Beginning of individual human life at 13th week of development

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Abstract

When does individual human life (personhood) begin? Brain cortex is necessary for the personhood but there exist two different types of cortex with two different stages of development. While neocortex does not begin to get organized before 24 weeks, allocortex is already formed at 13th week of development.

Allocortical structures such as hippocampal formation and amygdala are involved in the emotions and memory, and regarded as the seat of personhood. At 13th week, fetus has an adult type allocortex by functional and anatomic definition and it is the most reasonable time at which to fix the start of individual human life (personhood).

Most religious traditions hold that what makes one a person is the possession of a soul. Ensoulment seems to occur when allocortex is formed at 13th week of development. Allocortical birth theory suggests that abortion and embryo research are acceptable ethically up to the point of allocortex formation.

Key words: Allocortex; Amygdala; Development; Ethics; Hippocampal formation; Personhood

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Received: June 10, 2011
Accepted: August 1, 2011
Published online: August 10, 2011

DOI:10.5455/jeim.100811.hp.001

Introduction

One of the most controversial topics in modern bioethics, science, and philosophy is the beginning of individual human life (personhood). Many philosophers and scientists have argued about the definition of personhood and the time for the beginning of a human individual's life, however an acceptable explanation has not been provided yet. The consequences of this discussion are vitally important, as they may help to articulate more adequate arguments on some bioethical issues, like the definition of the moral status of embryos, abortion and embryo research. The purpose of the present study was therefore to propose when, in the course of normal development, an individual human life begins.

The availability of embryonic stem cells may open novel avenues for medical treatment of otherwise incurable diseases [1]. Embryonic stem cells are able to make any cell except placental cells and are also immortal [2]. However, the generation of human embryonic stem cells sometimes requires the destruction of early human embryos. This raises the same ethical questions and conflicts that are often heard when the ethics of abortion are discussed. Some people regard an embryo to be a full human person; it has all of the rights of any citizen including the right to life; thus any procedure that injures or kills an embryo is murder of a human. Most people however regard the beginning of individual human life to occur much later in pregnancy; thus, killing a recently fertilized embryo is not murder of a human person [3]. What is the status of the embryo at several days old? Is the embryo alive? Yes, from its beginning the embryo is cellular and it is alive, no one questions this. But, is the embryo human? If we could catch the embryo before it reaches a stage of being judged human, we would take the embryonic stem cells without any concern. Seeing that twinning can occur as late as day 14 after conception and such identical twinning will produce two individuals with different lives, this could be proposed as a pre-embryonic stage where the single individual person is not yet fixed [4]. Today, embryo research is allowed up to 14 days in United Kingdom after which the splitting and the forming of twins is no longer possible [4].

Most religious traditions hold that what makes one a person is the possession of a soul [4, 5]. When the body meets with the soul, it comes to be a human person, with all the attendant rights, especially his basic right to life. However, the exact gestational age at which ensoulment is believed to happen is debatable. Common views include
ensoulment happening at the moment of conception, at the formation of brain and at the time of viability [5, 6]. In all religious groups abortion has always been regarded as sinful. However, for many centuries the termination of a pregnancy at an early stage carried lesser penalties than one later. This was related to the view that the human soul does not enter the embryo until 40 days or so after conception [5, 7]. Most religious groups thus, make a distinction between the moral status of the unformed and formed embryo, and think of the human person in the full sense, coming only with a delayed ensoulment [6].

**Brain cortex and personhood**

What makes human beings human and when does individual human life (personhood) begin? From a medical point of view the function of the brain is fundamentally linked to being human. The brain controls almost all functions of the body and determines its psychological makeup [6]. Legal definition of death is based on the absence of brain activity, even though all the rest of the body is viable. Children born with anencephaly can never live an individual human life. Indeed, a living body without a brain would be a mass of cells without personhood. A conglomeration of cells in the early phase of pregnancy can hardly be characterized as a human person. Therefore personhood cannot occur until it has something that counts as a brain. The human identity, personality, and worth is associated with the functioning of the brain, so only when the brain is developed can there be any talk about an unborn human being [8].

In elaborating on this theory, Goldenring [9] defended the eight-week mark as the starting point for human (personal) life, indicating in his view the point at which there is integration of the brain as a whole. Kushner [10] argues that the initiation of brain activity is the most reasonable time at which to fix the start of life. Similar arguments are put forward by Shea [11] who recognizes that a new human life comes into being when the newly developing body organs and systems begin to function as a whole under the direction of a functioning brain at eight weeks of gestation. Emphasis is placed on a point during development when brain tissue begins to function. Brain death is the cessation of function of a brain; brain birth is the very gradual acquisition of function of a developing neural system. Is this developing neural system a brain? At some point, it must become a brain, but at what point? In particular, can we legitimately call it a brain at around eight weeks' gestation?

The fetal brain develops very gradually over time from a comparatively simple to a more complex structure that comprises a number of functionally differentiated neurological components, including the critical cortex. Brain cortex is the outer layer of cerebral hemispheres and it is responsible for sensory perception, movement, language, thinking, memory and consciousness [12]. Brain cortex is also necessary for the personhood [6, 13]. The development of different parts of brain begins at different stages in fetal development [14, 15]. The structure of the adult cortex is highly complex and specialized and a great deal of change must occur during fetal development before an adult-like cortical structure is recognizable. However, the cerebral cortex is an extremely rudimentary structure at 8 weeks of gestation on which so much emphasis is placed [15]. At this point, we must remember the existence of two different types of cerebral cortex and two different stages of cortical development. The bulk of the cerebral cortex is a six-layered structure called neocortex (young cortex). The remaining of the cortex around the hilus of the cerebral hemisphere is known as allocortex (other cortex) [12]. Allocortex has a relatively elementary structure with three basic layers and is composed of the olfactory cortex and hippocampal formation [12].

The neocortex undergoes a long period of differentiation and maturation and neocortical ‘life’ does not begin while the neocortex is getting organized [15]. Neocortical birth could be located after the 24th weeks of gestation when cortical organization in the fetus begins to resemble that of adult type [15]. During the early fetal period and midgestation, the individual neocortical layers are not easily identifiable since there is a continuous influx of new neurons into the cortical plate and this plate does not contain synapses until 22-24 weeks of gestation. The six-layered adult laminar pattern gradually appears after 24 weeks of gestation owing to the progressive differentiation of the cortical plate [16-18]. Thus, neocortical birth could be located at the occurrence of the first minimal level of structural organization of neocortex which starts after the 24th week of gestation [19].

**Development of allocortex**

The term allocortex is applied to the part of the brain that consists of a rim of cortical tissue around the hilus of the cerebral hemisphere [12]. There are
two allocortical formations in the mammalian brain: the hippocampal formation and the olfactory cortex. Parts of the surrounding transitional cingulate cortex may have the same origin [12]. Allocortex is the first part of the cortex to initiate differentiation from the 8th week onward and it forms a continuous, almost circular strip on the medial and inferior aspects of the hemisphere before 13th week of development [20-22]. At first, olfactory cortex occupies a large part of the basal aspect of the brain. Later in development, the olfactory cortex becomes restricted to a small part of the basal frontal lobe and the rostromedial part of the temporal lobe [23]. Entorhinal cortex and the cortical nucleus of the amygdala [23, 24] become the prominent structures of the adult olfactory cortex.

**a) Development of hippocampal formation**

Hippocampal formation is a large C-shaped allocortical structure in the medial aspects of the temporal lobe [12]. It begins to develop by 8-week gestation and one of the earliest sulci identified by fetal MRI is the hippocampal sulcus [25]. In the ninth week, the hippocampal primordial can be identified on the medial aspect of the developing cerebral hemisphere [26]. The hippocampal formation of adult type may be recognized at MRI of 13th week of development [26]. Most pyramidal cells are generated by the 13th week [27] and the subsequent period is characterized by an increase in the volume of the hippocampal formation. As most of the pyramidal cells have already formed and are currently undergoing the process of differentiation, the cellular components that increase in number thereafter are mainly of glial origin [26]. Hippocampal connections also develop prior to neocortical pathways, and reciprocal entorhinal-hippocampal projections are among the first cortico-cortical connections to be established in the human brain [28].

**b) Development of amygdala**

Parts of the basolateral-cortical complex of the amygdala are allocortex, and the various basolateral nuclei contain cortical-like neurons aggregated into nuclei of the amygdala [29]. Neurons destined for the amygdala are among the earliest postmitotic cells in the telencephalon [23]. The primordial human amygdala is recognized as a thickening in the ninth week of development. Slightly later, the medial nucleus develops first, followed by the basolateral complex later. All amygdaloid nuclei are present by 13th week [30, 31]. From now on, the macroscopic aspect of the amygdala remains unchanged until birth, whereas major developmental events take place at the level of cell differentiation [23].

**Allocortical birth at 13th week of development**

The most striking feature of the early human fetal brain is the differentiation of allocortical structures (hippocampal formation, entorhinal cortex, amygdala) and the intense expression of functional proteins in these allocortical areas [32]. As seen in the previous section, allocortex reaches its final structure at an earlier stage than the neocortex, and it is already developed at 13th week of development [20-22, 25, 26, 32-34]. From now on, the macroscopic aspect of the allocortex remains unchanged until birth, and its morphology in the early fetal period, neonatal and pediatric periods is quite similar [20, 26]. Thus, three-layered adult laminar pattern of allocortex appears before 13th week [21, 22] and allocortical birth could be located at the occurrence of the first minimal level of structural organization of allocortex at the 13th week of development. The first commissures to develop are also those associated with the allocortex [12]. The anterior commissure connects several structures of the allocortex on the two sides of the brain. The commissures of the neocortex develop later and follow the pathways already established by the commissures of allocortex [12].

Major allocortical structures in adults are hippocampal formation and amygdala. Hippocampal formation plays a key role in memory and emotion. It acts as a comparator of novel and familiar stimuli and in the initiation or inhibition of behavioral strategies as appropriate to the situation. It therefore becomes linked to emotions such as anxiety and to setting appropriate motor responses [29]. Elaboration of hippocampal functions is also associated with the development of self-awareness, consciousness of the self [9], and hippocampus seems to be essential for the preservation of identity [12]. The human amygdala on the other hand is the area of the brain that is best correlated with emotional reactions. The emotional aspect of the response of the individual is passed on to the frontal cortex, where “decisions” are made regarding possible responses. In this way, the response of the individual incorporates the emotional aspect of the situation [12]. Thus, allocortex can be regarded as the seat of emotion, memory and personhood.

We propose here an allocortical birth theory suggesting that an individual human life or personhood cannot begin until the development of the allocortex. Allocortex is reliably present at
about 13th weeks’ gestation, and formation of allocortex would indicate that the second level of life has commenced, and therefore could be taken to herald the beginning of an individual human life. We can say that the informational capacity of the zygote and early embryo is not sufficient to direct the development of anything personal, and is not sufficient to constitute a genetically stable subject as a human being. At the 13th week, fetus has distinctive human characteristics and possesses the primordia of all the internal and external organs and parts. An adult type allocortex also emerges at about 13 weeks’ gestation, and the fetus could be considered an individual human being starting then. Allocortical birth, the emergence of a mature allocortex is therefore proposed as a reasonable time to demarcate the beginning of personhood. Prior to 13 weeks, existence is limited to cells, organs, and organ systems which have the potential for integration into a full human organism. Standardization and widespread acceptance of a definition of "allocortical birth" would potentially clarify many medical and legal questions regarding elective abortion and embryo research. There must be a point during development following fertilization at which it is reasonable to claim that the organism changes from nonperson to person. When does this special point in development occur? Seifert treats the human body as a composite of a biological organism and an intellective soul [35]. If we accept that the soul essentially has the capacity for personhood, it seems that the soul does not begin to exist until there occurs an appropriate seat for the soul or personhood in the fetal brain. This position would seem to require that the immortal soul only be infused into a fetus with sufficient cortical development. We suggest therefore that the soul is added to the already-existing physical body, when the allocortex is formed at 13th week even in a pregnancy occurred by self-fertilization [36]. Prior to this point, there exists a cluster of biological cells which has the potential to develop as one human organism. This alternative is compatible not only with the facts of modern medicine but also with the traditional understanding of ensoulment defended by many theologians who argue that the peculiarly human soul is not incarnated until there is appropriately an organized matter [1].

Conclusion
Above considerations make it appear likely that the allocortex is a primary center for personhood and the fetus cannot be a moral person prior to the development of the allocortex. Therefore lawgivers, philosophers, scientists and whoever related may consider the beginning of individual human life in their decisions and procedures as the 13th week of development. Before this period, embryo must be regarded as a cell cluster which is to be respected but not accorded absolute protection. The allocortical birth theory suggests that an abortion before 13 weeks’ gestation kills potential human life, whereas abortion at a later point terminates actual human life (a person). This theory also says that society should not require funerals such a religious burial until the conception has reached 13 weeks of gestation. The allocortical birth theory further offers a clear choice point for the ethics of embryo research: stem cell research with spare embryos produced during infertility treatment, or embryos formed specifically for research or therapeutic purposes (even by cloning), is ethically acceptable up to the point of allocortical development.

Acknowledgements
I dedicate this work to my daughter Nihal who died of carbonmonoxide poisoning in utero at 8th month of development.

References