis of brain death on a clinical basis is comparable to certainty in the Islamic legal and theological sphere. Nevertheless, our objective in this descriptive analysis has been to identify a viable discourse on this issue as undertaken by both the clinical and legal disciplines, which continues to evolve. Our hope has been that the social science and clinical science experts may better understand each other's respective approaches to this issue. In the future, we hope to see a comprehensive Islamic discourse that addresses the uncertainties that exist, both in defining and diagnosing brain death, by incorporating a multidisciplinary approach that takes into consideration relevant factors from both the medical and the legal realms.

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