

Review

Liver in the Chinese and Western Medicine

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Keywords

Brain · Emotion · High blood pressure · Liver · Digestive system · Circulatory system · Reproductive system · Traditional Chinese medicine

Abstract

Background: The traditional Chinese medicine (TCM) is based on the 5-element theory, which emphasizes the importance of the dynamic balance among the liver, heart, spleen, lung, and kidney. It is quite confusing that the 5 viscera in TCM share the same names with the organs in Western medicine. Spleen is the only viscus that differs most from the modern concept, while the remaining 4 viscera can all find similarities with the corresponding organs in Western medicine; however, the viscus in TCM is always a broader concept. **Key Messages:** The 5 major functions of the liver in TCM correspond to the nerve-endocrine-immune network in Western medicine, and all of the functions are associated with emotion.

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Introduction

As a member of the 5 viscera in traditional Chinese medicine (TCM), the liver is not the organ in anatomy, but an abstract concept and a dynamic function system based on the anatomical liver. It is connected to the eyes, tendons and bones, and internal organs via meridians, with unique physiological functions and pathological manifestations, and simultaneously interacts with other Zang-Fu organs. However, the liver in the Western medicine only refers to the organ in anatomy, not containing the functions of the remaining systems and organs. We can see that the liver in TCM is more extensive and complicated compared to the

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one in Western medicine. However, during the recent years, more and more studies have proven that the 2 concepts have something in common [1–3].

The aim of this article is to analyze the similarities and differences between the “liver” in the TCM and Western medical systems as a help for future research.

Anatomy of the Liver

Western Medicine

In human beings, the liver is located in the upper right quadrant of the abdomen, below the diaphragm, in front of the gallbladder and the right kidney, and beyond the stomach. It weighs 1.23–1.45 kg in male adults and 1.10–1.30 kg in female adults. It is proven that the size of the liver approaches the maximum in adolescents, but then shrinks while aging, decreasing 100 g every 10 years after the age of 60 years [4].

Traditional Chinese Medicine

Ling Shu (spiritual pivot, Qin-Han dynasties, B.C. 221 to A.D. 220) says that the liver is located in the hypochondriac region, below the diaphragm, in front of the right kidney and the spine. This description generally conforms to that in the Western medicine. According to Nan Jing (classic of difficult issues, Han dynasty, B.C. 202 to A.D. 220), the liver weighs about 1.084 kg, also similar to the theory of the Western medicine. TCM also conducted a preliminary observation on the change of the liver with aging. Ling Shu reports that usually at the age of 50, the liver qi starts to decline, the lobes of the liver become thinner, the secretion of the bile also decreases, and the vision gets blurred. This point of view is very much close to that of the modern medicine.

The above references indicate that the liver in TCM has a clear morphological foundation, generally consistent with the modern anatomy. That is to say, the actual organ is part of the concept of the liver in TCM and is also the material foundation of the common parts between the Chinese and Western medicine with regard to the liver.

Nevertheless, different recognition methods of the Chinese and Western medicine lead to different views of the human body and diseases, physiology and pathology. The liver in TCM, however, is not limited to the anatomical concept. It is a comprehensive system that consists of various factors including anatomy, logical reasoning, and philosophy, and involving multiple systems and organs; i.e., TCM uses a much broader definition of the liver compared to the Western medicine [2].

Functions of the Liver

According to the Western medicine, with its numerous functions, the liver plays an important role in digestion, metabolism, detoxification, coagulation, and immune modulation.

In TCM, the function of the liver is connected to that of other internal organs, mainly covering the subsequent 5 aspects mentioned in what follows.

The liver is in charge of dispersion and dredging; it is mainly responsible for the regulation of emotion, the promotion of digestion and absorption, the maintenance of the circulation of qi, blood, and body fluid, as well as the reproductive function.

The liver houses the hun (our spiritual consciousness, the hun is critical to the spiritual and psychological dynamic of the individual. The hun loves life and favors the vital spark within us. It is the tool that motivates our higher desires and our passions. It governs our life

impulses and controls our automatic reflexes by means of our thought process, helping us control our speech and our actions. It allows for exchange, communication, and the expression of our desires and ideas. It animates our interpersonal relationships. The hun uses the shen [spirit] to manifest and show itself in all its grandeur: intelligence, spirituality, intuition, dreams, introspection, creativity, imagination, respect, love of and enthusiasm for life, ideas, and speech). The liver is in charge of storing blood and can modulate the blood volume. In a resting or a static situation, when the human body requires less blood flow, a large amount of blood is stored in the liver; when working or excited, the body requires more blood and the liver releases the stored blood to meet the requirements of the body and to maintain normal function. According to the TCM theory, qi and blood become most active in the gallbladder and liver meridians from 11 p.m. to 3 a.m., and it is therefore recommended for people to be in a deep sleep state during this period of time. Otherwise, the liver will fail to get enough nourishment from the blood and cannot perform well in storing blood and hun spirits, manifested by irritability and distraction.

The liver externally opens into the eyes, controls tendons, and manifests in the nails: by storing blood, the liver supports the normal functions of the eyes and nails. The liver meridian is connected to the eyes, and the visual ability mainly relies on the nourishment of liver blood. Therefore, the eyes can reflect the function of the liver: insufficient liver blood may cause dry eyes and blurred vision; hyperactivity of the liver fire will lead to pain and swelling of the eyes. The function of tendons also depends on the nourishment of liver blood. Numb or spastic limbs will occur when there is not enough liver blood to nourish the tendons. It is said that the nails are a surplus of the tendons. Plenty of liver blood can maintain the nail beds pink and nail plates firm; dry, brittle, and deformed nail plates usually indicate insufficient liver blood.

The liver is related to anger and anger impairs the liver: anger is an intense undesirable emotion induced by stimulations. The liver is the viscus most closely related to this emotion. Extreme anger can damage the liver, causing dysfunction in dispersion and dredging and upward flow of qi and blood, indicated by a red eye and face or even fainting spells, such as a cerebrovascular accident in modern medicine. Besides, the dysfunction of the liver in dispersion and dredging can also lead to emotional disorders manifested as irritability.

The liver is the source of endurance: good endurance indicates good function of the liver, and vice versa, which is consistent with the saying in modern medicine that patients with hepatic diseases easily feel fatigue.

Interaction between TCM and Western Medicine

Despite the similarities and differences in the concept of the liver between the TCM and the Western medicine, numerous pieces of evidence from the modern medicine can support the liver function theories of TCM. The relations between the 2 medical systems with regard to the liver are shown in Figure 1.

The Liver Storing Blood

Histologically, the liver is a blood bank that consists of hepatic sinusoids, which should be the histological foundation of the liver in storing blood [5, 6]. Under static conditions, the hepatic blood flow usually accounts for 1/4 of the cardiac output [7]. In right ventricular failure or whole heart failure, the congested liver enlarges its blood flow volume and thus reduces the venous return to the heart, which is significant in relieving the heart's burden. In

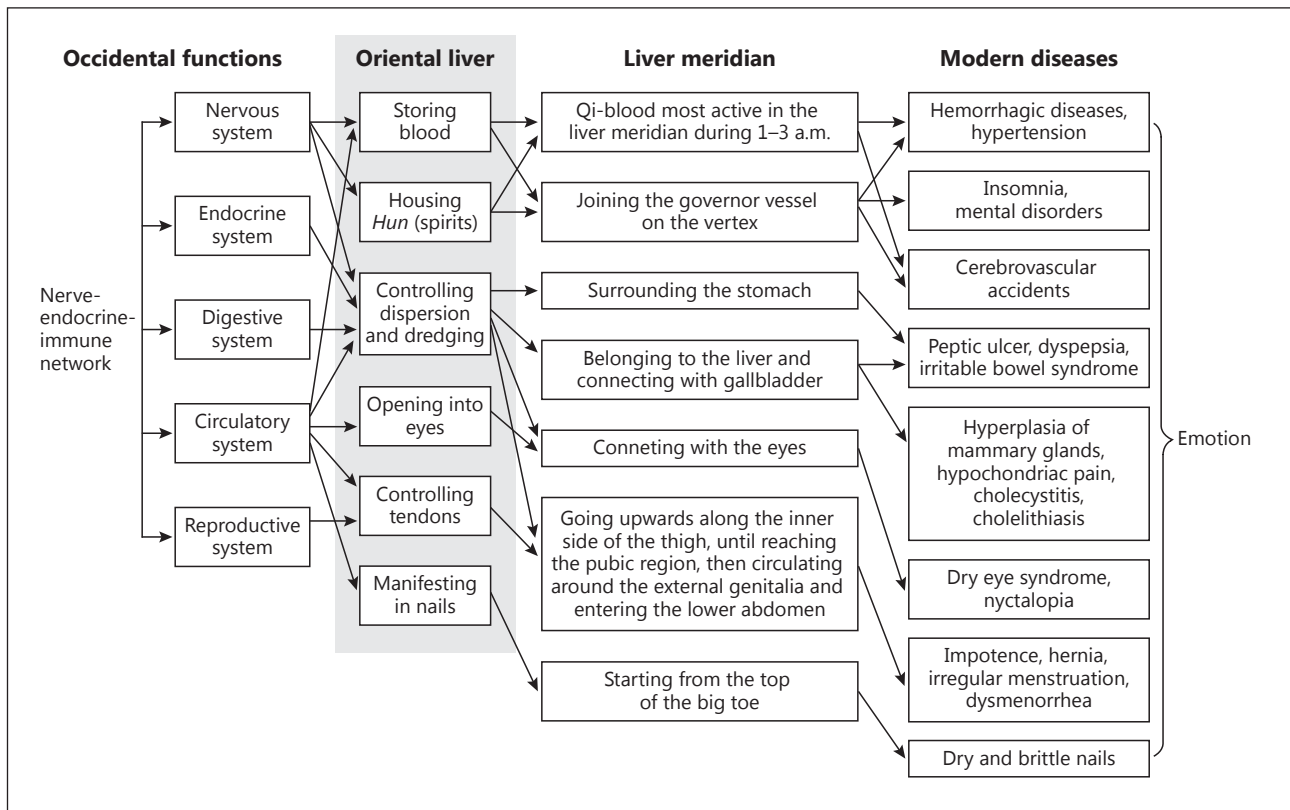


Fig. 1. Correspondence between the occidental and the oriental medicine regarding the liver functions (including the liver meridian). All the functions are associated with emotion.

a lying position, the venous return increases by 50% compared to that in a standing position. According to the TCM theory, blood goes back to the liver in a lying position. Hence, the liver's function of storing blood is important in restricting the venous return and protecting the cardiopulmonary function [8].

In the embryo, the liver is the organ for producing blood. In adults with severe anemia, the liver is able to partially restore its ability of producing blood. Thus, we say, the liver storing blood also refers to the relationship between the liver and the total blood flow volume and coagulation.

Besides, Fei Zhao-Fu found that people with a wiry pulse often present with an abnormal rheohepatogram, while people with a moderate or slippery pulse usually have a normal rheohepatogram, hence a wiry pulse should be associated with a dysfunction of the liver in storing blood [9].

The Liver in Charge of Dispersion and Dredging

The liver in charge of dispersion and dredging first of all refers to the fact that the liver regulates the qi activities and emotions, promotes digestion and absorption, maintains the normal flow of qi and blood, modulates water metabolism, and regulates the thoroughfare and conception vessels to adjust the sexual and reproductive functions. A large amount of studies suggest that the liver in TCM should be related to the nerve-endocrine-immune

network and that it governs the qi-blood activities via the nerves and endocrine [10], which is similar to Western medicine, according to which the liver regulates the whole body through metabolic function. For example, in TCM, the liver regulates the qi activities, similar to homeostasis emphasized by modern medicine; in TCM, the liver modulates emotions, which are considered to be closely related to the central neurotransmitters in modern medicine [11–15]; the liver governs dispersion and dredging, which conforms to the digestion and absorption theory in the Western medicine; in TCM, the liver maintains the normal qi activities, which is essential for the blood circulation [15, 16]; the dispersion and dredging function of the TCM liver is also closely associated with the water metabolism and reproductive function [17, 18].

Affiliations of the Liver

The liver controls the tendons and manifests in the nails, which refers to the fact that the tendons and fascia all rely on the nourishment of liver blood and the condition of the nails can reflect the level of liver blood. Someone observed the microcirculation of the nails and found that the indexes in the hepatic disease group were significantly abnormal compared to those in the nonhepatic disease group [19]. In patients with liver diseases, the imbalanced inactivation of estrogen may lead to an increase in melanin in skin cells, causing dark complexion, brown streaks on nail plates, and liver palms. It is proven that vitamin D is related to the function of muscles, tendons, and nails; the bile, secreted by the liver, can promote the absorption of vitamin D in bowels [20]. In hepatic encephalopathy, due to hypoglycemia, nitrogen poisoning and false neurotransmitters and other factors, cranial nerve dysfunction may develop, presenting asterixis.

Vitamin A is associated with nyctalopia and dry eye syndrome. The liver not only produces but also stores vitamin A. TCM often uses lamb or pork liver, which are rich in vitamin A, to treat nyctalopia and dry eye syndrome and can achieve a satisfactory result [21]. Besides, collecting blood from eyeballs of healthy mice is an effective method used in animal experiments, which somehow indicates that the eyes are very much dependent on blood [22]. It is said that at least 40% of eye diseases are related to the dysfunction of the liver [23]. Peng Qing-Hua also believes that there should be a specific relation between eye diseases and the liver [24]. There is a special genetic relationship between the liver and the eye regarding the embryonic development. When transplanted into the blastocyst cavity, adult liver tissues can lead to the formation of eyes [25], which provides further evidence for the theory that the liver opens into the eyes.

TCM holds that the liver is related to anger and anger may damage the liver, possibly inducing a cerebrovascular accident. According to the modern medicine, anger can lead to shortness of breath, increase the amount of erythrocytes in the blood, and promote coagulation, causing tachycardia, which will not only impair the cardiovascular system, but also affect the health of the liver. Therefore, irritated people run a high risk of both coronary heart disease and hepatic disease.

Conclusion

Taking into account the above references, we can say that the liver in TCM is morphologically based on the actual liver organ, and the physiological and pathological concepts are also somehow developed from the organ; the physiological and pathological understandings are involved in the construction of the visceral manifestations theory in TCM. However, despite these similarities, the content of the liver in TCM surpasses that of the liver organ in

the Western medicine, involving multiple systems and organs. Via the meridian system, the liver in TCM connects to the hypothalamus, reticular structure, limbic system, eyes, visual pathways, proprioceptive pathways, vestibular system, cochlear and auditory pathways, and motor conduction pathways, as well as the visceral sensory nerves dominating the liver, the gallbladder, the stomach, the esophagus, the splenic flexure of the colon, the pancreas, the lung, the colon, the pleura, and the nerves in charge of the reproductive system.

The differences in understanding the liver between the oriental and occidental medicine are based on the different cognition methods. TCM obtains knowledge above all through clinical observations and experiences, while the Western medicine through anatomy, physiology, and biochemistry. While TCM observes the human beings by combining the nature and society as a whole, the Western medicine separates the human beings from nature and society, and observes them in isolation. TCM recognizes the human body as a whole based on the 5-element theory, while the Western medicine focuses on the analysis of structures such as organs and tissues. TCM emphasizes the macroscopic relationships and general principles, while the Western medicine holds the microscopic structure and topical features. TCM thinks highly of reasoning, differentiating, and comprehending, but ignores morphological structure and solid evidences; on the other hand, the Western medicine gradually brings the understanding of the human body to a microscopic level by combining medical theories and novel natural scientific techniques and results.

During the recent years, the existence of meridian phenomena has been proven by relevant research, revealing the specific relationship between meridians and the corresponding Zang-Fu organs. Therefore, it is further suggested that the liver in TCM should be a regulatory chain with the liver organ as the center [26, 27]. This regulatory chain is featured by passing along the liver meridian, and the organic and functional changes can cause pathological changes along the meridian. The knowledge about the liver according to TCM benefits the health preservation of patients with liver diseases, e.g., guaranteeing sufficient sleep; following a bland diet and keeping away from cigarettes and alcohols; falling asleep before 11 p.m., as it is the self-healing period for the liver and gallbladder from 11 p.m. to 3 a.m.; frequently closing one's eyes for nourishing the spirit to prevent overuse of the eyes and consumption of liver blood.

In conclusion, the function of the liver in TCM is indeed complicated; however, we can find corresponding explanations in modern medicine, indicating that the liver theories of the 2 medical systems are connected. Furthermore, the TCM liver theory is beneficial to health cultivation in modern times.

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References

- 1 Zheng ML: On microscopic and macroscopic substance of liver manifestation in TCM. *Beijing Zhong Yi Yao Da Xue Xue Bao* 2013;36:305–307, 316.
- 2 Tong Y, Chen HJ, Zhang T, Zhang SJ: The comparative study on the organ of liver between traditional Chinese medicine and Western medicine. *Shandong Zhong Yi Za Zhi* 2000;19:515–518.
- 3 Lin Q: Linkage between liver theory of traditional Chinese medicine and theory of modern medicine. *Zhonghua Zhong Yi Yao Xue Kan* 2015;33:2997–3005.
- 4 Yang L, Wang BY: Foundation of liver aging. *Zhongguo Lin Chuang Yi Sheng* 2015;43:7–10.
- 5 He FJ, Wang J, Niu JZ: Study progress on hepatic sinusoidal wall cells. *Jie Pou Ke Xue Jin Zhan* 2001;7:156–157.
- 6 Chen H, Wu MC: Connection of liver functions and clinical surgery. *Wai Ke Li Lun Yu Shi Jian* 2003;8:414–415.
- 7 Yu JP, Zhu TG, Shen ZX: Evaluation on ultrasonic measurement of liver size and hepatic blood flow volume. *Zhongguo Yi Xue Ying Xiang Ji Shu* 1993;9:13–14.
- 8 Yang L, Jiang YY: Research progress of hepatic sinusoidal endothelial cells and hepatic sinusoidal capillarization. *Chuan Ran Bing Xin Xi* 2010;23:183–184.
- 9 Fei ZF: Study on objectify of wiry pulse. *Chin J Integr Med* 1984;4:243.
- 10 Chen JX, Yang WY: Exploration on research situation of nerves-endocrine-immunologic network and its relationship with liver of Chinese medicine. *Beijing Zhong Yi Yao Da Xue Xue Bao* 1995;18:7–11.
- 11 Gao XL, Zeng YE, Liu SQ, Wang SL: Acute stress show great influences on liver function and the expression of hepatic genes associated with lipid metabolism in rats. *Lipids Health Dis* 2013;12:118.
- 12 Yan C, Xu ZW: Exploration on central neurobiological mechanisms of Gan in taking charge of dispersion and regulating emotion. *Zhongguo Zhong Xi Yi Jie He Za Zhi* 2005;25:459–462.
- 13 Huang XH, Wu JH, Lin WT: Review of the research status and prospect of %HT and athletes mood. *Guangzhou Ti Yu Xue Yuan Xue Bao* 2015;35:90–93.
- 14 Liu CZ, Wu ZZ, Li M, Jia XQ, Zhang YF: Effects of Bugan Yangsui formula on the activity of central cholinergic nerve system in spontaneous aged dementia model. *Zhong Xi Yi Jie He Xin Nao Xue Guan Bing Za Zhi* 2004;2:402–404.
- 15 Chen LD, Zhang W: Retrospect and progress of hepatopulmonary syndrome. *Zhonghua Gan Zang Bing Za Zhi* 2003;11:318–320.
- 16 Grilo-Bensusan I, Pascasio-Acevedo JM: Hepatopulmonary syndrome: what we know and what we would like to know. *World J Gastroenterol* 2016;22:5728–5741.
- 17 Wang XX, Liu Y, Chen JX, Liu YY, Ma QY, Li XJ, Yan ZY, Wang MJ: Research progress on relationship between stagnation of liver qi and reproductive dysfunction. *Zhonghua Zhong Yi Yao Za Zhi* 2016;31:935–938.
- 18 Chen JX, Liu Q, Kou MJ, Liu YY, Liu Y, Wang XX: View on the traditional Chinese medicine treatment principle and prescription of premature ovarian failure from the liver theory. *Zhonghua Zhong Yi Yao Za Zhi* 2014;29:1916–1919.
- 19 Zhang JJ, Sheng GG: To look the scientificity of “the liver governing the eyes and its appearance can be reflected in the nails” from hepatopath’s microcirculations of nail fold and bulbar conjunctiva: a report of 64 cases. *Zhong Yi Yan Jiu* 1995;8:25–26.
- 20 Guo X, Yu TY, Zhou Q, Jia WD, Ma C, Tao YH: Review of the mechanism of muscle fatigue and injury. *Zhonghua Zhong Yi Yao Za Zhi* 2016;31:2720–2724.
- 21 Yang YS, Zhuang ZY, Wang Y, Lv H: The summary and analysis of prescription traditional Chinese medicine about nyctalopia recorded in old medical document. *Zhongguo Zhong Yi Yan Ke Za Zhi* 2007;17:54–56.
- 22 Deng N, Lin XY, Cai GX: TCM theoretical study on collecting eye blood from experimental animal. *Guang Ming Zhong Yi* 2014;29:4–5.
- 23 Zhang C, Chen Y, Yang M, Wang GY, Zhou P, Kou YH, Gao HW: Explanation of the Chinese medicine theory of “the liver opening into the eyes” from the modern medicine. *Shizhen Guo Yi Guo Yao* 2009;20:233–234.
- 24 Deng YF, Xu Q, Wang BH: Exploration and analysis of the liver opening into the eyes. *Hunan Zhong Yi Za Zhi* 2016;32:139–140.
- 25 Boriosi G, Cantoni T: The action of acupuncture and meridian on viscera formation in embryology. *Guo Wai Yi Xue Zhong Yi Zhong Yao Fen Ce* 1981;3:165–167.
- 26 Kondo T, Yoshimasu K, Tokunaga S, Sugahara H, Kanemitsu Y, Kubo C: Age-related changes in visceral patterns associated with anxiety disorders or depression according to traditional Chinese medicine. *Integr Med Int* 2014;1:80–92.
- 27 Kondo T, Tokunaga S, Sugahara H, Yoshimasu K, Kanemitsu Y, Kubo C: Identification of visceral patterns in patients with stress-related disorders. *Integr Med Int* 2014;1:185–198.