

Copper and Metabolic Syndrome: A Possible Correlation

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Metabolic syndrome (MetS), which involves the combination of risk factors for cardiovascular disease such as insulin resistance, abdominal fat, dyslipidaemia, glucose intolerance, and hypertension, has often been associated with more severe liver abnormalities [1]. The prevalence of overweight (body mass index > 25) and obesity (body mass index > 30) has reached epidemic proportions in most of the developed world. Obesity increases the risk for several co-morbidities including type 2 diabetes (T2DM), stroke, cardiovascular disease (CVD), and MetS, the further expression of which is hepatic steatosis [2]. The wide changes in life style and food habits occurred in the last decades, typically in the western countries, causing a pronounced increase of metabolic derangements occurrence.

Of particular interest is, even if too often understated, the association of several metabolic derangements to the deregulation of metal homeostasis. Trace elements have an important role in metabolism, growth, immunological, and neurological functions [3]. Copper, an essential trace element playing an important role in the human metabolism, primarily as a cofactor of many metalloenzymes, is mainly found in shellfish, organ meats, nuts, seeds, vegetables, and grains [3]. Throughout the years it has been shown that copper abnormalities are linked to CVD and cancer [4]. In fact, its deficiency may lead to arterial diseases and myocardial disease, besides pigmentation loss and neurological effects [3]. Copper exerts cytotoxic and genotoxic effects on human cells probably by enhancing the generation of reactive oxygen and nitrogen species [5]. In fact, it acts as a cofactor of key antioxidant enzymes such as superoxide dismutase and glutathione peroxidase [6]. It has been suggested that modifications of copper levels could cause changes in the activity of these enzymes, resulting in important consequences on the generation of reactive oxygen as well as nitrogen species and free radicals results in induction of oxidative stress in the cells and enhance antioxidant capacity [5,6].

Dietary copper is absorbed in the stomach and in the upper intestinal tract and reaches liver as a complex with serum proteins, such as albumin, or amino acids. Liver is the major storehouse for copper that is, in turn, reduced in a cupric state and transported across plasma membrane by CTR1 transporters.

This metal has a great redox potential and, for this reason, is a main cofactor for several enzymatic reactions and participates in cellular metabolism, e.g. aerobic respiration and antioxidant defense, ensuring the survival of living organisms [3-6].

Altered copper levels can promote oxidative stress occurrence, and related dysfunctions, like inflammation onset [7,8]. Accordingly, it is not surprising the very complex and redundant machinery that characterizes the control of copper, compared to other metals. It is clear that intracellular and extracellular copper needs to be maintained in a complex state to prevent the oxidative damage caused by free copper to DNA, proteins and membrane components.

Copper has the potential to give an important contribution to atherogenesis through its effects on extracellular matrix molecules and cells of the arterial wall, as well as on atherosclerotic plaques [9,10] and on platelet function. Furthermore, it was demonstrated that copper ions can catalyze the oxidative modification of low density lipoprotein (LDL) [11]. Furthermore, findings in human aortic endothelial cells suggest that intracellular copper causes activation of redox-sensitive transcription factors and up-regulation of protein

expression of vascular cell adhesion molecule-1 (VCAM-1), intercellular adhesion molecule-1 (ICAM-1), and monocyte chemoattractant protein-1 (MCP-1). On the other hand, copper chelation may attenuate TNF α -induced endothelial activation and, hence, inhibit vascular inflammation and atherosclerosis [12].

It's suggest that higher flavonoid intake, the most common group of polyphenolics in the human diet and relatively abundant in fruits, vegetables, grains, herbs, and beverages, is associated with a lower risk of MetS, especially under high levels of copper intake [13]. Recently, it's suggested that copper was associated with MetS and miR-21-5p, expression of gene significantly higher in subjects with MetS than those without MetS, participated in the development of MetS associated with copper [14]. Another, the diverse effects of flavin-containing and/or copper-containing amine oxidase inhibitors impairing adipocyte differentiation or limiting excessive fat accumulation indicates that further studies are needed to reveal their potential anti-obesity properties [15].

However, effects of copper on MetS and the mechanism underlying this effect are poorly understood. Several studies concerning copper in association with MetS have presented conflicting results in different countries. The clinical significance of these previous observations warrants further studies to investigate the role of copper in the development of MetS. Prospective or longitudinal studies are necessary to further clarify the association and/or correlation between copper and MetS.

Disclosure Statement

The author declare that there are no conflicts of interest.

Bibliography

1. Tarantino G and Finelli C. "What about non-alcoholic fatty liver disease as a new criterion to define metabolic syndrome?" *World Journal of Gastroenterology* 19.22 (2013): 3375-3384.
2. Finelli C., *et al.* "Should visceral fat be reduced to increase longevity?" *Ageing Research Reviews* 12.4 (2013): 996-1004.
3. Vetchý MPJVKKD. "Biological role of copper as an essential trace element in the human organism". *Ceská a Slovenská Farmacie* 67.4 (2018): 143-153.
4. Bost M., *et al.* "Dietary copper and human health: Current evidence and unresolved issues". *Journal of Trace Elements in Medicine and Biology* 35 (2016): 107-115.
5. Husain N and Mahmood R. "Copper(II) generates ROS and RNS, impairs antioxidant system and damages membrane and DNA in human blood cells". *Environmental Science and Pollution Research International* (2019).
6. Wu X., *et al.* "Influence of Dietary Copper Methionine Concentrations on Growth Performance, Digestibility of Nutrients, Serum Lipid Profiles, and Immune Defenses in Broilers". *Biological Trace Element Research* (2018).
7. Hassan I., *et al.* "Copper Mediates Anti-Inflammatory and Antifibrotic Activity of Gleevec in Hepatocellular Carcinoma-Induced Male Rats". *Canadian Journal of Gastroenterology and Hepatology* (2019): 9897315.
8. Polloni L., *et al.* "Action of copper (II) complex with β -diketone and 1,10-phenanthroline (CBP-01) on sarcoma cells and biological effects under cell death". *Biomedicine and Pharmacotherapy* 112 (2019): 108586.
9. Gao W., *et al.* "Copper sulfide nanoparticles as a photothermal switch for TRPV1 signaling to attenuate atherosclerosis". *Nature Communications* 9.1 (2018): 231.

10. Fukai T, *et al.* "Copper transporters and copper chaperones: roles in cardiovascular physiology and disease". *American Journal of Physiology-Cell Physiology* 315.2 (2018): C186-C201.
11. Bayrak A, *et al.* "The effect of HDL-bound and free PON1 on copper-induced LDL oxidation". *Chemico-Biological Interactions* 257 (2016): 141-146.
12. Wei H, *et al.* "Copper induces--and copper chelation by tetrathiomolybdate inhibits--endothelial activation in vitro". *Redox Report* 19.1 (2014): 40-48.
13. Qu R, *et al.* "Dietary Flavonoids, Copper Intake, and Risk of Metabolic Syndrome in Chinese Adults". *Nutrients* 10.8 (2018): E991.
14. Guo X, *et al.* "Associations of blood levels of trace elements and heavy metals with metabolic syndrome in Chinese male adults with microRNA as mediators involved". *Environmental Pollution* 248 (2019): 66-73.
15. Carpené C, *et al.* "Past, Present and Future Anti-Obesity Effects of Flavin-Containing and/or Copper-Containing Amine Oxidase Inhibitors". *Medicines (Basel)* 6.1 (2019): E9.

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