Chapter 1

# Complementary Therapy with Traditional Chinese Medicine for Treating Atherosclerosis-Related Diseases

Yu-Chiang Hung, Chun-Ting Liu and Wen-Long Hu

Additional information is available at the end of the chapter

**Abstract**

Atherosclerosis-related diseases are the leading cause of morbidity or mortality in the world. They result in serious outcomes such as sudden cardiac death, unstable angina pectoris, acute myocardial infarction, stroke, or intermittent claudication due to vessel obliteration or plaque rupture with subsequent thrombosis. There are some limitations with standard treatments such as antiplatelet drugs, angiotensin-converting enzyme inhibitors, beta-blockers, coronary artery bypass surgery, and percutaneous transluminal coronary angioplasty. Therefore, complementary and alternative medicine is necessary for medication. Traditional Chinese medicine is the main complementary therapy used in the Chinese community. This article aims to explore complementary therapy with traditional Chinese medication for atherosclerosis-related diseases. There is some scientific evidence to support that traditional Chinese medicine could treat atherosclerosis and its associated conditions. Acupuncture through needling on ST36, ST40, PC6, or BL15 could alleviate atherosclerosis-related cardiovascular diseases. *Tai chi* and meditation have beneficial effects for mental and physical health. In addition, extracts or compounds of single Chinese herbs such as *Salvia miltiorrhiza*, *Panax notoginseng*, *Ginkgo biloba*, *Curcuma longa*, *Crataegus pinnatifida*, *Paeonia lactiflora*, *Prunella vulgaris*, *Polygonum multiflorum*, *Coptis chinensis*, and red yeast rice also could treat atherosclerosis-related diseases through their endothelial protective, antioxidative, anti-inflammatory, inhibiting of smooth muscle cells proliferation, and lipid-lowering effects. In accordance with evidence-based medicine, well-designed and conducted clinical studies such as randomized control clinical trials will be necessary in the future.

**Keywords:** atherosclerosis, complementary medicine, traditional Chinese medicine

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## 1. Introduction

Atherosclerosis is the most common type of arteriosclerosis. It is a disease of the arteries characterized by the deposition of fatty plaques on their inner walls, which hardens or narrows medium to large blood vessels, especially the aorta, coronary arteries, and cerebral arteries [1]. Atherosclerosis-related diseases often lead to serious outcomes such as sudden cardiac death, unstable angina pectoris, acute myocardial infarction, stroke, and intermittent claudication due to vessel obliteration or plaque rupture with subsequent thrombosis [1,2]. Epidemiological studies indicate that, because of the adoption of Western lifestyle, the prevalence of atherosclerosis is increasing all over the world and will likely reach epidemic proportions in the coming decades [2]. The earliest visible lesion in the development of atherosclerosis is the fatty streak. It consists of aggregates of foam cells (i.e., lipoprotein-loaded macrophages) in the subendothelial space. Fatty streaks may also include T cells, aggregated platelets, and smooth muscle cells. A fatty streak is the precursor lesion of an atheroma that may become an atheromatous plaque [2]. In response to plaque growth, the arterial wall can remodel itself by increasing its external diameter to accommodate the plaque without narrowing the lumen. Thrombosis is the last stage in the disease process that is responsible for clinically observable adverse events mentioned previously.

Traditional Chinese medicine (TCM), especially herbal medicine, has been used for the treatment of cardiovascular diseases for hundreds of years, as documented in the *Yellow Emperor's Inner Canon* (*Huangdi Neijing*) and the *Essential Prescriptions from the Golden Cabinet* (*Jin Gui Yao Lue*). In Taiwan, Chinese herbal medicine is commonly used as complementary and alternative therapy for the treatment of cardiovascular-related diseases such as hypertension, dyslipidemia, and stroke. Thus, studies of the medicines used for the prevention and treatment of atherosclerosis have received much attention in the recent years. The cellular and molecular details regarding the underlying efficacious mechanisms of Chinese herbal medicine in treating atherosclerosis have just begun to be understood. Therefore, the purpose of this article is to present a brief description of the mechanisms of atherogenesis and to summarize the recent research results regarding the mechanisms of antiatherogenic Chinese herbal compounds commonly used in clinical practice. Other interventions of TCM such as acupuncture, *tai chi* and meditation will also be briefly discussed.

## 2. Pathology and risk factors of atherosclerosis

The pathology of atherosclerosis is a progressive process with increasing age that is related to some risk factors such as hypertension, hyperlipidemia, diabetes mellitus, obesity, and cigarette smoking [1]. Atherosclerosis begins with damage to the endothelium, which results in endothelial vasodilator dysfunction. The endothelium subsequently cannot modulate tone, growth, hemostasis, and inflammation throughout the circulatory system. Injured endothelial cells (EC) produce cell surface adhesion molecules such as vascular cell adhesion molecule-1 (VCAM-1), and thereby cause monocytes and T-lymphocytes to adhere to the endothelium and migrate beneath it [1,2]. Circulating monocytes and T-lymphocytes provoke an inflammatory response. The tight junctions between EC loosen and increase the permeability to

lipids, especially low-density lipoprotein (LDL). Once the oxidation of LDL has crossed the damaged endothelium into the intima, monocytes differentiate into macrophages and begin to take up oxidized LDL [1]. Macrophages bite and retain the lipid, and then become foam cells. The fatty streak consisting of lipid-containing foam cells in the arterial wall can evolve into atherosclerotic plaques or atheromas [1]. In addition, T-lymphocytes secrete cytokines that induce vascular smooth muscle cells to migrate from the media to the intima and proliferate shortly thereafter [1]. Over time, a growing lesion consisting of lipid and smooth muscle cells invade and narrow the lumen of the artery. Other extracellular matrix (ECM) components such as collagen, elastin, glycoprotein, and proteoglycans give tensile strength and viscoelasticity to the arterial wall. Increasing the synthesis of ECM components such as matrix metalloproteinases (MMPs) contributes significantly to ECM destruction, which renders the plaque more prone to rupture [1]. Once a plaque ruptures, it can trigger an acute thrombosis or embolism by activating platelets. It may finally lead to myocardial infarction, stroke, and even death.

## 3. Conventional treatment of atherosclerosis

Atherosclerosis treatment usually begins with lifestyle changes such as a low cholesterol diet, regular exercise, and quitting smoking. Depending on the severity of the disease, a person may be prescribed oral medication such as antiplatelets, angiotensin-converting enzyme (ACE) inhibitors, or beta-blockers. In patients with advanced disease, certain medical procedures such as percutaneous transluminal coronary angioplasty or coronary artery bypass surgery may be necessary.

## 4. Status and purpose

Conventional medical costs paid by patients or by the Bureau of National Health Insurance (Taipei, Taiwan) are expensive. The caregiver burden on the patients' families and government has increased yearly. In addition, conventional therapies for atherosclerosis-related diseases have some limitations such as statin-induced rhabdomyolysis or hepatitis, and antiplatelet agent-related gastrointestinal bleeding or peptic ulcer. Complementary and alternative therapy is another option for atherosclerosis medication. Traditional Chinese medicine is the primary complementary therapy used in the Chinese community. The aim of this paper is to explore complementary therapy with traditional Chinese medication for treating atherosclerosis-related diseases.

## 5. Atherosclerosis corresponds to blood stasis syndrome

According to TCM theory, obstructed circulation of blood results in blood stasis syndrome (Xue Yu), which is an important pattern of slowing or retardation of the blood circulation. The main symptoms may include stabbing pain with a fixed position, tenderness, local purpura,

lumps, dark-purple lips and finger nails, a blue-purple tongue, and a thready or hesitant pulse. Blood stasis syndrome in TCM corresponds to atherosclerosis in modern Western medicine. Both blood stasis syndrome and atherosclerosis are the predevelopment or initial stage of ischemic heart disease, myocardial infarction, or stroke (Figure 1). With early treatment by medication, the progression of cardiovascular or cerebral vascular disease will not worsen.

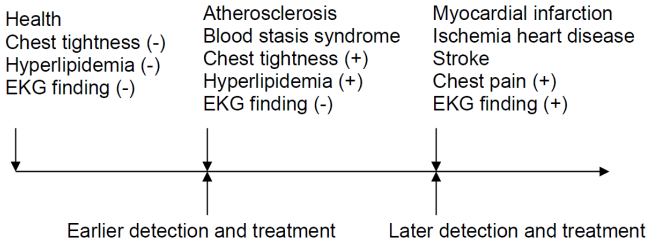


**Figure 1.** Progression from health to cardiovascular or cerebrovascular disease. EKG, electrocardiogram.

## 6. Atherosclerosis-related cardiovascular or cerebral vascular diseases

Table 1 shows atherosclerosis-related cardiovascular or cerebrovascular diseases. Atherosclerosis can cause embolism, thrombosis, ischemia, infarction, stenosis, or occlusion of the arteries. Some Chinese herbs can promote blood circulation or remove blood stasis and may be useful for treating atherosclerosis-related diseases.

| ICD-9-CM | Diseases |
|---|---|
| 4140 | Coronary atherosclerosis |
| 4400 | Atherosclerosis of the aorta |
| 4149 | Chronic ischemic heart disease, unspecified |
| 4148 | Other specified forms of chronic ischemic heart disease |
| 4118 | Other acute and subacute forms of ischemic heart disease |
| 410 | Acute myocardial infarction |
| 4110 | Postmyocardial infarction syndrome |
| 412 | Old myocardial infarction |
| 4297 | Other certain sequelae of myocardial infarction, not elsewhere classified |
| 444 | Arterial embolism and thrombosis |
| 4292 | Cardiovascular disease, unspecified |
| 433 | Occlusion and stenosis of precerebral arteries |
| 434 | Occlusion of cerebral arteries |

ICD-9-CM, *International Classification of Diseases, 9th Revision, Clinical Modification* (US Centers for Disease Control and Prevention (CDC), Salt Lake City, Utah; 1996).

**Table 1.** Atherosclerosis-related cardiovascular or cerebrovascular diseases

## 7. Chinese single herbs and atherosclerosis-related diseases

### 7.1. Effect of herbal extracts/compounds on the initiation of an atherosclerotic lesion

Several strategies exist for the treatment of atherosclerosis and associated diseases such as risk factor modification, antioxidation, anti-inflammation, and antiplatelet accumulation. Hypercholesterolemia, a primary risk factor that leads to atherosclerosis, is associated with the development and progression of atherosclerosis. Hypercholesterolemia and endothelial injury lead to the infiltration of LDL particles into the subendothelial space. Lowering cholesterol can provide the initial blockade [2].

The 10 traditional Chinese herbs commonly used in clinical practice that reportedly reduce the production of LDL and/or oxidative LDL are *Salvia miltiorrhiza* [3], *Panax notoginseng* [4], *Ginkgo biloba* [5], *Curcuma longa* [6], *Crataegus pinnatifida* [7], *Paeonia lactiflora* [8], *Prunella vulgaris* [9], *Polygonum multiflorum* [10], *Coptis chinensis* [11,12], and red yeast rice [13]. Single compounds or crude extracts isolated from *Salvia miltiorrhiza* [3], *Ginkgo biloba* [14], *Prunella vulgaris* [9], *Polygonum multiflorum* [15], and red yeast rice [16] restore epithelial function by regulating the endothelial nitric oxide synthase/nitric oxide (eNOS/NO) pathway. Oxidized low-density lipoprotein (ox-LDL) in the absence of high-density lipoprotein (HDL) can stimulate EC activation and subsequent expression of adhesion molecules such as the vascular cell adhesion molecule (VCAM-1) and the intercellular adhesion molecule (ICAM-1) [17]. These adhesion molecules recruit circulating macrophages and T-lymphocytes into the subintima; this action is mediated by macrophage chemoattractant protein-1 (MCP-1) [17].

As Table 2 shows, single compounds and/or herbal extracts from these 10 TCM herbs inhibit the expression of adhesion molecules (i.e., VCAM-1 and ICAM-1). Among them, *Salvia miltiorrhiza* [3], *Panax notoginseng* [4], and *Coptis chinensis* [18] can downregulate the expression of MCP-1. Furthermore, ox-LDL can stimulate macrophages and T-lymphocytes to produce inflammatory cytokines such as interleukin-1-beta (IL-1β) and tumor necrosis factor alpha (TNF-$\alpha$) in the vessel wall, which further activate EC and promote vascular smooth muscle cell (VSMC) proliferation and migration [1]. *Salvia miltiorrhiza* [3], *Curcuma longa* [19], *Paeonia lactiflora* [8], and *Coptis chinensis* [18] suppress the expression of TNF-$\alpha$. Nuclear factor kappa B (NF-κB) can regulate the expression of multiple inflammatory cytokines such as MCP and cell adhesion molecules (e.g., ICAM-1 and VCAM-1) so as to affect the atherogenic process. Most of the 10 TCM herbs can block the NF-κB pathway involved in the inflammatory process (Table 2).

### 7.2. Effect of herbal extracts/compounds on the propagation of an atherosclerotic lesion

Stimulated by inflammatory cytokines such as interleukin-1$\alpha$ (IL-1$\alpha$) and TNF-$\alpha$, VSMCs propagate and migrate from the media to the intima and produce collagen, which forms the substance of the fibrous cap of the mature lesion [1,20]. Signaling interactions between CD40- and CD40L-expressing cells result in the formation of matrix metalloproteinases (MMPs), which degrade collagens and the thin fibrous cap and lead to the formation of vulnerable plaques and rupture [20]. Among the 10 TCM herbs, *Salvia miltiorrhiza* [3] and *Panax notogin-*

| Herb/ interventions | eNOS/ NO | LDL/ox-LDL | VCAM-1 | ICAM-1 | MMP-9/2 | CD40 | MCP-1 | NF-κB | TNF-α |
|---|---|---|---|---|---|---|---|---|---|
| *Salvia miltiorrhiza* | ↑ [3] | ↓ [3] | ↓ [3] | ↓ [3] | ↓ [3] | ↓ [3] | ↓ [3] | ↓ [3] | ↓ [3] |
| *Panax notoginseng* | | ↓ [4] | ↓ [38] | ↓ [38] | ↓ [21] | ↓ [21] | ↓ [4] | ↓ [4] | |
| *Ginkgo biloba* | ↑ [14] | ↓ [5] | ↓ [39] | ↓ [39] | ↓ [22] | | | ↓ [40] | |
| *Curcuma longa* | | ↓ [41] | ↓ [6] | ↓ [6] | ↓ [19,23] | | | ↓ [23] | ↓ [19] |
| *Crataegus pinnatifida* | | ↓ [7] | ↓ [24] | ↓ [24] | ↓ [24] | | | | |
| *Paeonia lactiflora* | | ↓ [8] | ↓ [42] | ↓ [43] | | | | ↓ [43] | ↓ [8] |
| *Prunella vulgaris* | ↑ [9] | ↓ [9] | ↓ [38] | ↓ [38] | | | | ↓ [38] | |
| *Polygonum multiflorum* | ↑ [15] | ↓ [10] | ↓ [39] | ↓ [39] | | | | | |
| *Coptis chinensis* | | ↓ [11, 12] | ↓ [40] | ↓ [40] | ↓ [25] | | ↓ [18] | ↓ [25] | ↓ [18] |
| Red yeast rice | ↑ [16] | ↓ [13] | ↓ [41] | ↓ [42] | ↓ [26] | | | ↓ [26, 41] | |
| Acupuncture | ↑ [38] | ↓ [39] | | ↓ [39] | ↓ [41] | | ↓ [39] | | ↓ [40] |
| *Tai chi*/yoga | | ↓ [42,43] | | | | | | | |

The up arrow (↑) indicates increased expression; the down arrow (↓) indicates decreased expression.

eNOS, endothelial nitric oxide synthase; ICAM-1, intercellular adhesion molecule; LDL, low-density lipoprotein; MCP-1, macrophage chemoattractant protein; MMP-9, matrix metalloproteinase-9; NF-κB, nuclear factor-kappaB; NO, nitric oxide; ox-LDL, oxidized low-density lipoprotein; TNF-α, tumor necrosis factor alpha; VCAM-1, vascular cell adhesion molecule-1.

**Table 2.** Multiple signaling molecules involved in atherosclerosis and regulated by Chinese herbs

*seng* [21] reduce the expression of CD40 and the activity of MMP-2. In addition, *Ginkgo biloba* [22], *Curcuma longa* [19,23], *Crataegus pinnatifida [24], Coptis chinensis* [25], and red yeast rice [26] have an inhibitory effect on MMP-2 and/or MMP-9. Table 3 summarizes the target activities of these herbal extracts or compounds in atherosclerosis.

*Salvia miltiorrhiza* has been widely used in the Chinese population for treating cardiovascular and cerebrovascular diseases. Its specific clinical use is for angina pectoris, hyperlipidemia, and acute ischemic stroke [27], which are all closely associated with atherosclerosis. According to TCM theory, *Salvia miltiorrhiza* promotes blood circulation, removes blood stasis, and relieves pain. Several compounds derived from *Salvia miltiorrhiza* have been well studied in the treatment of atherosclerosis. Protocatechuic aldehyde derived from *Salvia miltiorrhiza* inhibits lipopolysaccharide-induced human umbilical vein EC apoptosis via the regulation of

| Herbs | Compound/extract | Target | Reference |
|---|---|---|---|
| *Salvia miltiorrhiza* | Protocatechuic Aldehyde | Reduce caspase-3, and VSMC migration and proliferation | [28,29] |
| | Cryptotanshinone | Increase NO; reduce ox-LDL, ICAM-1, VCAM-1, and monocyte adhesion | [30] |
| | Tanshinone IIA | Reduce ROS, Bax/Bcl-2, caspase-3, LOX-1, NF-κB, ox-LDL, monocyte adhesion, VSMC migration and proliferation, macrophage, cholesterol accumulation, CD 40, TNF-α MMP-2, MMP-9, and platelet aggregation | [34,35,36,43,49] |
| | *Salvianolic acid B* | Reduce ICAM-1, E-selectin, NF-κB, ox-LDL, MMP-2, and MMP-9 | [31-33] |
| *Panax notoginseng* | *Panax notoginseng Saponins* | Reduce ICAM-1, VCAM-1, ox-LDL, IL-1β, MMP-9, MMP-2, NF-κB, CD40, and MCP-1 | [4,21,38] |
| *Ginkgo biloba* | *Ginkgo biloba* Extract | Increase eNOS/NO; Reduce LDL, VCAM-1, ICAM-1, E-selectin, MMP-2, and NF-κB | [5,14,22,39,40] |
| *Curcuma longa* | Curcumin | Reduce LDL, VCAM-1, ICAM-1, MMP-2, MMP-9, TNF-α, and NF-κB | [6,19,23,41] |
| *Crataegus pinnatifida* | *Crataegus pinnatifida* extract | Reduce LDL, VCAM-1, ICAM-1, and MMP-9 | [7,24] |
| *Paeonia lactiflora* | Paeonol | Reduce VCAM-1, ICAM-1, and TNF-α | [42,43] |
| | Total glucosides of peony | Reduce LDL and TNF-α | [8] |
| *Prunella vulgaris* | *Prunella vulgaris* extract | Increase eNOS/NO; reduce LDL, VCAM-1, ICAM-1, and NF-κB | [9,38,44] |
| *Polygonum multiflorum* | 2,3,5,4'-tetrahydroxystilbene-2-O-beta-D-glucoside (TSG) | Increase eNOS/NO; reduce LDL, VCAM-1, and ICAM-1 | [10,15,39,45] |
| *Coptis chinensis* | Berberine | Reduce LDL, ox-LDL, VCAM-1, ICAM-1, MMP-9, MCP-1, NF-κB, and TNF-α | [11,12,18,25,40,46] |
| Red yeast rice | *Monascus purpureus*-fermented rice extract | Increase eNOS/NO; reduce LDL, VCAM-1, ICAM-1, MMP-9, MMP-2, and NF-κB | [13,16,26,41,42,47,48] |

eNOS, endothelial nitric oxide synthase; ICAM-1, intercellular adhesion molecule; IL-1β, interleukin 1β; LDL, low-density lipoprotein; LOX1, lectin-like oxidized low-density lipoprotein receptor-1; MCP-1, macrophage chemoattractant protein; MMP, matrix metalloproteinase; NF-κB, nuclear factor-kappaB; NO, nitric oxide; ox-LDL, oxidized low-density lipoprotein; ROS, reactive oxygen species; TNF-α, tumor necrosis factor alpha; VCAM-1, vascular cell adhesion molecule-1; VSMC, vascular smooth muscle cells.

**Table 3.** The target activity of herbal extracts or compounds in atherosclerosis

caspase-3, the migration and proliferation of VSMC, and intravascular thrombosis [28,29]. Cryptotanshinone derived from *Salvia miltiorrhiza* suppresses the increase in endothelial permeability, which is likely because of the restoration of NO bioavailability in EC. Cryptotanshinone also can attenuate monocyte adhesion to EC through inhibiting the expression of adhesion molecules. Salvianolic acid B, a water-soluble antioxidant obtained from *Salvia miltiorrhiza*, can reduce oxidative stress, inhibit LDL oxidation, and reduce oxidized LDL-induced cytotoxicity [31]. Salvianolic acid B also inhibits VCAM-1 and ICAM-1 expression in TNF-$\alpha$-treated human aortic EC, and attenuates MMP-2 and MMP-9 expression in vivo in apolipoprotein E-deficient mouse aorta and in vitro in LPS-treated human aortic smooth muscle cells [32,33].

Tanshinone IIA, another compound derived from *Salvia miltiorrhiza*, markedly inhibits the elevation of ROS evoked by hydrogen peroxide. Tanshinone IIA significantly decreases the hydrogen peroxide-induced expression of proapoptotic proteins Bax and caspase-3 and significantly increases the expression of antiapoptotic protein Bcl-2 in EA.hy926 cells [34]. Tanshinone IIA inhibits oxidized LDL-induced lectin-like oxidized low-density lipoprotein receptor-1 (LOX1) expression in macrophages by reducing intracellular superoxide radical generation and NF-κB activation [35]. Tanshinine IIA also reduces the expression of CD 40, TNF-$\alpha$, MMP-2, MMP-9, and suppresses VSMC migration and proliferation, macrophage cholesterol accumulation, and platelet aggregation [36].

Hung et al. [37] report that a low dose (0.015 mg/mL) of *Salvia miltiorrhiza* aqueous extract significantly inhibited the growth of a rat smooth muscle cell line (i.e., A10) under Homocysteine(Hcy) stimulation, and *Salvia miltiorrhiza* aqueous extract treatment decreased the intracellular reactive oxygen species (ROS) concentration in terms of reducing p47 (phox) translocation and increasing catalase activity. The signaling profile suggests that *Salvia miltiorrhiza* aqueous extract inhibits Hcy-induced A10 cell growth via the protein kinase C/mitogen-activated protein kinase (PKC/MAPK)-dependent pathway [37].

## 8. Acupuncture and atherosclerosis-related diseases

In addition to herbal medicine, acupuncture has been used for a long time in the treatment of cardiovascular disease in Asia. Acupuncture is applied in the treatment of hypertension and hyperlipidemia, which are risk factors leading to atherosclerosis. Kim et al. [50] demonstrated that electroacupuncture on the *Zusanli* (ST36) (Figure 2) point reduces hypertension by activating nitric oxide synthase signaling mechanisms [50]. Tian et al. [51] report that electroacupuncture on the *Fenglong* (ST40) point downregulates the effect of plasma total cholesterol, LDL, MCP-1, and ICAM-1 in hyperlipidemic rats. Another study by Xiao et al. [52] showed that electroacupuncture on the *Fenglong* (ST40) point effectively lowers serum total cholesterol, LDL, and macrophage TNF-$\alpha$ and IL-6 levels in hyperlipemia rats. Li et al. [53] showed that electroacupuncture of the *Neiguan* (PC6) and *Xinshu* (BL15) points can suppress the increased expression of CD 40 L and MMP-9 proteins of coronary artery tissue in rats with coronary atherosclerotic heart disease.

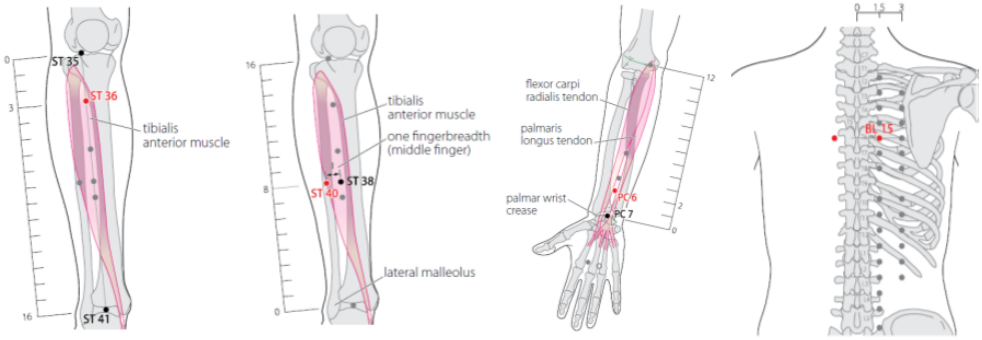


**Figure 2.** The World Health Organization (WHO) standard acupuncture point locations of ST36, ST40, PC6, and BL15 [54].

## 9. Mind–body exercise of *tai chi* and yogi

*Tai chi chuan* (*tai chi*) is a Chinese traditional mind–body exercise with low to moderate exercise intensity. Previous studies have shown that it offers benefits for aerobic capacity, muscular strength, balance, and cardiovascular risk factors such as hypertension, diabetes mellitus, and dyslipidemia. Furthermore, *tai chi* appears to be safe and effective for patients with acute myocardial infarction, coronary artery bypass grafting surgery, congestive heart failure, and stroke [55]. A study conducted in India shows that regular yogic practices can significantly reduce blood pressure, heart rate, body fat, total cholesterol, triglycerides, and LDL.These reactions are beneficial for cardiac and hypertensive patients [56].

## 10. Meditation, mind, and atherosclerosis

Certain mental disorders and stress are conducive to atherosclerosis. Kroenke et al. [57] revealed that a negative mood is predictive of a greater progression of calcified atherosclerosis, compared to a positive mood. Everson-Rose et al. [58] found that high levels of stress, hostility, and depressive symptoms are associated with a significantly increased risk of incident stroke or transient ischemic attacks in middle-aged and older adults. Stillman et al. [59] and Wang et al. [60] also noted that anxiety can potentially predict a worse outcome through worsening of vascular function in patients with coronary atherosclerotic disease.

Meditation is an alternative medicine practice for mental and physical health. It has salutary effects on patients with anxiety [61, 62], depression [61, 63], and stress [64, 65]. Some articles report that meditation can calm the emotions and produce beneficial effects on the cardiovascular system, particularly with regard to vascular aspects [66-68]. Walton et al. [68] advocate meditation to reduce traditional and novel risk factors for cardiovascular diseases; for example,

meditation (1) decreases blood pressure; (2) reduces the use of tobacco and alcohol; (3) lowers the cholesterol level and lipid oxidation; and (4) decreases psychosocial stress.

The mechanism and neurobiological effects of mindfulness meditation involve (1) deactivation of the default mode network, which generates spontaneous thoughts, contributes to the maintenance of the autobiographical self, and is associated with anxiety and depression; (2) the anterior cingulate cortex, which underpins attention functions; (3) the anterior insula, which is associated with the perception of visceral sensation, the detection of the heartbeat and respiratory rate, and the affective response to pain; (4) the posterior cingulate cortex, which helps one to understand the context from which a stimulus emerges; (5) the temporoparietal junction, which assumes a central role in empathy and compassion; and (6) the amygdala, which is implicated in fear responses [69].

## 11. Further research

There are few studies on formulas or single herbal drugs interaction in the treatment of atherosclerosis. In accordance with evidence-based medicine, well-designed and conducted clinical studies such as randomized control clinical trials will be necessary in the future.

## 12. Conclusions

Atherosclerosis-related diseases are the primary causes of death. In addition to standard treatment, complementary therapy needs to be face up. Traditional Chinese medicine is a popular complementary and alternative medicine (CAM) in East Asia and throughout the world. There is increasing scientific evidence demonstrating that TCM has potential for treating atherosclerosis and its associated conditions. Acupuncture, *tai chi*, and meditation have beneficial effects for atherosclerosis-related cardiovascular diseases. Extracts or compounds of single herbs of some Chinese herbs such as *Salvia miltiorrhiza, Panax notoginseng, Ginkgo biloba, Curcuma longa, Crataegus pinnatifida, Paeonia lactiflora, Prunella vulgaris, Polygonum multiflorum, Coptis chinensis*, and red yeast rice through their endothelial protective, antioxidative, anti-inflammatory, and lipid-lowering effects may act on multiple mechanisms involved in the pathogenesis of atherosclerosis.

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