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Administration of turmeric (curcumin) in chronic renal failure; a narrative review on current knowledge

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Abstract

Chronic kidney disease (CKD) is a health issue in the past but today it has become a global health threat. These patients experience a wide range of problems, thus it is very useful to make a change in their lives. Hemodialysis reduces the level of antioxidants required for the body and causes oxidative stress. Many studies have noted the positive role of anti-oxidants in chronic diseases, cardiovascular diseases, hypertension, and kidney diseases, however, some studies have reported their slight effect on reduction of mortality and cardiovascular diseases. Turmeric is one of the sources of antioxidants and one of the seasoning used in foods. Given the properties and many applications of turmeric (curcumin) which are mentioned in ancient and new sources as well as in traditional medicine, many empirical and human studies have been conducted so far to investigate its effects. Hence, in this study we reviewed previous studies in order to investigate the effects of the turmeric (curcumin) on patients with CKD. Given the properties of turmeric, its consumption has been recommended to control digestive and liver diseases, cancer, arthritis, allergy, asthma, atherosclerosis, Alzheimer's disease, and high blood sugar. Given the results of studies conducted on the anti-inflammatory effects of turmeric, it can be concluded that turmeric can be used as a proper source for the preparation and production of anti-inflammatory drugs or a supplementary pharmaceutical to be used for hemodialysis patients.

Keywords: Chronic kidney disease, Curcumin, Antioxidants, Hemodialysis

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Introduction

Chronic kidney disease (CKD) is a health issue in the past but today it has become a global health threat. The number of people affected by chronic kidney failure is increasing and every year more than one million people who suffer from end-stage chronic renal failure (CRF) die from the disease (1). These patients experience a wide range of problems, thus it is very useful to make a change in their lives. Fatigue is a common problem faced by dialysis patients. Fatigue is the most important complication caused due to vitamin C deficiency (2).

Hemodialysis reduces the level of antioxidants required for the body and causes oxidative stress; moreover, CRF is associated with oxidative stress (3). Excess production of free radicals creates a condition which is known as oxidative stress and it is one of the causes of vascular lesions (4). Free radicals affect carbohydrates, fats, proteins, and DNA of the cells; they mainly affect fats too (5,6).

Free radicals cause lipid peroxidation and destroy molecules and cellular structures (endothelium and red blood cells) (7). The results of some studies have suggested that dialysis increases the risk of production of free radicals (8-10). Small proteins such as immunoglobulin G and complements attach to the membrane of dialysis device and activate granulocytes and consequently result in free radical production (11,12).

Cardiovascular lesions are one of the main reasons for mortality in patients with CKD who undergo dialysis. Increased production of lipid peroxidation and depletion of antioxidants are among the factors which cause atherosclerosis in hemodialysis patients (13).

CKD is associated with the high incidence of cardiovascular diseases which are the most common cause of death in dialysis patients; in addition to high rates of mortality, they impose high treatment costs on the patients (5,6). Chronic renal insufficiency, even after the elimination of the primary cause, progresses towards end-stage renal disease (ESRD) which is due to the changes in nephrons adaptability. After making the initial damage, it causes scars and destroys nephrons, thus leading to end-stage renal disease.

Many studies have noted the positive role of anti-oxidants in chronic diseases, cardiovascular diseases, hypertension, and kidney diseases. However, some studies have reported their slight effect on reduction of mortality and cardiovascular diseases (14-21). Antioxidants are present

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Implication for health policy/practice/research/ medical education

Turmeric is a material with strong anti-inflammatory and antioxidant properties. Given the properties of turmeric, its administration has been recommended to control digestive and liver diseases, cancer, arthritis, allergy, asthma, atherosclerosis and renal disease.

in some types of foods and some studies have noted their role in healing chronic diseases. Additionally, the role of antioxidants in medicinal plants was highlighted (22,23).

Turmeric is one of the sources of antioxidants and one of the seasoning used in foods. Turmeric is made from a plant with the scientific name curcuma longa. Turmeric is a member of Zingiberidae subclass, Zingiberales order, Zingiberaceae family, and curcuma genus. Chemical composition of turmeric is composed of 5% essential oil and 5% base material of turmeric, i.e. apolyphenol called curcumin. Its application and benefits are pointed out in traditional medicine. As noted in traditional medicine, it is mainly used as an anti-inflammatory agent. Additionally, in the book entitled *Law in Medicine* (Ibn Sina) its advantages are discussed (24). Because of its strong antioxidant properties, turmeric is one of the most effective agents used for preventing the spread of cancer in the body cells (25). Many clinical trials have been conducted to investigate the benefits of turmeric daily intake (26). It has been suggested that turmeric can reduce the severity of symptoms of Alzheimer's disease (27). In addition, the active in gradient in turmeric, i.e. curcumin, has anti-inflammatory and analgesic effects similar to conventional pain killers (28). The anti-inflammatory effect of curcumin is comparable to anti-inflammatory effects of steroidal and non-steroidal drugs and phenylbutazone. The drug shows anti-inflammatory effects via inhibiting the synthesis of inflammatory prostaglandins. In a study on rats, the administration of 3 mg/ kg of curcumin sodium inhibitor led to inhibition of lipoxygenase and cyclooxygenase (29).

Given the properties and many applications of turmeric (curcumin) which are mentioned in ancient and new sources as well as in traditional medicine, many empirical and human studies have been conducted so far to investigate its effects. Hence, in this study we reviewed previous studies in order to investigate the effects of the turmeric (curcumin) on patients with CKD.

Materials and Methods

In this study we used several keywords including curcumin, curcumin in patients undergoing hemodialysis, and antioxidants and searched the literature and the indexed scientific data bases including PubMed and Scopus to find and review the relevant articles.

Curcumin in animal studies

Numerous empirical studies have been conducted to investigate the effect of curcumin. The studies have investigated its effect on the central nervous system, kidney, liver, and infectious agents, and its role in preventing corruptibility and healing wounds.

The empirical studies which investigated its effect on the nervous system and brain suggest that it facilitates the proliferation and differentiation of rat embryonic neuro-progenitor cells and changes them into astrocytes (30). It also has a protective effect on memory and prevents the related damages in animal samples, thus it may be used for developing anti-Alzheimer's drugs (31). In addition, another study has noted the positive effects of curcumin on intracranial pressure, systemic hyponatremia, and hydrocephaly in animal samples (32).

Turmeric may have a protective effect against kidney and liver toxicity caused by certain medications (33,34). In a study on animal samples, the results showed the protective effect of turmeric on renal toxicity caused by cadmium. The obtained results suggest that turmeric extract has a protective effect against renal toxicity caused by exposure to heavy metals (33). Some other studies have suggested the positive effects of curcumin in the treatment of complications caused by exposure to heavy metals (35). In an empirical study, turmeric powder was administered for diabetic animals that were in contact with lead acetate. The evaluation of the studied animals showed that turmeric powder improved insulin secretion and increased blood total protein. Accordingly, it was suggested that antioxidant compounds found in turmeric are effective in reducing the effects of exposure to heavy metals, particularly in diabetic patients (36). In another empirical study, the results proved the protective effects of curcumin and vitamin E against carbonetrachloride-induced renal toxicity. The mentioned study suggests that the administration of vitamin E together with curcumin enhances its antioxidant effect (37).

Another study investigated the protective effects of turmeric on kidneys of diabetic mice. In this randomized case-control study, it was shown that turmeric had renal protective effects in diabetic mice (38).

In another study, the researchers conducted a research on animal samples to examine a hypothesis suggesting that turmeric has a renal protective effect on acute renal injury caused by ischemia. The results of the mentioned study showed that the administration of turmeric extract before and after kidney injury did not have a significant renal protective effect on artery blood flow (immediately after making perfusion) and glomerular and tubular function. However, after some shorter periods of renal ischemia, it improved some other markers of renal injury and appearance features (39). In a similar study it was reported that curcumin (the active ingredient in turmeric) can have therapeutic effects on ischemic renal tissue damages and can lead to reperfusion. The results of the mentioned study, which was conducted on animal samples suggested that three subsequent doses of curcumin was better than a single does and had better effects on tissue injuries resulting from ischemia/renal reperfusion (7,40). Another study reported the same effect. In the mentioned study,

the animals received turmeric powder and 30 days later renal ischemia was induced. The results obtained from the study showed that turmeric powder significantly prevented functional and tissue damages to the kidney caused by ischemia/reperfusion (41,42).

Likewise, in another study it was assumed that renal damage caused by nephrectomy is associated with oxidative stress, glomerular hypertension, and hyper filtration; the researcher investigated the effects of turmeric on the mentioned renal damage. The results showed that turmeric was effective in preventing hemodynamic changes in glomerular blood circulation, inflammatory renal damage, and intensified renal function disorder caused by the reduction in kidney size (43).

In an interesting study, the effects of antioxidants present in the extracts of turmeric, shallots, and a combination of these two on the shelf life of fish past eat a temperature of minus 18°C were investigated. The results showed that the extracts of turmeric and shallot had antimicrobial and antioxidant properties which protected the good features of frozen fish paste and delayed the microbial corruption, fat corruption, and protein corruption (44).

The anti-parasitic effects of turmeric are reported by a study. According to the mentioned study, the hydro-alcoholic extract of turmeric and licorice had anti-parasitic (anti-leishmania) effects. In addition, the overall effects of turmeric was stronger than that of licorice (45).

In another study on animal samples it was shown that turmeric extract was effective in treating and healing wounds (46).

Human studies

Given the multiple properties of turmeric reported in empirical studies, several different human studies have also been conducted to investigate its effects on diseases and disorders (47-62).

A study investigated the regular consumption of turmeric and the results showed that its consumption led to a reduction in plasma malondialdehyde and increased the activity of antioxidant enzyme of red blood cells and catalase in patients with CRF (47). It also improved some serum indices such as serum LDL-C and HDL-C (48).

According to the results of a meta-analysis study, it is suggested that the previously conducted studies have provided the necessary scientific basis to confirm the important role of turmeric in preventing and treating diabetes and its complications (49). Curcumin affects the majority of the mechanisms of diabetes, such as insulin resistance, hyperglycemia, hyperlipidemia, and islet cells necrosis. However, it is noted that a majority of previously conducted studies investigated the effects of curcumin on diabetes complications including microalbuminuria, nephropathy, and retinopathy. Thus, further studies are needed to prove the effects of curcumin on diabetes (49).

According to the results of a clinical trial, the administration of turmeric by hemodialysis patients was associated with a significant reduction in inflammatory markers. Given the reduction and control of inflammatory factors IL-6, HSCRP, and TNF-α in patients consuming turmeric, it can be considered as an effective anti-inflammatory drug (50).

A review study has noted several other herbs that have anti-inflammatory properties. Turmeric is one of the plants which have an anti-inflammatory effect similar to that of ibuprofen (51).

Based on the results of another review study, turmeric plant has some pharmacological effects on diseases with metabolic disorders such as cancer, liver and gastrointestinal disorders, cardiovascular diseases, Alzheimer's disease, arthritis rheumatoid, and diabetes. The mentioned study suggested carrying out further clinical trials to prove its efficacy (52).

Wound healing was one of the effects of turmeric observed in animal studies (46). A human study reported the effect of turmeric ointment on healing wounds caused by episiotomy. In the mentioned study it was shown that the use of turmeric ointment increased the speed of recovery of episiotomy wounds (53).

A study investigated the effects of turmeric consumption on anthropometric indices, glycemic status, and fat profile in patients with diabetes type II. The results of the mentioned study indicated that the consumption of turmeric powder improved serum fat profile and reduced body mass index in patients with diabetes type II; however, it did not have any effect on glycemic status (54).

The results of another study showed the protective effects of turmeric against chronic heart disease; as reported, the observed effect was associated with its anti-oxidative properties (55).

Another study highlighted the important role of mitochondria in the course of some diseases including CKD; it reported that some antioxidants such as curcumin are effective in the prevention of infection and the inhibition of the progress of diseases (56).

According to the results of a research study, curcumin can act as an agent to inhibit cell divisions, thus prevent cancers caused due to the uncontrolled divisions of cells. However, to prove this finding further studies are needed to investigate the protective effects of this plant against cancers (57).

A study investigated the antioxidant and anti-inflammatory effects of turmeric over a period of eight weeks in patients with CKD. The study reported that consuming turmeric for eight weeks did not have any effects on inflammatory and antioxidant activity levels in patients with CKD (58).

As the results of another study showed, curcumin had an inhibitory effect on cytokines and TGF-β. The study suggested that supplements containing curcumin were apparently useful for patients with CKD and prevented the progress of the disease (59).

Based on the results of a study, the consumption of supplements containing turmeric concurrent with an aerobic exercise for six weeks had a positive effect on reducing CRP. In addition, it was found that physical activity along with turmeric supplemental ion had positive effects on body structure in the long- term (60).

The protective effects of turmeric against kidney disease are reported by other studies as well; as they have suggested, the consumption of curcumin could prevent the progress of the disease (61,62).

Conclusion

Previous studies which have been conducted on animal samples and clinical trials have somewhat provided scientific evidences to confirm that curcumin is effective in treating and preventing the progress of renal complications in diabetes and healing wounds, pains, and inflammation of the joints. Based on the results of both animal and human studies, the administration of turmeric has been effective in healing several different diseases. Turmeric is a material with strong anti-inflammatory and antioxidant properties. Given the properties of turmeric, its consumption has been recommended to control digestive and liver diseases, cancer, arthritis, allergy, asthma, atherosclerosis, Alzheimer's disease, and high blood sugar. Given the results of studies conducted on the anti-inflammatory effects of turmeric, it can be concluded that turmeric can be used as a proper source for the preparation and production of anti-inflammatory drugs or a supplementary pharmaceutical to be administered for hemodialysis patients. Treatment by pharmaceutical herbs is increasingly recognized as one of the main components of complementary medicine. Before the initiation of the use of alternative and complementary medications, it is necessary to conduct exact tests to evaluate the mechanism of action, complications and side effects, and drug interaction and tolerance.

It should be also considered that further studies are needed to prove the positive effects of turmeric on the prevention and treatment of different diseases.

Authors' contribution

MZ searched and gathered the related articles as well as writing. MZ prepared the draft. MRT edited the final manuscript several times. All authors read and signed the final paper.

Conflicts of interest

The authors declare no conflict of interest.

Ethical consideration

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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