

# ORIGINAL ARTICLE

## Evolution of Embryology from Rational Science to Evidence-based Science

### Abstract

The process of embryogenesis has long fascinated scholars, both in ancient Unani medicine and modern science, as it holds the key to the formation and development of life. In Unani medicine, the understanding of embryogenesis is deeply rooted in the philosophy of life, emphasizing the importance of reproduction for species survival. This article delves into the Unani perspective on embryogenesis, highlighting the role of Manī (semen) and the interplay of Arkān (elements) in shaping the development of the embryo.

Unani scholars have expounded on various aspects of embryogenesis, including the formation of essential organs, sex differentiation, and the roles of Quwwat tanasuliyya (reproductive faculty) in Manī production and fertilization. They also described a holistic view of embryonic development, from the formation of the Zubda (zygote) to the differentiation of vital organs, aligning with some principles in modern embryology.



This article explores striking similarities between Unani and modern scientific concepts of embryogenesis, such as gastrulation, umbilical vessels, and sex differentiation. Additionally, it discusses aspects like quickening, lactational amenorrhea, and foetal presentation, where Unani insights align with contemporary medical knowledge. All the relevant literature on Unani medicine has been evaluated, assessed and analysed based on classical texts. Additionally, several papers in this regard were also searched using search engines, namely PubMed, Google Scholar, and ScienceDirect.

The evolution of embryology as a scientific discipline has seen significant transformations, progressing from its early rudimentary stages to a more evidence-driven approach. This shift towards empirical science becomes readily apparent when examining the historical trajectory of embryological development.

**Key words:** Embryogenesis, Fertilization, Sex Differentiation, Fetal Development, Unani Medicine Philosophy

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## Introduction

The importance of reproduction should be understood before discussing the process of embryogenesis. The ability to reproduce is no doubt the most visible trait of life. Humans have a limited lifespan depending upon the availability of *Ruṭūbat gharīziyya* / innate moisture, and *Ḥarārat Gharīziyya* / innate heat transferred from parents to offspring (Itrat, and Haque, 2013, pp. 459-462) Every individual has a definite proportion of *Ruṭūbat Gharīziyya*, which keeps vanishing till the end of life (Ahmad, and Ishtiyaque, 1982, p. 509) The complete diminution of *Ruṭūbat Gharīziyya* results in the falling-off of *Ḥarārat Gharīziyya* which leads to death, known as “*Ṭabī’ī / Ḥaqīqī Maut*”. For the sustenance of life on earth, humans must evolve new ones as it is necessary for the survival of their species. (Kabiruddin, 2021, p. 50)

The study of how an embryo and foetus form and develop is known as embryology. The process of cell division and differentiation during the early stages of development is called embryogenesis.

## Arkān, the Basic Unit of Life

*Mawālīd Thalātha* (Trimatter), i.e. Animals, plants, and minerals make up the entire universe, and these are made up of *Arkān* (*Arḍ* / soil, *Mā’* / water, *Hawā* / air, *Nār* / fire), which is thought to be the fundamental, essential and existential component of everything present in the world. (Kirmani, 1935, p. 13) These *Arkān* make up the human body as well. The organs are made up of different ratios of these components, and each of them performs a unique function. Because of the almost equal inclusion of these *Arkān*, it is thought that human beings are granted the highest status in the universe as a species. Aristotle has highlighted four fundamental causes for the generation of *Mawālīd Thalātha*. Human beings are also formed by these causes viz; material causes out of which human being is made (Female *Manī* / *Baiḍa* and menstrual blood); efficient cause- its maker (Male *Manī*); formal cause- that shapes the material cause (*Mizāj*, *Quwā*) and the final cause-its purpose (Formation of the embryo) (Shah, 2007, p. 45; Belo, 2007, pp. 55-90). (Figure 1)

## Why has Man been Given the Status of *Ashraful Makhlūqāt*?

The answer can be found in the philosophy of Unani medicine, which states that the appropriateness of the *Mizāj* determines the virtues and perfection of any compound. An appropriate *Mizāj* is one in which the proportion of *Arkān Arba ‘a* must be equal. However, having a perfect *Mizāj* is approximately impossible. *Mizāj Insāni* is somewhat close to *Mu’tadil ḥaqīqī*, so man is given the status of *Ashraful Makhlūqāt* (Ahmed, 1980, p. 28)

After the mutual interaction of *Kaifiyāt Arba ‘a* (Four primary qualities) i.e. *Ḥarārat*, *Burūdat*, *Ruṭūbat*, and *Yubūsat* residing within *Arkān*, initially, *Mizāj* is formed followed by *Sūrat naw’iyya*. *Ṭabī’at* and other *Quwā* which are developed later. (Rusd, 1987, p. 37) *Arkān* forms the basic unit of every compound in the universe, including human beings. *Mādda Manwiyya* is also composed of these *Arkān*. There are numerous hypotheses on the origin of *Manī*, its characteristics, and the number of seeds-Sperma in Greek. *Manī* is a vital biological fluid believed to be the primary component of the generation and creation of human beings. (Flemming, 2021, pp. 158-172) Some of the theories about *Manī* are mentioned in Table 1. (Wilberding, 2016, pp. 58-60; Needham, and Hughes, 2015, pp. 31-71; Roe, 2003, pp. 31-35, 43, 44, 91-92, 112-113)





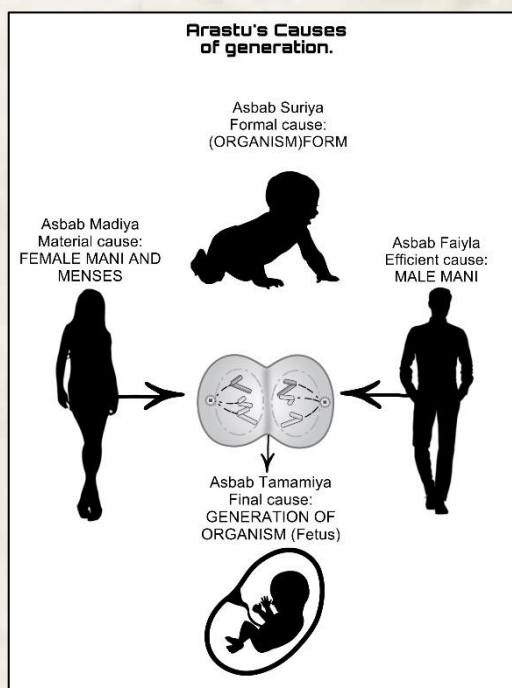


Figure 1. Arastu's concept of four causes.

Table 1: Ancient Theories of Embryogenesis

Number of Seeds Involved	Corporeal Origin of Seed	Manner of Offspring's Physical Presence of Seed
1. One-seed theory (monogenesis)	1. Encephalo-myelogenic theory	1. Preformationism
2. Two-seed theory (duo-genesis)	2. Pangenesis	2. Epigenesis
	3. Haematogenous theory	

### 1- One seed theory

In the book "On the Generation of Animals", Aristotle mentions that only male *Manī* is responsible for foetus formation. Menstrual blood and female *Manī* provide nutrition to the growing foetus (Flemming, 2021).

### 2- Two seed theory

In the book "On the Nature of Child", Hippocrates mentions that male and female *Manī* are needed for embryogenesis. Galen and Herophilus supported this theory and stated that female *Manī* could transform motions to the growing foetus.

### 3- Encephalo-myelogenic theory

Alcmaeon states that *Manī* comes from the brain and bone marrow.

### 4- Pangenesis

Anaxagoras and Democritus state that *Manī* comes from the whole body, especially the *A'dā Mufrada* / simple organs.





### 5- Haematogenous theory

Given by Rabban Tabari, it states that *Manī* is the concocted form of blood.

### 6- Preformation theory

Preformation theory states that there is unfolding and growth of preformed parts i.e., the embryo only increases in size.

### 7- Epigenesis

Aristotle and Galen hold that Embryo development occurs as a progressive and gradual differentiation of an unstructured gamete.

Human embryogenesis revolves around the concept of *Manī*. Ibn-i Qayyim asserted that both male and female *Manī* have generative capacity (Gadelrab, 2011, pp. 40-81). Every component of each parent's body contributes some aspects to the formation of *Manī*; hence it serves as a metaphor for many bodily components. Atibba called *Manī* as *Mutashābiha al Imtizāj*, i.e., it looks analogous, but its components are different. It is the essence of *A'dā Mufrada* of both parents. *Manī* was also an essential tool for sex determination during ancient times. Unani Atibba believed in three principles for sex determination. One principle suggests that maleness and femaleness depend on the body's right and left sides. If male *Manī* from the right testicles after mixing with female *Manī* implants in the right side of the uterus, the foetus will be male and vice versa. Another principle suggested that males were related to hot, dry *Mizāj* of *Manī* and females to cold, wet *Mizāj*. The last principle was that despite both male and female *Manī* present in the zygote, sex would be determined by the one which will be dominant and more assertive during the generation process. (Bradley, Leonard, and Totelin, 2021, p. 145) (Figure 2)

*Manī* is made up of *Arkān*. When the *Manī* of both parents mix, the intermixing of *Arkān* takes place, which gives rise to the formation of a new quality that is different from the parents, and this is the *Mizāj* of that zygote. After *Mizāj*, *Şūrat* is formed, *Ṭabī'at* and other *Quwā* are developed later, which are responsible for the normal functioning of the growing foetus. It is neither the precursor nor itself a *Mizāj*. *Şūrat*, *Ṭabī'at* and *Quwā* are always subjected to *Mizāj*. (Figure 3)

The reproductive faculty of both genders, known as *Quwwat tanāsuliyya*, controls all aspects of *Manī* production, storage, and ejaculation, as well as the processes of fertilization, cleavage, and implantation. This ability is a component of *Quwwat ṭabī'iyya*, which is essential for the survival and reproduction of an individual. (Ahmed, 1980, pp. 185-188) The two faculties, known as *Muwallida* and *Muṣawwira*, are part of the reproductive faculty.

### 8- *Quwwat Muwallida* (Generative Faculty)

*Quwwat Muwallida* is necessary for producing *Manī* in the genital organs of both men and women. It prepares each component of *Manī* in a way that it can develop into a specific organ.





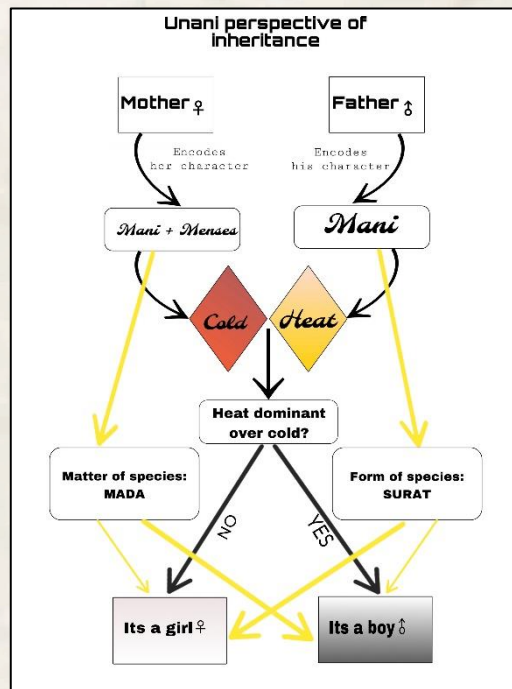


Figure 2. Sex differentiation

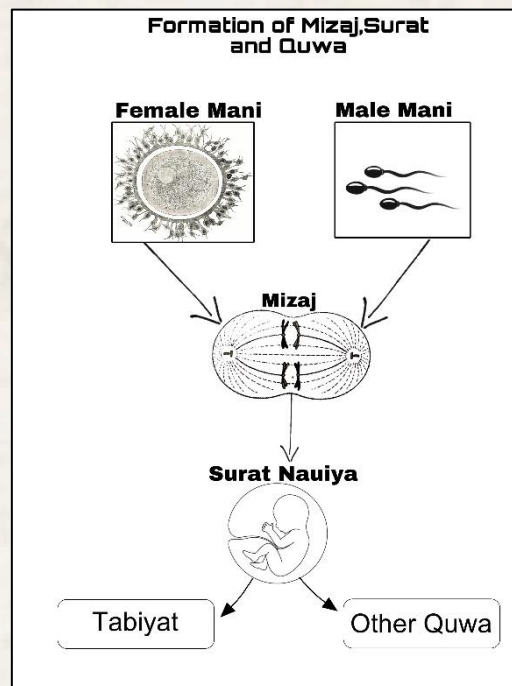


Figure 3. Formation of mizā j, sūrāt and quwā

**9- Quwwat Muşawwira (Formative Faculty)**

*Quwwat Muşawwira* is called imprinting faculty, necessary for the development of organs. It plans how organs will form, including their size, shape, smoothness, roughness, formation of cavities, depressions and proximity of organs with each other. These two



*Quwā* are innate/imbibed in nature.

Based on the holistic perspective of Unani Atibba in the classical literature, the role of these faculties in embryonic development is very painstaking. Additionally, it is possible to strengthen these faculties to prevent some birth defects by taking into account the staggering discoveries that embryology has achieved.

*Harārat Gharīziyya* is the tool of *ṭabī'at* which is endowed in the embryo at the time of conception. It is responsible for the growth and development of the foetus inside the womb (Tipo, Khanam, and Khan, 2019, pp. 31575-31577) All faculties, *Quwwat Haiwaniyya*, *Quwwat Ṭabī'iyya*, *Quwwat Nafsaniyya*, *Quwwat Tanasuliyya*, depend on *Harārat Gharīziyya*, performing all the functions for survival and continuation of life.

### Process of Embryogenesis

A few days after a woman has stopped menstruating is referred to as the fertile window by Unani scholars (Ibn Abbas, 2010, pp. 44-48) There is a probability of conception at such a period if male *Manī* enters the uterus. (Ibn Abbas, 2010, pp. 44-48) A *Nuṭfa* is initially produced when it mixes with the female *Manī*.

For embryogenesis, four powers have been endorsed by Majusi, which are mentioned below:

#### 1- *Quwwat Jāziba*

It attracts male *Manī* into the uterus.

#### 2- *Quwwat Māsika*

It retains the embryo in the uterus and closes the cervical Os till the foetus development is completed.

#### 3- *Quwwat Mughayyira*

It brings about fertilization, Cleavage, and differentiation.

#### 4- *Quwwat Dāfi'a*

It is concerned with the expulsion of the foetus at the time of delivery. (Ahmed, 1980, p. 188)

The process of embryogenesis begins when male and female *Manī* are released into the vaginal tract and the fallopian tube. Due to its *Hārr* nature, the male *Manī* has mobility and moves towards the fallopian tube where it fuses with the female *Manī*.

After the fusion of male and female *Manī*, *Quwwat Māsika* of the uterus gets activated, holding the *Manī* in its place. Then, *Quwwat muṣawwira* and *ḥarārat* act over on it. There is the formation of a bubble-like structure called *Zubda / Hubāb / Fain* as mentioned by the Atibba, which contains all three types of *Rūḥ* in it i.e *Rūḥ haiwāni*, *Rūḥ nafsāni* and *Rūḥ Ṭabī'ī*. *Quwwat muṣawwira* brings the *Rūḥ* towards the places where it acts as a precursor of organ formation. The *Rūḥ* stays there so that the organs form from the respective *Rūḥ*. (Figure 4)





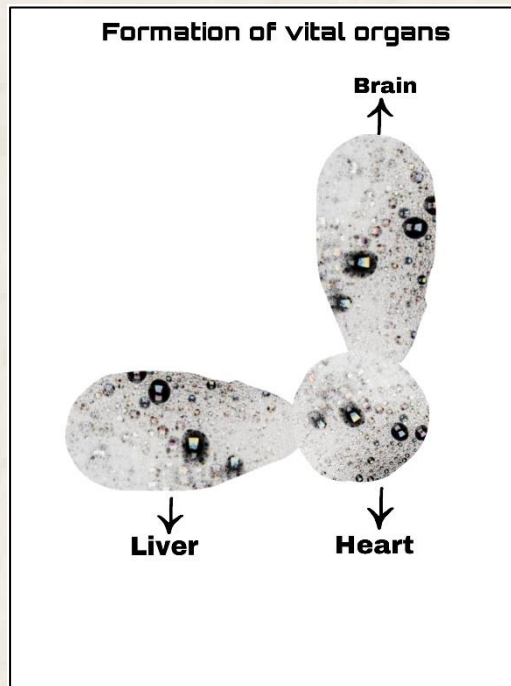


Figure 4. Formation of Vital organs

Two swellings appear from above (Cranial) and to the right (Lateral) of it, creating a cavity in its centre. These swellings get separated after some time. The middle, right and upper parts become the vital organs i.e., the heart, liver, and brain, respectively. (Ibn Abbas, 2010, pp. 44-48; Jurjani, 2010, pp. 602-607; Avicenna, 2010, p. 1060; Hubal, 2005, p. 76) There is the formation of a foetal membrane around this structure. Menstrual blood and *Rūh* from the uterus are directed to this membrane once it has fully developed. Vessels emerge with this membrane, namely *Mashīma*. Two more membranes are developed during this process. The vessels formed on *Mashīma* are combined and formed two veins and two arteries which give rise to the foetus's umbilical cord. Though the structure of vital organs is differentiated before the formation of the umbilical cord, their functions occur only once the umbilicus is formed (Ibn Abbas, 2010, pp. 44-48; Jurjani, 2010, pp. 602-607; Avicenna, 2010, p. 1060; Hubal, 2005, p. 77). During the initial phase of embryonic development, there are two umbilical arteries and two veins which are then combined to form a single artery and a single vein, respectively. These vessels embedded in placental layers supply food and oxygen to the developing foetus (Rabban Ṭabarī, 2002, pp. 42-43)

Different Atibba had different opinions over which organ was formed first. It was Aristotle who claimed that the heart is the first organ that develops initially as it is the organ that supplies *Rūh* and nutrition to other organs, including the liver and brain (Kabiruddin, 2021, pp. 41-43; Hubal, 2005, p. 76) Jalinus and Hippocrates mentioned the liver and brain to be the first developed organs in an embryo, respectively. (Hubal, 2005, p. 76)

The limbs and other organs are formed after the vital organs. The sequence of events in embryogenesis according to the Unani perspective is given below in Figure 5. (Ibn





Abbas, 2010, pp. 156-158; Jurjani, 2010, pp. 602-605; Avicenna, 2010, p. 1060; Hubal, 2005, p. 70)

The Unani system of medicine gives specific names to various phases of embryonic development. *Zubda* is the first stage resulting from the mixing of *Manī* of both parents, which results in the production of a bubble-like shape also known as *Hubāb*. The formation of *'Alqa*, a structure created when all the blood and *Rūh* gushes into the *Zubda*, occurs next. *Muzgha* is the third phase, in which the vital organs are fully differentiated. *Janīn* or the foetus being the last stage is a structure that resembles a human being because all its organs are fully matured and differentiated. The whole process is completed in 35-45 days. The foetus grows in size inside the womb and comes out after the completion of the gestational period (Ibn Abbas, 2010, pp. 156-158; Jurjani, 2010, pp. 602-607; Avicenna, 2010, p. 1060; Hubal, 2005, p. 70; Rabban Ṭabarī, 2002, pp. 42-43)

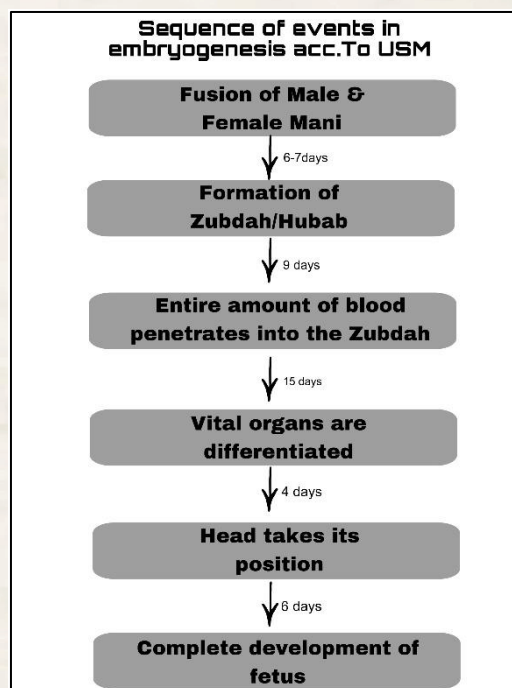


Figure 5. The sequence of events during embryogenesis

### 5- Estimated Time of Baby Delivery

Unani Atibba has linked the time of the delivery of the baby when the foetus gets *Sūrat* and makes its first movement within the womb. As already mentioned, male and female foetus grow at different rates depending upon the *ḥarārat* and *burūdat*, respectively. Their movement and the time of delivery also differ. The estimated time of delivery is mentioned in the Figure 6. (Ibn Abbas, 2010, pp. 156-158; Jurjani, 2010, pp. 602-607; Avicenna, 2010, p. 1060)





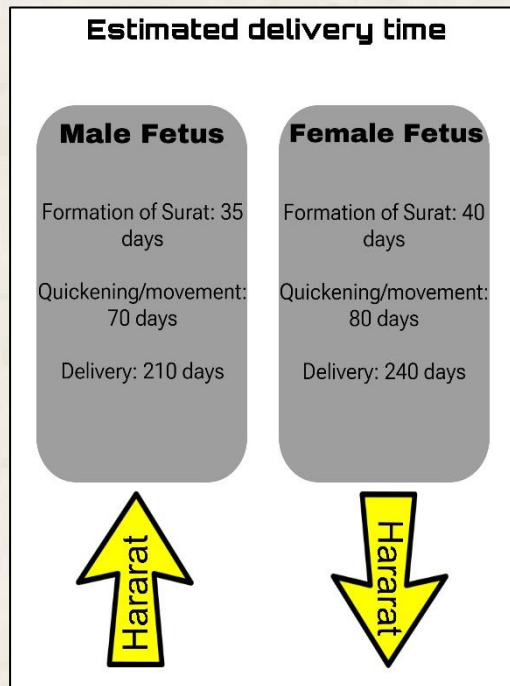


Figure 6. Estimated time of delivery according to USM

### Delivery of Baby

The uterine cavity and placental supply of nutrients from mother to foetus are both insufficient to ensure its survival when it has fully developed. The foetus needs to be expelled from the uterus to start a new beginning. The expulsion of a baby from the womb is supposedly caused by the *Quwwat dāfi'a*. The membranes that surround the foetus rupture once the foetus has fully developed. The fluid spills out and irritates the uterus, which activates the *Quwwat dāfi'a* of the uterus. This in turn stimulates the uterus to contract, resulting in the delivery of the baby (Ibn Abbas, 2010, p. 173; Hubal, 2005, p. 76)

### 1- Similarities with modern medicine

There are some disciplines perceived by Unani scholars that are central to both Unani and modern medicine domains. During the ancient era, philosophy and logic were used to assess the world. It included a wide range of subjects viz; anatomy, mathematics, physics, biology, and embryology as well. Unani Atibba achieved greatly in these domains despite the lack of allied sciences and interpretive tools. They have mentioned, in their books, embryogenesis which resembles that of modern medicine. Some of the similar aspects are briefly mentioned in Table 2, below:





**Table 2:** Comparative analysis between Unani and modern perspective of embryogenesis.

	Modern perspective	Unani perspective
Embryonic folding	When longitudinal and transverse folding takes place, the flat trilaminar embryonic disc is said to undergo folding and become more cylindrical. Both lateral folding and craniocaudal folding are included, which take place concurrently. The brain develops from the craniocaudal end, the digestive system and the respiratory system from lateral folding. (Atkinson, 2013, p. 76; Sadler, 1988, p. 131)	In the Unani system of medicine, a similar concept has been mentioned by the Atibba in their books. When the <i>Manī</i> from both man and woman combine, a structure that resembles a bubble called the <i>Zubda</i> is formed. A lateral or right-sided enlargement and a cranial swelling or upright swelling develop from this structure. These swellings eventually detach and differentiate into specific organs. The cranial part develops into the brain and the right-sided swelling develops into digestive organs including the liver. (Ibn Abbas, 2010, pp. 156-158; Jurjani, 2010, pp. 602-607; Avicenna, 2010, p. 1060)
Gastrulation	During embryonic development, gastrulation is the process that converts an embryo from a blastula, which has a single layer of cells to a gastrula, which has numerous layers of cells. By way of gastrulation, layers are transformed into germ layers or unique tissues that give rise to certain organ systems. The Gut and related organs are derived from the Endoderm, and the skin and Nervous system will develop from the Ectoderm, which is the top layer. The Mesoderm gives rise to connective tissues, muscles and the heart. (Sadler, 1988, p. 131; Ghimire, et al, 2021, p. 100-108; Muhr, Arbot, and Ackerman, 2020; Solnica-Krezel, and Sepich, 2012, pp. 687-717)	This process was discussed thousands of years ago in the Unani system of medicine. They held the opinion that the <i>Nufā / zygote</i> is naturally endowed with all three types of <i>Rūh</i> namely, <i>Rūh Haiwāni</i> , <i>Rūh Nafsāni</i> and <i>Rūh Ṭabīʿī</i> . The organs that are associated with the particular type of <i>Rūh</i> are formed by the transfer of this <i>Rūh</i> to its precursor with the help of <i>Qiwwat Muṣawwira</i> . The Heart and some Respiratory tissues are developed from <i>Rūh Haiwāni</i> . Organs concerned with the digestive system including the liver are produced by <i>Rūh Ṭabīʿī</i> . The brain, spinal cord and nerves collectively known as the nervous system are developed by <i>Rūh nafsāni</i> . (Avicenna, 2010, p. 1060)
Umbilical vessels	There are initially four vessels, two arteries and two veins. The arteries transmit the venous blood from the foetus to the placenta. By the fourth month, only the left umbilical vein which delivers oxygenated blood remains after the right umbilical vein gets atrophied. (Heil, and Bordon, 2023; Burton, and Jauniaux, 2018, p. 373; Konar, 2018, pp. 32-44)	In Unani tib, it is already mentioned in the literature, that initially there are two palpable ( <i>Mutaḥarrrik</i> ) and two non-palpable ( <i>Ghair Mutaḥarrrik</i> ) vessels. After some time, there remains only one vein that they say is red in colour, which goes from the umbilical cord towards the liver. The two arteries emerge from the placenta and go via the umbilical cord towards the heart directly. (Ibn Abbas, 2010, pp. 156-158; Jurjani, 2010, pp. 602-607; Avicenna, 2010, p. 1060; Hubal, 2005, p. 70, 76-77; Rabban Tabarī, 2002, pp. 42-43)
Sex differentiation	The Wolffian duct (mesonephric duct) and Mullerian duct (paramesonephric duct) develop in 25-30 days and 40-48 days of gestation, respectively. If the embryo is Male, the organs start to develop earlier as anti-Mullerian hormone and androgen secreted by the developed testes regress the Mullerian duct. Differentiation of the Wolffian duct follows to form epididymis, vas deferens, seminal vesicles, ejaculatory ducts, etc. (Chiga, et al, 2014, pp. 663-668; Zhao, and Yao, 2019, pp. 602-616; Rubin, and Pfaff, 2010, pp. 133-134)	The male foetus begins to develop before the female foetus, according to Unani Atibba. The foetus's sex is determined by innate heat and <i>Mizāj of manī</i> . The foetus will be Male if <i>Mizāj of Manī</i> is <i>Hārr</i> . Democritus claims that <i>Manī</i> which triumphs over the other is what causes sex differentiation to occur. According to Unani literature, the development of the male embryo takes about 35 days; however, the development of the female embryo takes longer i.e., 40-45 days. Since it is <i>Bārid</i> in comparison to males. Hippocrates observed instances of miscarriages that happened in less than 30 days, they would always be Male. (Ibn Abbas, 2010, pp. 156-158; Jurjani, 2010, pp. 602-607; Avicenna, 2010, p. 1060; Hubal, 2005, p. 70, 76-77; Rabban Tabarī, 2002, pp. 42-43)
Quickening and breast milk formation	Quickening is the term used to describe the initial foetal movements that the mother feels. These movements serve as a sign to the expectant mother that the foetus is developing inside her womb. The 16th -22nd week of pregnancy is when quickening frequently happens.  During the 2nd half of pregnancy, secretory initiation or stage-1 lactogenesis occurs. By week 16 of pregnancy, milk production in the breast takes place. (Neville, Morton, and Umemura, 2001, pp. 35-53)	According to Unani <i>tib</i> , breast milk formation starts in the mother when quickening is initiated in the womb. If the embryo develops in 35 or 40 days, quickening will start in 70 or 80 days, respectively and lactogenesis will occur in the breast simultaneously. It is approximately nearly 16 weeks of pregnancy as mentioned in modern medicine. (Ibn Abbas, 2010, pp. 156-158; Jurjani, 2010, pp. 602-607; Avicenna, 2010, p. 1060)
Closure and dilatation of cervical Os	The cervix plays a crucial role in fertilization, pregnancy, maintenance and parturition. The cervix stays closed throughout the pregnancy despite numerous forces acting against it. This makes it possible for it to serve as a barrier against the ascent of vaginal bacteria and to keep the developing embryo inside the uterus. It relaxes, shortens and dilates during labour to provide room for the baby to pass through it. (Nott, et al, 2016, pp. 1-7)	<i>Ibn Hubal Baghdadi</i> , in his book <i>Mukhtarāt fil tib</i> , has mentioned that the cervical Os becomes narrow during pregnancy and at the time of birth of the baby it dilates. (Ibn Abbas, 2010, pp. 156-158; Jurjani, 2010, pp. 602-607; Avicenna, 2010, p. 1060)





Site of fertilization	Fertilization takes place in the fallopian tube. (Chiga, et al, 2014, pp. 663-668)	The fusion of Male and female <i>Manī</i> takes place in <i>Qarn al Raḥim</i> i.e., fallopian tube. (Ibn Abbas, 2010, pp. 156-158)
Lactational amenorrhoea	During breastfeeding the hypothalamus of the mother is stimulated by the sucking of the nipple. It reduces the secretion of gonadotrophin-releasing hormones (LH, FSH) which are necessary for ovulation and menstruation, resulting in anovulation and amenorrhoea (lactational). (Pillay, and Davis, 2022; Veke-mans, 1997, pp. 105-111; Ferreira, et al, 2015, pp. 660-663)	Majusi has mentioned that <i>khoonn haiz</i> / menstrual blood ceases in some women after childbirth when the female breastfeeds the baby. (Ibn Abbas, 2010, pp. 156-158)
Foetal presentation	The presentation of a foetus means how it's positioned in the uterus. Cephalic presentation is the most common presentation of a baby. Between the 32nd-36th weeks of pregnancy, the foetus settles into this head-down position, facing the back of the mother. (Göttlicher, and Madjaric, 1985, pp. 534-538; Makajeva, and Ashraf, 2021)	Head-down (Cephalic) presentation is mentioned by Unani Atibba as the most common presentation of a baby with the face of the baby facing the back of the mother. It takes place in the eighth month of pregnancy. The baby attains this position in the 8th month of pregnancy according to Unani literature. (Hubal, 2005, p. 76; Razi, 2001, p. 98)
Delivery position	The most used position in normal delivery is lithotomy in which the positioning of the mother's feet is above or at the same level as her hips, lying on her back with support, supine position with knees, hips flexed, and thighs apart. (Gaffka, 2016)	A woman should lie in a supine position, legs separated from each other with flexion of knees. (Razi, 2001, p. 120)
Breast retrogression in abortion	During pregnancy, breast changes take place. These become denser, heavier and increase in size. During the abortion, there is retrogression of these changes. (Konar, 2018, p. 282)	A decrease in the size of the breast is an important sign of abortion mentioned in Unani literature. (Avicenna, 2010, p. 1060 Lucknow, India: 1889; Razi, 2001, p. 75)
Foetal membranes	<p>The foetal membranes surround the foetus during pregnancy. They are amnion, chorion, allantois and yolk sac.</p> <p>Chorion: develops from a rich blood supply and forms an intimate association with maternal endometrium, together forming the placenta.</p> <p>Amnion: contains a thin, transparent fluid providing a cushion against mechanical injuries.</p> <p>Allantois: stores urinary wastes and helps in the exchange of gases in general. It develops from an amniotic membrane. (Konar, 2018, p. 41; Bourne, 1962, p. 193)</p>	<p>Foetal membranes are developed to safeguard the foetus during embryonic development. The names and purposes of some of these membranes are mentioned in Unani medicine dating back thousands of years. They believed that the foetus is suspended in a fluid medium. The foetal membranes are mentioned below:</p> <p><i>Mashīma</i> is a double-layered vascular membrane consisting of blood vessels that feed the foetus. It is a part of the fetoplacental circulatory system. The placenta and chorionic membrane are collectively known as <i>mashīma</i>.</p> <p><i>Sīqa</i> lines the cavity formed by <i>Quwwat muṣawwira</i> which is in direct contact with the growing embryo. This layer is thin and is formed by the female <i>Manī</i> to protect the foetus and contains the fluid in which the foetus suspends.</p> <p><i>Lafāifi</i> is a membrane formed between <i>Mashīma</i> and <i>Sīqa</i>. It is a tube-like part which collects the urine of the foetus. (Ibn Abbas, 2010, p. 158; Jurjani, 2010, p. 603; Avicenna, 2010, p. 1060; Hubal, 2005, p. 75; Rabban Ṭabarī, 2002, p. 42)</p>
Pluripotency of foetal membranes	Extra embryonic tissues have been claimed to contain stem/progenitor cells giving rise to most of the cells in an organism. (Riboldi, and Simon, 2009, pp. 351-355; Miki, et al, 2007, pp. 91-96; Cox, and Ralston, 2022, pp. 661-662)	Hippocrates has mentioned that the foetal membranes are made from <i>Manī</i> which contains pluripotent cells that can form any organs. (Zulkifl, and Khan, 2018, p. 9)
Initiation of thelarche and menarche	Thelarch, the development of breast tissue typically begins before menarche (first menstruation). Thelarch begins between 8-13 years of age, signifying the activation of the hypothalamus-pituitary-gonadal axis, leading to the release of estrogen. (Viner, Allen, and Patton, 2017, p. 1841; Rosenfield, Lipton, and Drum, 2009, pp. 84-88; Breehl, and Caban, 2018; Temesváry, 1903, p. 511-525) Menarche typically takes place 2-3 years following the onset of thelarche, and approximately six months after reaching the peak height velocity (PHV) during the growth spurt.	Aristotle in his work "On the Generation of Animals" delved into the concept of <i>Ishtrāk</i> , wherein he observed that the commencement of menstruation, or catamenia, in females often precedes thelarche i.e., the breast development. According to him, when the breasts of a female have visibly expanded to a point where they were raised to two-fingers breadth, it is indicative of the onset of menstruation. His insight suggests that certain physical changes are early indicators of significant biological events. (Boylan, 1987, pp. 95-97)



<p>Role of seminal vesicle</p>	<p>The seminal vesicles produce a dense and sticky fluid that contains various components, including fructose, a sugar that serves as an energy source for sperm cells. This fluid also contains proteins, enzymes, vitamin C, and prostaglandins. One crucial protein produced by the seminal vesicles is semenogelin, which plays a vital role in creating a gel-like structure around ejaculated sperm, preventing them from undergoing immediate capacitation. (McKay, et al, 2018; Malm, et al, 1996, pp. 48-53)</p>	<p>Khusyatayn or testes are connected to two elongated sac-like structures known as <i>zurūf</i>. These <i>zurūf</i> are referred to as <i>aw'iyya manī</i>, which are the seminal vesicles. Within these, the fluid gets refined and concocted, resulting in a denser and more viscous consistency (<i>Ghalīz</i> and <i>luzaj</i>). (Ibn Abbas, 2010, pp. 155-156)</p>
<p>Function of urethra</p>	<p>The primary function of the urethra is to facilitate the passage of both urine and semen. It acts as a connection between the lower urinary tract, including the bladder, and the external environment, enabling the expulsion of urine from the body. Additionally, the urethra serves as a conduit for the release of ejaculate from the distal parts of the male reproductive system, including the vas deferens, seminal vesicles, and prostate. (Stoddard, and Leslie, 2019)</p>	<p>The urethral orifice, known as "<i>maftūh al-bawl</i>" in Unani terminology, is the opening at the tip of the penis. It is recognized as the common pathway for the flow of both urine (<i>bawl</i>) and "<i>Manī</i>" (semen). The concept emphasizes that these two distinct substances pass through the same channel. (Ibn Abbas, 2010, pp. 155-156; Ansari, 2018, p. 20)</p>
<p>Equal role of both parents in embryo formation</p>	<p>Humans inherit 23 pairs of chromosomes, comprising 22 pairs of autosomes and one pair of sex chromosomes (XX or XY), totalling 46 chromosomes. These pairs consist of one chromosome from each parent, resulting in children inheriting an equal contribution of genetic material from both their mother and father. (Morgan, 1910, pp. 449-496)</p>	<p>Ibn Qayyim asserted that both male and female seeds possess generative power. He argued that the formation of a child results from the combination of equivalent seeds and rejected the notion that the father's sperm alone possesses an active principle. In his view, both male and female seeds have generative potential, with the female seed being considered weaker. When these male and female seeds are mixed, they collectively give rise to a third power that leads to the creation of an embryo. (Gadelrab, 2011, pp. 40-81)</p>
<p>Antepartum haemorrhage</p>	<p>Apart from the immediate risks posed to the mother due to sudden bleeding and the potential need for surgical intervention, APH can also jeopardize the well-being of the fetus. This includes the risk of uteroplacental insufficiency, preterm birth, and even perinatal mortality. (Bhandari, et al, 2014, pp. 44-52)</p>	<p>Majusi argued that antepartum haemorrhage, which is bleeding during pregnancy, can lead to abortion or preterm birth because of the lack of proper nutrition for the fetus. When the fetus does not receive adequate nutrition due to antepartum haemorrhage, <i>Ṭabī'at</i> recognizes this as an imbalance and triggers the natural process of expelling the alive or deceased fetus to restore the mother's health and maintain equilibrium. (Ibn Abbas, 2010, p. 161)</p>

## Discussion

Unani *Tib* has thoroughly appreciated and understood the genesis, nature, and constitution of man. Utilizing just what they already understood, they had to create an understanding of physiology, anatomy, embryology, and other sciences. Although it was more challenging for them to observe how the internal changes occurred, they used logic to understand these aspects. There was no scientific knowledge of embryology before the discovery of the mammalian ovum which was discovered by Karl Earnest. The actual development of the human foetus was only known when ultrasonography was used for uterine scanning in the late 1950s. The invention of microscopy helped biologists to examine the embryo and observe how it goes through various stages of development.

The present article delves into the intricate details of embryogenesis from the perspective of Unani medicine, juxtaposing it with contemporary knowledge in modern medicine. Unani Atibba studied embryology by using samples derived from maternal deaths and abortions. Philosophers believed in vital forces being responsible for the development of the embryo. Before humans had the technologies, the actual emergence of life and the concept of embryogenesis were the trending topics of the then-era. Hippocrates, Aristotle, Galen, Majusi, and Avicenna, the eminent scholars, were the explorers of anatomy, physiology, and embryology. Their work on embryology continues to maintain a special place in scientific-based medicine, as well. Their books have been the greatest miracles and the best source to pursue information about embryology. The books "The Generation of Animals" by Aristotle, "On the Nature of Child" by Hippocrates, "Kamil Sanaa" by





Abbas Majusi, "Alcanon" by Avicenna, and many more have beautifully described the beginning, growth, and sequential developmental stages of intrauterine life. Their detail coincides with recent discoveries despite being among the philosophical phenomena.

In summary, this article presents a rich and well-researched exploration of embryogenesis through the lens of Unani medicine, drawing parallels with modern medical understanding. It highlights the ancient wisdom of Unani scholars and their holistic approach to comprehending the complex process of human development. This interdisciplinary approach fosters a deeper appreciation for the contributions of traditional medical systems to our understanding of human biology and reproduction, offering potential avenues for future research and collaboration between traditional and modern medical practices. After surveying the classical Unani literature, researchers observed that due to a lack of scientific evidence, ultrasonography, and microscopy, the Unani physicians and philosophers could not further evaluate this branch, but their concepts are near to accuracy when compared to evidence-based medicine. There should be further research on this topic so that the concept will be clearer and more validated.

### Conclusion

Understanding Unani medicine's historical perspectives on embryogenesis not only offers a glimpse into ancient medical wisdom but also sheds light on potential avenues for further research and integration with modern science. This interdisciplinary exploration highlights the enduring relevance of embryogenesis as a fundamental biological process and its profound significance in both traditional and contemporary medical contexts.

### Authors' Contribution

Sabba Saltanat collected the data, analyzed them, and draft the article; Wasim Ahmad performed the conception or design of work. Abdul Haseeb Ansari did the critical revision of the article and Arshad Jamal performed the final approval of the version to be published. All authors read and approved the final version of the work.

### Conflict of Interest

None.

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