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Review

Atheroprotector role of the spleen based on the teaching of Avicenna (Ibn Sina)

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ABSTRACT

Many studies have proven atherosclerosis is an inflammatory immune disease. The spleen plays an important immune role in the human body. Splenectomy is often used in several clinical disorders; but recent studies have shown that splenectomy may be effective in the development of atheroma lesions. Ibn Sina or Avicenna was known as one of the greatest philosopher and physician in Islam and in Medicine. He is remembered for his masterpiece, The "Al-Qanun fi al-Tibb" or "Qanun of medicine". According to the "Al-Qanun fi al-Tibb", spleen as storage organ plays an important role in absorption and secretion of the black bile in the human body. Therefore any disruption in the function of the spleen can lead to various diseases such as atherosclerosis. Based on his description, it is clear that Ibn Sina first described the role of spleen in prevention of atherosclerosis. In this review, we discuss the Avicenna (Ibn Sina) aspect of atheroprotector role of the spleen.
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1. Introduction

Ibn Sina in his famous book, the Al- Qanun fi al-Tibb [1,2], has expressed different functions of the spleen, the types of its diseases and their signs and symptoms [3]. Based on the Qanun of medicine there are four humours in the body. Equilibrium quantity and quality of these humours are important for maintaining the optimum human health [4]. He noted that the spleen is the most important organ to store and regulate black bile in the human body [3]. Any dysfunction of this organ can lead to some diseases such as atherosclerosis [5]. Based on his description, it is clear that Ibn Sina first described the role of spleen in prevention of atherosclerosis. In this article we presented a brief account of atherosclerosis, Ibn Sina's works and discuss his description of the atheroprotector role of the spleen.

2. Splenectomy accelerates atherosclerosis

Up to a few decades ago the spleen, for most scholars, has always been considered a mysterious organ that is possible to live without it [6]. Because its long-term safety has been not well elucidated, splenectomy has been often used for therapeutic and diagnostic purposes in several clinical disorders such as trauma and several hematologic diseases [7,8]. The spleen plays an important immune role in the human body by trapping and processing antigens, homing, transforming and proliferating lymphocytes, and activating macrophages [8–10].

Atherosclerosis is a multifactorial [11,12] and progressive disorder causally related to multiple cardiovascular diseases [13,14]. Many different factors play important roles in the development of atherosclerotic lesions [15]. Several studies have shown that atherosclerosis is an inflammatory immune disease [16–20]. However, the main factors responsible for the maintenance of immune regulation in a proinflammatory situation are poorly understood [21]. Atherosclerosis is identified by vascular inflammation and associated with local and systemic immune responses to oxidized LDL and other antigens [16]. The oxidative theory suggests that the atherosclerotic process could be initiated by damage to the vascular endothelium, formed by deposit of oxidative modifications in the LDL molecule. It is stated that the progression of the disease is preserved by the interaction between the modified lipoproteins, such as oxidized LDL, and T cells, B cells, macrophages and normal cellular constituents of the arterial wall [8,17]. Spleen hosts a pool of B cells and plays an important role in B cell maturation [16,22,23]. B cell activation has been related with protection against atherosclerosis [24,25] and the spleen hosts regulatory T cells, which are reported to have a protective role in atherosclerotic lesion formation. According to these issues, the spleen is the principal organ responding to blood antigens such as oxidized LDL [8]. Splenectomy eliminates the valuable ability of the immune role of this organ. In addition, it should be emphasized that recent studies have shown that spleen-associated immune activity protects against atherosclerosis [7,16,17,26,27].

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Moreover, observations on the increase of plasma lipids and the frequency of ischemic coronary diseases after splenectomy for trauma in patients, led to the hypothesis that the spleen participates in lipid metabolism and atherosclerosis [28,29]. In addition, some studies proved that lipid metabolism suffers influence of the spleen, observing an increase on serum levels of cholesterol after spleen removal in animals [9]. Research carried out in apolipoprotein E deficient mice, indicated that after splenectomy lesions in the aortic root were significantly larger in splenectomized mice [8]. These researches and other similar studies suggest a possible role for the spleen in lipid metabolism and may therefore influence atherosclerosis [10,28–32].

3. Avicenna's works and his Qanun of medicine

"Ibn Sina" or "Avicenna" as known in the west (980–1037) was a foremost Iranian physician [33–35]. He is regarded as the father of modern medicine and clinical pharmacology [5]. Ibn Sina was the author of almost 276 books on medicine, philosophy, physics, theology, psychology, mathematics, logic, love, music, some stories and Holy Koran interpretation. All of them were written in Arabic except for very few books written in Persian (his mother tongue). His masterpiece the "Al-Qanun fi al-Tibb", which is written in Arabic, is the most famous medical textbook ever written [33,36–38]. "Al-Qanun fi al-Tibb" which is very close to the modern medical texts follows regarding classification, causes of diseases, epidemiology, symptoms and signs, treatment and prognosis [36]. Ibn Sina in the Qanun, similar to scientists in the modern era, discusses on human body and its disorders based practical experiences and experimental methods [39]. He as a meticulous clinical observer, examined patients carefully and wrote of their signs and symptoms in detail [37]. "Al-Qanun fi al-Tibb" as an essential medical encyclopedia containing all medical knowledge for scholars in the Islamic territories and Europe for almost a millennium [40].

The "Al-Qanun fi al-Tibb" consists of five books [41,42]; the first book concerned with general anatomy and principles of medicine (Kolliat). The second is about materia medica (Mofradat). The third is about diseases occurring in a special organ. The fourth is about diseases not specific to one bodily part (such as fevers) and traumatic injuries (such as dislocations of bones and fractures). The fifth book is about compound drugs (Qarabadin) and their uses [33,42]. Al-Qanun fi al-Tibb begins by a definition of medicine: Medicine is a science, from which one learns the states of the human body; health and disease and what causes them, in order to preserve good health when it exists, and restore it when it is lacking [36,43]. In summary about Ibn Sina's role in medicine and his valuable works can be said: Medicine was absent till Hypocrites created it, dead till Galen revived it, dispersed till Rhazes collected it, deficient till Avicenna completed it [36].

4. Humours

The Iranian traditional medicine system makes effort to propose the best possible ways by which a person can lead an optimum healthy life with least illness.

"Humour" or "Khelt" as called in the traditional medicine textbooks, is a wet and fluid substance which foodstuffs in the first stage of permutation become it. Normally there are four humours in the human body: "Phlegm or Balgham, Blood or Dam, Yellow bile or Safra and Black bile or Sauda". Each of them; is related with a pair of qualities: cold and wet, hot and wet, hot and dry and cold and dry, respectively [4,34]. In the Qanun of medicine, majority of the diseases are caused by the endogenous factors by excessive accumulation of blood and superfluous or abnormal humours [4].

Based on the Al-Qanun fi al-Tibb, there are special organs in the human body to store some of humours [4]. The most important role of these storage organs is preventing entry of high volume of humours into the blood circulation [3].

5. Spleen function and atherosclerosis based on Avicenna's view point

The discussion of the spleen and its important roles in the human body appeared in the fifteenth chapter of book 3 of the Qanun, which was dedicated to "spleen functions, diseases and its anatomy" [3]. Spleen or "Tahal" as called in the Qanun of medicine, is a special place to store and secretion of black bile in the blood circulation [3,4]. After splenectomy there is no place to store black bile and remains large volume of black bile in the blood circulation [4]. The cornerstone of health in the Al-Qanun fi al-Tibb and Iranian traditional medicine system is the right ratio and specific balance of humors based on their quality and quantity. This means that disequilibrium of humours quantitatively or qualitatively causes diseases [5,34]. On the contrary of normal condition, black bile because of its quantity imbalance loses its normal functions and gets abnormal characteristics; in other words, in any cases the function of "Tahal" get impaired; black bile removed of its normal conditions and gets abnormal [3]. Abnormal black bile because of its characteristics has affinity to deposit in any tissue in the body. Any reason which increases abnormal black bile deposition in tissues, will result in "sclerosis". For instance deposition of abnormal black bile in wall of artery causes "atherosclerosis" [5].

According to the Iranian traditional medicine, there are several distinct strategies for prevention and treatment of spleen disorders that may lead to new methods to prevention and treatment of atherosclerosis.

6. Conclusion

This review presents the relation between atherosclerosis and spleen function from the view point of Ibn Sina. The accurate observations of the most famous medieval Iranian traditional physician, "Ibn Sina" [2] provide a precise and comprehensive description of the atheroprotector role of the spleen in the human body [5]. On the basis of clinical presentation and its apparent causes, this pioneer traditional practitioner could reveal the cause of this relation based on the principles of Iranian traditional medicine [3]. This finding was an important element in designing the treatment plan. The data presented here provide an overview of the knowledge of the spleen roles in the human body at the time. This information helps us to understand the development of medical sciences in the middle ages.

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