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Understanding Baomai 胞脉 and Baoluo 胞絡: A

Multidisciplinary Approach

Abstract: Combining traditional Chinese and Western medicine perspectives, we found prenatal neurocognitive development to be influenced by the Bao Mai and Bao Luo channels. We propose that, to help us better understand the mutual interactions between pregnant and fetus, the function of these channels should be expanded to include these mechanisms.

1 Etymological Aspects of Baomai/Baoluo

1.1 Bāo 胞

The Shuowen, the original Han dynasty dictionary by Xu Shen define Bāo (胞) as “Uterus, place inside the mother from which a baby is born. The character is created using Moon/Meat (月肉) for the meaning part and the use of 包/ “package” as phonetic part.”⁵

¹ Jiaxing, China and São Paulo, Brazil.

² Heidelberg, Germany.

³ Rio de Janeiro, Brazil.

⁴ Santa Cruz, USA.

⁵ 《说文解字》胞，婴儿生在其中的娘胎。字形采用“肉（月）”作偏旁，采用“包”作声旁。

The character *bao* 胞 represents a “wrapper” *bao* and is written with the radical for flesh (肉 (月→月) Radical 130 in Kangxi Dictionary 康熙字典). Therefore, *bao* is part of the human body. As for the female body “*bao*” is often translated as “uterus”. But the *bao* may just be a kind of muscular wrapper in the body as *Lingshu*, chapter 63, states⁶:

when [the sour taste] resides in the stomach, the inner of the stomach is harmonized and warm, it flows down to the bladder, the bladder’s *bao* being thin and weak shrinks when accepting the sour taste [...]

(*Lingshu*, chapter 63)⁷

[Figure 1 Here](#)

1.2 Mai 脉 and Luo 絡

“Xue mai 血脈”, “jing 經” and “luo 絡” appeared together in the Han Shu ·Yi Wen Zhi or Treatise on Literature of The History of The Former Han Dynasty 汉书·艺文志,

“Medical classics explore the origins of blood vessels 血脈, jing-luo 經絡, bone marrow, yin-yang, exterior and interior in order to treat various diseases from the root”, where seemingly differentiated blood vessels from Jing Luo.

⁶ Bao here is interpreted as the wrapper around the bladder but the bladder itself may also be seen as a kind of *bao*.

⁷ *Lingshu yishi*. In: Nanjing TCM University (eds.): *Annotated and Translated Edition of the Spiritual Pivot of the Classic of Internal Medicine of the Yellow Emperor*. Shanghai kexue jishu chubanshe: Shanghai, 1997.

Jing Luo 經絡 functions to carry and move qi and blood in the body. Guan Tzu Water and Earth states that “Water is the qi and blood of the earth, running on the earth which is just like qi and blood flowing in the vessels”. Judged from the cognizing order, the flow of qi and blood in man is analogized and inferred from the natural phenomenon of water flow in the rivers under the earth. The extensions from “vessel 脈” to “jing-luo 經絡” and from “blood” to “qi and blood” are also closely related to the application of acupuncture, moxibustion, tuina, qigong, etc, which explore the phenomenon of qi and blood flowing in the body, thus enriching the understanding on the “vessels”.

Seeing that “jing 經” and “luo 絡” are subdivisions of “Mai 脉” or Vessel, i.e. Jing Vessel and Luo Vessel, Jing-Luo system is surely the “Vessel system” – being mainly composed of Jing Vessels and Luo Vessels.

The standardized translation for “经脉” approved by the World Health Organization (WHO) is *meridian*, which implies a two-dimensional grid. Seeing that “Jing Mai 经脉” can carry and move qi and blood and so must be a three-dimensional tube, and that “Channel” – another popular translation in the West, indicating a three-dimensional tube – is a polysemant, whose meaning is not clear and definite, and that “Jing Mai” and “Luo Mai” are further divisions of “Mai or Vessel”, “Vessel” can refer to a three-dimensional tube of the human being and therefore is a strict and proper translation for *jing mai* worth to be popularized in the future (Lan, 2012, p. 214)⁸.

⁸ Lan, F.: *Culture, Philosophy, and Chinese Medicine: Viennese Lectures (Culture and Knowledge)*. Peter Lang Publishing Group, 2012, p. 214. Similar discussions also appear in op. cit. pp. 290, 329–332.

2 Important Actors in the Prenatal Development: Uterus, Bao Mai and Bao Luo, Heart, and Kidneys

Traditional Chinese medicine (TCM) describes all the aspects of female reproduction – the organs, the glands and their secretions, and the psyche – in terms of kidney function, heart function and the uterus. TCM texts say: “the Uterus, the Heart and Kidney form the core of reproductive activity.” The uterus describes the arena where all of this happens⁹. When we use the term uterus in a Chinese medicine context it is a translation of the term Bao Gong (胞宮), which includes all the reproductive organs: uterus, ovaries, fallopian tubes and cervix. Judging by the number of times bao appears as the uterus (13 times in 9 chapters) in *Suwen*, women’s reproductive health formed an important aspect of Han medicine. This is not surprising given the Confucian environment with its family-centered ethics, ancestor worship, and a strong emphasis on healthy offspring (Leo, 2011, p. 126)¹⁰.

Bao, seen as the uterus, pertains to the so-called “extraordinary organs” (qi hang zhifu 奇恒之腑) and chapter 11 of *Suwen* calls it *nizibao* 女子胞. The pathways or

⁹ The process of understanding the importance and roles of the uterus took place around differing opinions and points of view. For a view about the history of this process, see Wu, Y-L.: *Reproducing Women: Medicine, Metaphor, and Childbirth in Late Imperial China*. University of California Press: Berkeley, 2010, pp. 92–97.

¹⁰ Leo, J.: *Sex in the Yellow Emperor’s Basic Questions*. Three Pines Press: Dunedin, 2011, p. 126.

channels, Bao Mai (Uterus vessel 胞脉) and Bao Luo (Uterus channel 胞络), provide the means of communication between heart, uterus and kidneys (Lyttleton, 2013, p. 10)¹¹, with Renmai, Chongmai and Dumai also playing important roles. Wiseman translates the Baoluo as “uterine network vessels” and Baomai as “uterine vessels” (1996, p. 401)¹² and suggests that there are more than one Baoluo or Baomai. In the same sense Unschuld and Tessenow translate Baoluo as the “network vessel of the uterus” and Baomai as “uterus vessel” (2008, p. 20)^{13,14}.

Suwen, in chapter 33, makes these two vessels responsible for a regular menstruation and pregnancy and considers them very sensitive to emotional disturbances. In chapter 47, Su Wen says “[t]he Uterus Channel extends to the Kidneys.”¹⁵ Also, the Uterus is physiologically related to the Heart via a channel called the Uterus Vessel (Bao Mai).

¹¹ Lyttleton, J.: *Treatment of Infertility With Chinese Medicine*. Elsevier Health Sciences: London, 2013, p. 10.

¹² Wiseman, N.: *English-Chinese Chinese-English Dictionary of Chinese Medicine*. Hunan kexue jishu chubanshe: Changsha, 1996, p. 401.

¹³ Unschuld, P./Tessenow, H.: *A Dictionary of the Huang Di Nei Jing Su Wen*. University of California Press: Berkeley, 2008, p. 20.

¹⁴ They offer a literal translation of *mai* and *luo* in order to maintain the difference that is made in the original text. They do not explain the difference between the two vessels or of the meaning of the vessels.

¹⁵ 《素问 奇病论第四十七》 胞络者，系于肾。

Chapter 33 of the Simple Questions says: “When the period does not come it means that the Uterus Vessel is obstructed. The Uterus Vessel pertains to the Heart and extends to the Uterus.”¹⁶

The *Selected Historical Theories of Chinese Medicine* (《中医历代医话选》) says:

The Pericardium (Xin Bao) is a membrane wrapping the Heart on the outside [...] the Uterus connects downwards with the Kidneys and upwards with the Heart where it receives the name of Connecting Channel of the Envelope of the Heart' (Xin Bao Luo) (Maciocia, 2015, p. 168.)¹⁷

In TCM it is said that Kidney jing dominates reproduction. Kidney jing plays a key role in feminine physiology at all stages from puberty to pregnancy to menopause. Aspects of the kidney also influence libido and sexual function (Lyttleton, 2013, p. 9).

We also can see that of the eight extraordinary vessels in Chinese medicine, Ren Mai and Chong Mai are greatly involved in reproduction and fertility. Both vessels originate in the kidneys and flow through the uterus. These two vessels are critical in female reproductive function and exert strong influence on the organs of the abdomen as the vessels pass through them (*ibid.* p. 21).

After the woman has conceived, the uterus vessel has to stay healthy to bring the pregnancy to completion. If it does not function properly, it can play havoc with her health.

¹⁶ 《素问 坪热病论第三十三》月事不来者胞脉闭也，胞脉者属心而络于胞中。

¹⁷ Maciocia, G.: *The Foundations of Chinese Medicine*. Elsevier Health Sciences: London, 2015. p. 168.

While the kidneys and the heart control the processes necessary for female fertility, they are not the only organs or systems involved. The spleen and liver also contribute in less direct ways to aspects of reproduction and fertility. The spleen produces blood through transforming food and nutrients and the liver stores and moves the blood. Therefore, these two organs contribute to nourishing the uterus. The spleen also controls the circulation of blood in the vessels. The liver is responsible for the smooth movement of Qi and therefore plays a critical role in events surrounding ovulation and menstruation. The lungs are less involved in this process but also influence Qi circulation (*ibid.* p. 9).

2.1 Baozhong: The Place of Activity of Baomai and Baoluo

The main pathology of Baomai and Baoluo vessels is disruption *jue* 绝 resulting in an undernourishment of the *baozhong* which, in women, leads to missing menstruation or even sterility and abortion. As there are no anatomical descriptions of these two kinds of vessels, we can only hypothesize that Baomai is (are) nourished by the heart's blood – needed in the whole genital apparatus – and whether the Baoluo takes essence from the kidneys to nourish the *baozhong*^{18,19} (Flaws, 2005, p. 9).

Baozhong is introduced in *Suwen*, chapter 33 as the structure to which the Baomai connects. We can attempt to understand it as the “center of the uterus”, but attention must be drawn to the fact that this area or structure must also exist in the male organism. Rochat de la Vallee states that here the *baozhong* does not exactly represent the uterus,

¹⁸ See also *Lingshu*, chapter 65.

¹⁹ Flaws, B.: *A Compendium of Chinese Medical Menstrual Diseases*. Blue Poppy Press: Boulder, 2005, p. 9.

but, “the center of what is wrapped and protected and thus designates the protection of the origin of life.” (Rochat de la Vallee/Larre, p. 165)²⁰ Indeed a new life does come into existence in the uterus, but also by the action of the female and male gonads.

Both Huang Fumi in his *Zhenjiu jiyijing jiaozhu* 《针灸甲乙经》 and Li Shizhen in his *Bencao gangmu*. 《本草纲目》 (Outline of the materia medica) state that the *Baozhong* is also the origin of Renmai, Dumai and Chongmai and several classics mention the term without strictly defining it.

In other texts, *Baozhong* is associated with several structures like the Mingmen (Riegel, 2010; Unschuld, 1986, p. 320; *ibid.* p. 399; Lingshu, p. 369)^{21,22}, the uterus and the palace of sperm²³ (Lingshu, 393f), the extraordinary vessels (Riegel, 2016)²⁴ and the classic book *Leijing* 《类经》 correlates it with the Lower Dantian.

²⁰ Rochat de la Vallee, E./Larre, C.: *The Extraordinary Fu*. Monkey Press: London, 2003, p. 165.

²¹ Riegel, A.M.: *Die Niere shen. Klassische Konzepte der traditionellen chinesischen Medizin im Lichte der modernen Schulmedizin*. Bacopa: Schiedlberg, 2010.

²² Unschuld, P.U./ Bian, Q.: *Nan-ching the Classic of Difficult Issues*. University of California Press: Berkeley, 1986.

²³ Bao or baozhong does exist in man and woman. In women, the baozhong may refer to the uterus, in man the “palace of sperm” may be interpreted as the testes with the reservoir that is the epididymis. See also *Lingshu*, chapter 65, which deals with the question why women do not have a beard.

²⁴ Riegel, A.M.: “Qijing bamai – The eight extraordinary vessels. A concept of Chinese medicine based on the Yijing”. In: F. Wallner/G. Kluenger Nordhausen (eds.),

2.2 *Bao* and the Palace of *jing*

The palace of *jing* may be seen as the testes and the epididymis, the reservoir for sperm. The same palace of *jing* exists in the female organism as the ovaries, where the female *jing* is stored. Both structures do emerge from the primordial kidney, making the kidney responsible for the gonads. When *Lingshu*, chapter 44, states that Chongmai is the Great *luo* of the Shao Yin channel and originates under the kidney we may assume that this is the primordial kidney and thus the kidney channel is also associated with it.

But all the structures described here do meet at a place which in the female organism becomes the uterus. Seen from both genders this place is only the center of the urogenital system and the center of the “origin of life”. The Baomai has contact with this region but we do not know when Baomai comes into existence. As it is only active in the adult female organism, we may see *baozhong* as this origin of life or the whole of uterus, ovarian tubes, and ovaries. In the male organism we may understand the *baozhong* as the region of the testes including the epididymis, the “palace of *jing*” and the penis, which is needed to bring the fertile sperm to the “entrance” of *bao* in the female.

2.3 Baomai, Baoluo, Renmai and Chongmai, the Vessels Which Are Responsible for Blood

The sexual potentials of man and woman are bound to the kidney and have their origin in the primordial kidney. We also find the origin of the Renmai and Chongmai there. Moreover, these two vessels are responsible for blood, particularly so in the female

Constructive Realism – Philosophy, Science and Medicine (libri nigri 53). Verlag Traugott Bautz, 2016.

organism, where they provide the menstrual blood. That Renmai and Chongmai can be called the “sea of blood” might also be seen in the embryonic development. In the embryonic tissue, we find the AGM – aorta-gonad-mesonephros – region, located close to the urogenital system, generating the gonads and the metanephros. Pietilä and Vainio (2005 p. 805)^{25,26} found that this region produces hematopoietic stem cells and that “[t]he AGM region is the first intra-embryonic area where hematopoietic stem cells (HSCs) capable of colonizing adult bone marrow have been detected” (*ibid.* p. 804). As this area pertains to *baozhong* in the embryo this could be an explanation for the responsibility of the two extravessels for blood.

Suwen, chapter 33, makes clear that the Baomai is (are) necessary to provide blood for the *baozhong*. It assumes that Baomai is active in the female organism but this does not necessarily mean that man doesn't have Baomai. The character *mai* is used for channels and for blood vessels. As blood vessels the Baomai may be interpreted – at least in part – as coming from the aorta, originating in the heart and running downward, and dividing in numerous branches. In the female *baozhong*, Baomai might then be the arteria uterine, the arteria ovarica, and their branches. These are branches of the aorta iliaca anterior, itself a branch of the aorta abdominalis. In the male *baozhong*, Baomai on the other hand might represent the corresponding vessels in the male organs (e.g. the arteria

²⁵ Pietilä I./Vainio, S.: “The embryonic aorta-gonad-mesonephros region as a generator of haematopoietic stem cells”, *Journal Compilation APMIS*, 12(113), pp. 804–812.

²⁶ They can be found there since the eleventh day of pregnancy. (*ibid.* p. 805).

testicularis and the arteria deferentis) which are branches of the aorta iliaca interna, all being – in terms of Chinese medicine – the sun-luo 孙络 of the aorta abdominalis.

2.4 Baomai and Baoluo as a Circuit

In this sense Baomai and Baoluo prescribe a circuit, although Bob Flaws sees quite another circuit, summarized in the following way:

[...] the baomai is the pathway by which heart blood is transported down to the uterus.

Whereas, the bao luo is the pathway by which yin essence is transported to the uterus but also from thence upward via the chong mai/bao mai to the heart and upper body. The uterus is the juncture between the bao mai and bao luo, and, therefore, also between the heart and kidneys or the upper and lower burners.

(Flaws, 2005. p. 10)

First, he sees Baoluo as a plural, the “network vessels distributed over the *bao gong* which supply and fill the *bao gong* with kidney essence” (*ibid.*, p. 9). Therefore, Flaws interprets the character luo as small connecting vessels whereas the *Suwen* commentary by Yang Weijie interprets the character as the “xinbao luo”, an indication that this vessel(s) pertain to the pericardium.

As for Baomai, he associates this vessel with the pericardium and states that it is “the vessel by which the heart sends blood down to the uterus” (*ibid.*, p. 9). In the end he interprets Baomai as a synonym for Chongmai. “Baomai” then is “a term used in theoretical and introductory discussions” (*ibid.*) This metaphor does not hold logically: the Baomai transports blood downward whereas the Chongmai transports Qi and blood upward, and a vessel or channel can only flow in one direction.

3 Prenatal Cognitive Development: Classical Chinese Medicine and Western Medicine Perspectives

3.1 Modern Science Perspectives on Prenatal Cognitive Development

Pregnant women can attest that the fetus responds and even communicates to stimuli. But since “of all the measures available for examining cognition in infants, only Heart Rate is available presently for use in the fetus” (Kisilevsky/Hains, 2010, p. 60–75)²⁷, western science is starved of data. It has been taking steps though, by using, e.g. “exposure learning, classical conditioning and habituation” (Hepper, 1996)²⁸ and “focusing on audition and olfaction/taste, [it] has shown that the fetus is capable of learning and that some reflexive behaviour of the fetus allows simple communicative acts” (Huotilainen, 2004)²⁹. It is easier to assess the newborn, even if the methodologies are not necessary so, and researchers have found that “the neonate even prefers the smells and tastes that

²⁷ Kisilevsky, B.S./Hains, S.M.J.: “Exploring the relationship between fetal heart rate and cognition”. *Infant & Child Development*, 19, 2010, pp. 60–75.

doi:10.1002/icd.655.

²⁸ Hepper, P.G: “Fetal memory: Does it exist? What does it do?”. *Acta Paediatrica Supplement*, 416, 1996, pp. 16–20.

²⁹ Huotilainen, M.: “Foetal learning – a bridge over birth”. Retrieved on April 27, 2017 from

https://www.edu.helsinki.fi/lapsetkertovat/lapset/In_English/Huotilainen.pdf.

he/she was exposed to during pregnancy (Liley, 1972)³⁰ and “prenatal music exposure alters the fetal behavioral state and is carried forward to the newborn period.” (James/Spencer/Stepsis, 2002, pp. 431–438)³¹.

It is interesting to point that auditory, acoustics and cognition remind us about the relation between Kidneys (Ear/hearing) and cognitive development. Fetal Heart Rate and Cognition highlights the relationship between Heart and Mind (Shen 神) in early stages of human life

3.2 Ancient Chinese Perspectives on Prenatal Cognitive Development

Taijiao (Fetal Education)

Taijiao is a series of purposive preparations during gestation that exert direct or indirect influences on physical and psychological aspects of pregnant women for the sake of positive fetal development regarding physiological and mental health. Taijiao inception is recommended as early as the second month of pregnancy. Its benefits comprise better embryonic growth of sensory, neurological, and physical functions, along with infantile development in language learning and psychological well-being, thus indicating an

³⁰ Liley, A.W.: “The foetus as a personality”. *Australian and New Zealand Journal of Psychiatry*, 6, 1972, p. 99.

³¹ James, D.K./Spencer, C.J./Stepsis, B.W.: “Fetal learning: A prospective randomized controlled study”. *Ultrasound in Obstetrics and Gynecology*, 20(5), 2002, pp. 431–438. See also prenatal maternal speech influences newborns’ perception of speech sounds.

extended impact on progression from the fetus and adolescent stages to the whole life span. (Cheng, 2016)³².

The concept of *taijiao* (fetal education) is different from ‘prenatal education’. The current Western notion of prenatal education encompasses ideas of proper nutrition and health for the pregnant woman, and hence the fetus. The concept of *taijiao* also includes the idea that the mind, body, and spirit of the fetus can be molded by the outside world while it is still in the womb.

Later exhortations to avoid frog and rabbit meat were to prevent a colicky baby or one born with a harelip, respectively. Poetry and music, on the other hand, could engender peaceful and intelligent offspring.

(Cheng, *op. cit.*)

Fetal education instructed pregnant women to discipline their emotions, behavior, and environment to nurture the physical and moral development of the impressionable fetus (Richardson, 2015)³³.

To use a more modern metaphor found in a 1915 issue of the *The Ladies’ Journal*: “When taking photographs, if there is a smile, then after developing the image, there is the same smile. If there is anger, then after developing, there is the same anger.” (Lackner and

³² Cheng, F-K.: “Taijiao: A traditional Chinese approach to enhancing fetal growth through maternal physical and mental health”. *Chinese Nursing Research*, 3(2), 2016, pp. 49–53.

³³ Richardson, N.C.: *A Nation in Utero: Pregnancy and Fetal Education in Early Republican China, 1912–1937*. PhD Dissertation, University of California: Davis, 2015.

Vittinghoff, 2004, p. 671)³⁴ These quotes emphasize that the impressionable fetus can be influenced by the signs and sounds experienced by the pregnant woman, as well as the woman's own emotional state during pregnancy – her smiles or anger.

The blocked passage of Baomai and Baoluo during pregnancy may cause disturbance of the education of the fetus, but it is also the psychic situation which determines the success of all the efforts of prenatal education. This is because the heart blood directly influences the fetus via the Baomai vessels. Heart blood stores the shen. In case of blood deficiency, the shen cannot be stored. Disturbances of shen are the result. And disturbances of the shen directly influence the fetus and impairs his development, from the mental and physical point of view.

3.3 Some Fetal Cognitive and Behavioral Effects Due to Exposure to Maternal Psychosocial Experiences

A review by Monk, Spicer and Champagne remarks that recent data suggests children gestated under significant stress, anxiety or depression are more likely to display characteristics considered precursors to psychopathologies, evidence that “fetal exposure to maternal psychosocial experiences contributes to the determination of children's neurodevelopmental trajectories” (Monk et al., 2012)³⁵. That's particularly harmful, they argue, due to the “important role of epigenetic mechanisms in regulating gene activity,

³⁴ Lackner, M./Vittinghoff, N.: *Mapping Meanings. The Field of New Learning in Late Qing China. Sinica Leidensia*, Vol. LXIV. BRILL: 2004, p. 671.

³⁵ Monk, C./Spicer, J./Champagne, F.A.: “Linking prenatal maternal adversity to developmental outcomes in infants: The role of epigenetic pathways”. *Development and Psychopathology*, 24 (04): 2012, pp. 1361–1376.

neurobiology, and behavior and the potential role of environmentally-induced epigenetic variation in linking early life exposures to long-term biobehavioral outcomes” (ibid.).

Cecil Reynolds, expands on that, noting that “in view of the complexity of the cortex and its prolonged development” (Reynolds, 2014)³⁶ it’s unreasonable to blame cortical developmental issues only on genetic defects, for a multitude of other factors, including “psychoactive drugs (e.g., nicotine, antidepressants), toxic substances, or brain trauma, and nutritional or other environmental circumstances (e.g., maternal stress)” (ibid) could play a similarly important role.

On a different direction, a previous study by Jarrett Barnhill reminds us that “the impact of abnormal brain development plays a pivotal role in the lives of many people with intellectual disabilities, [...] influenc[ing] not only brain function but also sensitivity to environmental stress, deficits in adaptive skills, affect regulation, impulse control, and communication skills.”(Barnhill, 2004)³⁷, a sentiment amalgamated by Callander and Travis – founders of Wellness Associates, a resource center for healthcare and well-being practitioners:

[S]cores of studies in recent years have documented the potential for increased risk of lifelong problems for prenatex exposed to excessive maternal stress, anxiety, and depression. [...] Parents – and hence their unborn – do better when living in a calm, addiction-free environment, supported by family and friends.

³⁶ Reynolds, C.: *Handbook of Clinical Child Neuropsychology*. Springer, 2014, p. 29.

³⁷ Barnhill, J.: “Developmental neuropsychiatry: Embryology and psychopathology”.

NADD Bulletin, VII (5), Article 3: 2004.

(Callander/Travis, web)³⁸

3.4 Some Fetal Cognitive and Behavioral Effects due to Exposure of Alcohol and Drugs during Pregnancy

Cognition is the act or process of acquiring knowledge through perception, attention, association, memory, reasoning, judgment, imagination, thought and language. The teratogenic and cognitive development effects caused by antenatal exposure to alcohol, cocaine and cannabis have been investigated worldwide by different researchers that aimed to evaluate if maternal drug use was related to cognitive and behavioral disorders in infants (Huizink/Mulder, 2006)³⁹.

Many researchers have identified that a routine antenatal exposure to any of these chemical substances is responsible for promoting many adverse child behavioral and cognitive outcomes including Attention Deficit Hyperactivity Disorder, increased externalizing behavior and decreased cognitive function (Passeya et al., 2014)⁴⁰.

³⁸ Callander, M.G./Travis, J.W.: “Myth: The fetus’ brain and personality development are independent of their womb experience.” Retrieved on April 27, 2017 from <http://www.thewellspring.com/flex/pregnancy/2388/myth-the-fetus-brain-and-personality-development-are-independent-of-their-womb-experience.cfm>.

³⁹ Huizink, A.C./Mulder, E.J.: “Maternal smoking, drinking or cannabis use during pregnancy and neurobehavioral and cognitive functioning in human offspring”. *Neuroscience & Biobehaviral Review*, 30(1), 2006, pp. 24–41.

⁴⁰ Passeya, M.E./Sanson-Fisher, R.W./D’Este, C.A./Stirlinga, J.M. & Stirlinga, J.M.: “Tobacco, alcohol and cannabis use during pregnancy: Clustering of risks.” *Drug and Alcohol Dependence*, 134, 2014, pp. 44–50.

3.4.1 Prenatal Alcohol Exposure

The negative influence of maternal alcohol intake during pregnancy was previously analyzed and an adverse alcohol effect on cognitive development was not detected in children without Fetal Alcohol Syndrome (FAS) diagnosed. FAS refers to a pattern of anomalies that include craniofacial, central nervous system (CNS), body growth, and various sensory anomalies due to moderate to intense mother alcohol ingestion during pregnancy (Bailey et al., 2004; Bhutta et al., 2002; Kelly et al., 2009; da Silva-Lopes et al., 2016.)^{41,42,43,44}.

⁴¹ Bailey, B.N./Delaney-Black, V./Covington, C.Y./Ager, J./Janisse, J./Hannigan, J.H., et al.: “Prenatal exposure to binge drinking and cognitive and behavioural outcomes at age 7 years.” *American Journal of Obstetrics and Gynecology*, 191, 2004, pp. 1037–1043.

⁴² Bhutta, A.T./Cleves, M.A./Casey, P.H./Cradock, M.M./Anand, K.J.S.: “Cognitive and behavioural outcomes of school-aged children who were born preterm: A meta-analysis.” *JAMA*, 288, 2002, pp. 728–737.

⁴³ Kelly, Y./Sacker, A./Gray, R./Kelly, J./Wolke, D./Quigley, M.A.: “Light drinking in pregnancy, a risk for behavioural problems and cognitive deficits at 3 years of age?” *International Journal of Epidemiology*, 38, 2009, pp. 129–140.

⁴⁴ da Silva-Lopes, L./Amelio, P.A./Ferraz, P.R./Silva, S.M.G./Rodrigues, M.R./Ferreira Medeiros, M.: “Sistematiza ção De Cuidados De Enfermagem Para Gestantes Usu árias De Crack Baseada Em Estudo Bibliogr áfico”. *Revista Eletrônica Est ácio Saúde*, 5, 2016, pp. 123–137.

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Michael Church and James Kaltenbach, classify the hearing disorders associated with FAS into four types: “developmentally delayed auditory function, sensorineural hearing loss, intermittent conductive hearing loss owing to recurrent serous otitis media, and central hearing loss” (Church/Kaltenbach, 1997)⁴⁵ and that, improvements to the children functional levels are possible with “early identification and intervention to treat hearing, language, and speech problems.” (ibid).

Martin and Dombrowsky’s review examines studies that collectively show negative effects on higher-level cognitive functioning, including “cognitive flexibility, response inhibition, and planning and concept formation/reasoning” (Martin/Dombrowsky, 2008, p. 156)⁴⁶, impairment of “memory, recall and recognition of verbal information, memory for stories or designs, and spatial memory” (loc. cit.). They also remark that “[a]ttention deficits and hyperactive behavior are considered a hallmark of prenatal alcohol exposure and may be as sensitive an indicator of prenatal alcohol (and dose dependent) exposure as physical features” (ibid. p. 157).

3.4.2 Prenatal Marijuana Exposure

The Martin and Dombrowsky book also indicate that marijuana exposure during pregnancy may also have deleterious effects, and that it “has been associated with increased tremors, exaggerated and prolonged startle response, visuospatial reasoning

⁴⁵ Church, M.W./Abel, E.L.: “Fetal alcohol syndrome. Hearing, speech, language, and vestibular disorders”. *Obstetrics & Gynecology Clinics of North America*, 25(1), 1998 (March), pp. 85–97.

⁴⁶ Martin, R.P./Dombrowski, S.C.: *Prenatal Exposures/Psychological and Educational Consequences for Children*. Springer: New York, 2008.

capacity, short term memory, sustained attention and attentional deficits, altered sleep patterns and reduced habituation to visual stimuli.” (ibid., p. 156)

3.4.3 Prenatal Crack Cocaine Exposure

Ross points out that the “vast majority of drugs of abuse do cross the placenta and, then it can directly act on its molecular target in the fetus” (Ross et al., 2015)⁴⁷ and, unsurprisingly, cocaine exposure also leads to “language deficits, behavior defects, and executive functioning abnormalities. [...] [and also] abnormalities related to lower arousal, poorer quality of movement and self-regulation, higher excitability, jitteriness, and more non-optimal reflexes”. A previous work by Hurt found problems in “language, attention and perceptual reasoning skills” (Hurt et al., 2009)⁴⁸ and another by Singer reported that “cocaine-exposed children had significant cognitive deficits and a doubling of the rate of developmental delay during the first 2 years of life [...] it is possible that these children will continue to have learning difficulties at school age.” (Singer et al.,

⁴⁷ Ross, E.J. et al.: “Developmental consequences of fetal exposure to drugs: What we know and what we still must learn.” *Neuropsychopharmacology*, 40(1), 2015, pp. 61–87. Accessed on 23 April 2017.

⁴⁸ Hurt, H./Betancourt, L.M./Malmud, E.K./Shera, D.M./Giannetta, J.M./Brodsky, N.L./Farah, M.J.: “Children with and without gestational cocaine exposure: a neurocognitive systems analysis”. *Neurotoxicology and Teratology*, 31(6), 2009 Nov–Dec, pp. 334–341. doi: 10.1016/j.ntt.2009.08.002. Epub 2009 (August 15).

2010)⁴⁹ This more worrisome conclusion is reflected also in Ross' work: "behavioral outcomes observed at birth due to the cocaine exposure continue and sometimes worsen after 12 months of age" (Ross, 2015). These children display behaviors that can be "associated with less sociability, more withdrawn behavioral problems, more anxious/depressed behaviors and symptoms" (ibid.), all commonly considered to be "precursors of later psychiatric problems" (ibid), e.g. "disruptive behaviors including aggression and delinquent behavior at 9 years of age" (ibid) where reported in literature.

Trying to elicit causes, Lamy argues that some of these problems might result from misdiagnosed withdrawal syndrome then echoes the already listed consequences and adds "attention deficit disorders with impulsivity or with hyperactivity (ADHD), and memory disorders" (Lamy *et al.*, 2015)⁵⁰ to the list, reinforcing that "the prevalence of depressive or anxiety disorders may also be increased in these children." (ibid.), and Martin and Dombrowsky state that, "[conceptually] cocaine's effect on the monoaminergic system [...] was thought to presage later difficulties with attention, aggression, impulsivity and mood lability." (Martin/Dombrowsky, p. 169).

⁴⁹ Singer, L.T./Arendt, R./Minnes, S./Farkas, K./Salvator, A./Kirchner, H.L./Kliegman, R.: "Cognitive and motor outcomes of cocaine-exposed infants". *JAMA*, 287(15): 2002, pp. 1952–1960.

⁵⁰ Lamy, S./Laqueille, X./Thibaut, F.: "Consequences of tobacco, cocaine and cannabis consumption during pregnancy on the pregnancy itself, on the newborn and on child development: A review." Retrieved on October 9, 2017 from <https://www.ncbi.nlm.nih.gov/pubmed/25439854>, translated from: *Encephale*. 2015 Jun; 41 Suppl 1:S13–S20. doi: 10.1016/j.encep.2014.08.012.

3.5 The Chinese Medicine Perspective

Chinese medicine describes a central role of the Heart when it is dealing with emotional imbalance. The Heart is said to be the house of the spirit and when it is damaged there can be many psychological manifestations – some of them deep in the subconscious, some of them manifesting in high levels of anxiety and a number of other clinical symptoms. The Heart also has a direct link to the uterus and in fact is of key importance in controlling the ‘opening and closing’ of the uterus. Disturbed Heart Qi during pregnancy can lead to inappropriate opening of the uterus and miscarriage.

Treatment to prevent miscarriage should always be mindful of the heart and be settling or calming to the mind. Addressing the heart Qi is recognized as a very important part of TCM infertility treatment. (Lyttleton *op. cit.*, p. 311)

A basic therapeutic principle of pregnancy diseases is to “calm the fetus” (prevent miscarriage) while treating the disease. If the mother’s disease causes the fetus to be restless, the emphasis is on treating the mother’s disease, the dispelling of which will allow the fetus to calm itself. If the mother’s disease is secondary and caused by the threat of miscarriage, measures should be taken to calm the fetus. When the fetus is calm, the mother’s disease will be cured automatically. Calming the fetus is done by reinforcing the kidney, strengthening the spleen and soothing the liver in order to reinforce the foundation of the fetus, boost the source of blood and regulate qi movement. (Zhaoling 2015, pp. 366–367)⁵¹.

As we can see, TCM describes the importance of communication between the heart and the uterus via the Bao vessel. After experiencing shock or great stress, the heart

⁵¹ Zhaoling, Y.: *Gynecology in Chinese Medicine*. PMPH-USA, 2015, pp. 366–367.

and kidney can be practically traumatized. This often leads to heart heat, which causes Heart *qi* to stagnate and, if the uterus opens suddenly, can cause a miscarriage or intermenstrual bleeding (Hemm, 2017)⁵².

Alcohol or drug abuse, if extreme, can create such toxic conditions for the fetus that it cannot survive. Or they damage the mother's health sufficiently that her body is unable to sustain the pregnancy. In TCM such agents are usually said to create internal Heat, which at a certain level damages the endometrium and, as we discussed above, increases the risk of miscarriage due to disharmony in the Heart–Uterus connection via the Bao vessel (affected by toxic or internal Heat) (Lyttleton *op. cit.*, p. 278).

Sudden upset, shock, emotional trauma or more chronic agitation or anxiety are often symptoms of Heart Qi stagnation. The patient may complain of palpitations, insomnia, and diagnosed psychosis. The treatment principle in this pathology would be to calm the shen and circulate the Heart Qi (*ibid.*, p. 285).

If the Heat affects the Heart, then there is a high risk of miscarriage because the Heart–Uterus connection via the Bao vessel can be disturbed. TCM theory posits that the Heart Qi has much to do with ‘opening’ of the Uterus and, when its Qi is disturbed (for example by Liver-Fire), the disruption in the Bao vessel may precipitate an untimely opening of the Uterus. For this reason, the cautious doctor is ever mindful of the Heart and Kidney relationship in early pregnancy. What this means is that the mental and

⁵² Hemm, D.: “Physiology and pathology of fertility and reproduction from the TCM perspective”, *Musculoskeletal Key*, last modified 2017, retrieved on April 27, 2017, <http://musculoskeletalkey.com/physiology-and-pathology-of-fertility-and-reproduction-from-the-tcm-perspective/>.

emotional state of the newly pregnant woman can influence the pregnancy and a skillful doctor will take measures to safeguard the fetus by using acupuncture or herbs to calm the woman's mind if she is excessively anxious or agitated (ibid.).

Women, are cautioned to control their emotions, especially during pregnancy. Suwen's explains, in chapter 44, how emotions such as sadness can disharmonize the flow of Qi⁵³, thus affecting the uterus. According to Suwen, this can manifest itself clinically as bloody urine, but it also follows that internal agitation of Yang will adversely affect fetal health, possibly leading to an abortion:⁵⁴

When sadness and grief are excessive, then the network [vessels] of the uterus rupture.

When the network [vessels] of the uterus rupture, then the yang qi is agitated internally.

⁵³ Suwen in Chapter 39 《举痛论》 explains how the sorrow produces disharmony in

the Qi flow: "When one is sad, then the heart connection is tense. The lobes of the lung spread open and rise and the upper burner is impassable. The camp [qi] and the guard [qi] do not disperse. Heat qi is in the center. Hence, the qi dissipates.

(悲则心系急，肺布叶举，而上焦不通，荣卫不散，热气在中，故气消矣).

⁵⁴ The text mentions bloody urine but illustrates what could happen to other Lower

Burner organs – as the uterus. For a pregnant woman, this could cause vaginal bleeding that might indicate high abortion risk (or an actual abortion). We find

similar passages in another text as T à sù by Y áng sh àngsh àn 《太素 五脏凄》

卷二十五，杨上善注 e Zhòng guǎng bǔ zhù huángdì nèijīng sù wèn by Wáng

bīng 《重广补注黄帝内经素问 痞论》卷十二，王冰注.

When it is effused, then a collapse occurs below the heart. [Patients] frequently pass urine with blood⁵⁵.

Yang Shangshan in Chapter 44 of Taisu. adds: “When there is excessive sorrow, the collateral network vessel of the uterus is severed. When this is the case, yang qi cannot move internally”⁵⁶ (Leo 2011, pp. 126–127).

3.6 Pathologies of Baomai and Baoluo

The *Suwen* lists some pathologies of the two vessels Baomai and Baoluo which are based on disruption, i.e. an impaired flow of Qi and blood due either to mental disturbances or mechanical obstruction⁵⁷.

In Western medicine, it is a well-known phenomenon that a long-term grief, sorrow and mental pressure result in menstrual disorders, either in mid-cycle bleedings or in amenorrhea. If this severe impairment of *shen*, i.e. the psyche occurs during pregnancy this might be a reason for abortion. Chinese medicine explains this by undernourishment of the *bao* by stagnation of Heart Qi in the upper part of the body, in Western medicine the mechanism is not clear.

⁵⁵ 痿论》悲哀太甚，则胞络绝，胞络绝则阳气内动；发则心下崩，数溲血也

⁵⁶ Also in Taisu: 《太素 五脏痿》卷二十五，杨上善注[悲哀大甚胞络绝，绝则阳气

内动，发则心下崩，数溲血。]胞络者，心上胞络之脉。心悲哀太甚，则令

心上胞络脉绝，手少阳气内动有伤，心下崩损，血循手少阳脉下，尿血，致

令脉虚为脉痹，传为脉痿。

⁵⁷ Suwen, chapters 33 and 44.

The other pathology that concerns pregnancy is the syndrome which we may identify as the compression syndrome of the caval vein⁵⁸. The Suwen Chapter 47 states:

When a woman is pregnant and in the ninth month she loses speech what is the reason for this? Qibo said: <This is because the *luo* and *mai* of the *bao* are disrupted.> Huangdi: <What does this mean?> Qibo: <the *Baoluo* is bound to the kidney; the *shaoyin* channel pertains to the kidney and is bound to the tongue, therefor she cannot speak. (Yang 1990, p. 356)

In late pregnancy the unborn fetus becomes heavy and presses not only on the vessels and channels, i.e. on *Baomai* and *Baoluo* but also on the kidney channel. The *Qi* of the kidney channel cannot rise upward to nourish the tongue.

This passage shows the close affiliation between the two *shaoyin* channels of heart and kidney. Both channels do have contact to the root of the tongue. The pressure on *Baomai*, *Baoluo* and *shaoyin* channels in this case might be interpreted as a compression of the caval vein during late pregnancy (see above) which goes along with temporary loss of consciousness, dyspnea and hypotonus; or on the other hand a precursor of a preeclampsia which goes along with hypertension edema and proteinuria (EPH). These symptoms all make visible the stagnation of *Qi* in the heart and kidney channels and a disruption of the flow of *Qi* between the upper and the lower part.

3.6 The Significance of *Baomai* and *Baoluo* for Treatment

Baomai and *Baoluo* are two different kinds of vessels. On the one hand we may interpret *Baomai* as arteries, branches of the aorta abdominalis which provide blood to the uterus and the ovarian tubes or in man to the gonads (testes) and the penis. The *Baoluo* in this

⁵⁸ Y. Weijie (1990) p. 356.

context may be interpreted as the caval vein. On the other hand, both vessels are close to the channels of heart and pericardium, the Baomai being close to the heart channel, the Baoluo to the channel of pericardium on the one hand and to the kidney channel on the other hand. According to the statement of *Suwen* (47) the Baoluo seems to be a branch of the kidney channel or at least to have a direct contact to this channel.

The statements of the *Suwen* (33) and (44) make clear that one could observe the influence of the psyche on the menstrual behavior and in a broader scope of pregnancy. The descriptions based on the theory of the channels attribute the impairment of the menstrual cycle or abortion to a lack of heart blood in the uterus. This becomes plausible when one attributes the production or the circulation of gonadotropines and gonadal hormones to the circulation of blood *xue*. And one might imagine that sterility, infertility and abortion may be due to undernourishment of the endometrium with blood. But there is also the *shen* aspect which may be impaired by the disruption of Baomai or Baoluo. Impairment of the *shen* may also result in menstrual disorders, sterility and even abortion or delayed development of the fetus.

The preeclampsia, which may be described in *Suwen* (44), really goes along with alterations in the mother's blood along with hypertension, which may be understood, in Chinese medicine as a disharmony between heart and kidney – or Baomai/Baoluo and kidney – or as a stagnation of the heart-Qi and -blood in the upper part. Hypotony in the late pregnancy is said to be due to a blockage of both, Baomai and Baoluo. And in particular the Baoluo – interpreted as the vessels leading to the caval vein – may be seen as responsible for the lack of blood in the upper part which makes hypotension, vertigo and dyspnea.

Therefore, we see that Baomai and Baoluo were mixed concepts of anatomy and channel theory that particularly served to explain certain pathologies in menstrual behavior and pregnancy. As for the male organism, the two vessels and their pathologies were no subject of discussion. However, we might imagine that erectile dysfunction due to nervousness and stress might have its source in undernourishment of the male genitals due to the disruption of Baomai or Baoluo. So in this case instead of only soothing the liver one has to calm the spirit, clear the heat of the heart and activate the blood circulation downward. In acupuncture, there are several points on the Shaoyin- and Jueyin-channels that are useful: Pc 6, Pc 7, H 7, Ren 14, Ren 17, Liv 3, Ki 3 and Yingtang. The points Pc 6, Pc 7, H 7 and Yingtang are also apt for pregnancy.

4 Conclusions

The concept of Baomai and Baoluo is discussed in different ways.

There are experts who see a connection between Baomai and Baoluo and the vessels of Renmai and Chongmai. An argument for this idea is the fact that in the specialized literature following the *Huangdi neijing* there is a little mention of the two vessels and problems of menstruation and pregnancy are mainly discussed in relation to Renmai and Chongmai. It seems nevertheless more plausible that Baomai and Baoluo be different from Renmai and Chongmai. The two vessels are described as nourishing vessels, especially for the genitals that means their scope of activity is rather restricted. Moreover, there is no question about their origin in the *baozhong*.

The concept of Baomai and Baoluo may have its source partly in anatomic findings and it seems to be a mixed concept between anatomy and channel theory. As part of the channels they may be understood as branches of the heart channel and the

pericardium channel, respectively. The characters of *mai* and *bao* in their names may also be a hint to the location of the vessels: the Baomai might nourish the deeper layers of the corresponding tissues, and the *luo* might nourish the superficial layers of the tissues, as it is the case for the rest of the channels and luo vessels. As anatomically visible vessels they may represent the small arteries and veins which are branches of the aorta abdominalis (Baomai) and the caval vein (Baoluo).

Baomai and Baoluo can also be placed as possibly important actors for pre-natal psycho/neurocognitive processes. As a relatively new field of study for Western medicine, Chinese Medicine's views about the physiology of the channels and organs involved in a pregnancy can provide enriching insights and Strangifications (Greiner/Wallner/Gostentschnig, 2006) for further research and discussions.

During pregnancy, Bao Mai and Bao Luo are responsible for the flow of Qi, Blood and Essence (Jing) in the uterus, nourishing and supporting the development of the fetus. We can understand this dynamics as a bi-directional information flow between pregnant and fetus. The fetus exhibits cognitive capacities since early gestation stages and various factors (stress, substance abuse, and environment) can affect its development.

As shown above, heart and kidneys play key roles on processes involved in fertility and gestation. We have also shown that heart and kidneys are involved on the pre-natal psycho/neurological development, as one of heart's function is to house the Mind/Shen, and the kidneys are also linked to the brain and related with the development of the nervous system (Maciocia op. cit., pp. 156–157).

For these reasons, we can't neglect the importance of the Bao Mai and Bao Luo channels when studying pre-natal psycho/neurocognitive processes, for it's through these

channels that heart and kidney communicate with the uterus, and when analyzing the citations to the Bao Mai and Bao Luo channels in ancient texts we can ascribe to them a central role on the interaction dynamics between environment, pregnant and fetus.

Heart and kidneys use the Bao Mai and Bao Luo channels not only to support the physical development of the fetus, but also serve as information exchange pathways between pregnant and the fetus⁵⁹.

During pregnancy, Bao Mai and Bao Luo are responsible for the flow of Qi, blood and essence (Jing) in the uterus, nourishing and supporting the development of the fetus.

Current research shows that the fetus, since its first weeks, already develops cognitive capacities essential to further post-natal developments and that those capabilities can be harmed by the pregnant exposure to stress, malnutrition, abuse of toxic substances, polluted environment, and others. The ancient Chinese belief is that the fetus was highly impressionable by outside forces which aligns with modern observations of the development of cognitive abilities in the fetus from external stimuli.

The ancient Chinese believed that pregnant and fetus exchanged information, and prescribed that the gestation happened in a harmonically balanced environment, stress-free, with the pregnant following a strict diet and avoiding exposure to factors detrimental to fetal development.

What astonishes is the fact that the concept of Bao Mai and Bao Luo seems to have fallen into oblivion during Chinese medical history. But it can explain several phenomena which we know in Western medicine and its understanding opens new ways

⁵⁹ Here we consider “information” to be all stimuli (e.g. sounds, hormonal changes) that can be directly (or indirectly) physiologically sensed by pregnant and fetus.

in diagnosis and treatment of menstrual disorders, sterility, infertility, the female psyche, and the erectile dysfunction and impotence of man.

We propose to extend the Bao Mai/Bao Luo functions to include their possible connection to the dynamics of pre-natal psycho/neurocognitive development in addition to their already known roles on ovulation, menstruation and fertility. By doing this we are not trying to diminish or ignore the importance of other channels as Dumai, Ren Mai and Chong Mai⁶⁰ (or all the 5 Zang organs⁶¹ for fetal development but, instead we believe that this could help understand how, and through which specific pathways, the mutual interactions between pregnant and fetus happen on processes related to neurocognition. Further reflections and a deeper understanding of the role of heart and kidneys on the pregnant–fetus relationship might allow a reframing of ancient practices as the Taijiao, removing them from mere folk beliefs or traditional culture, positioning fetal education as a practice with support on fundamental Chinese medicine theories, and opening a dialog with modern scientific observations.

A deeper understanding will also foster the development of preventive and follow-up strategies, focused on the pre-natal psycho/neurocognitive processes, with the

⁶⁰ Late imperial authors stated that the womb vessels were in fact the thoroughfare and controller vessels, two circulation tracts that had a special relationship with the womb. See Y-L. Wu *op. cit.*, p. 91.

⁶¹ See Theoretical Research of Five Organs Regulating the Female Reproduction in Traditional Chinese Medicine 中医五脏调控女性生殖的理论研究 《河北医科大学》 2015 年班光国.

aim to enrich the gestation process since the first weeks for better fetal cognitive development. It also allows for new reasoning to support initiatives that advocate for the gestation to happen in a tranquil environment, facilitating lifestyle changes for all those involved. We have shown that both Chinese tradition and modern science agree that while pregnant and fetus are the main actors, the whole family (father, family relations and friends) and multiple societal aspects can also have persistent, long-term influences (positively or adversely) on how the children – and future adult – will perceive and relate to the world.

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Fig. 1: Bāo 胞 in Seal Script 篆書 (zhuànshū). From meat 月肉 and phonetic 包.

Meaning womb. 包 is also related to womb ("Etymology", [Chineseetymology.Org](http://www.chineseetymology.org))⁶².

⁶² "Etymology." Retrieved on April 2, 2017 from <http://www.chineseetymology.org>.