

Is Taurine a Pharmaconutrient?

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Traditionally food and medicine has over lapping responsibility for well-being. Though medicine has well define role in treatment yet there are several conditions where only medicine is not delivering the effects as desire, especially in surgery, critical illness, burn and other wound healing. In such situation, several parenteral and enteral nutritional supplements have been designed, use and placed under broader term, immunonutrition, later to utilize nutritional treatment in all such happing constitute the term pharmaconutrition. Hence in historical term, immunonutrition is the precursor pharmaconutrition. Pharmaconutrition can be defined as the use of nutrients for their abilities to exhibit their potentials to modulate inflammatory and/or immune response, facilitating healing or endocrine actions. Numbers of the recognized pharmaconutrients are not too many, basically extending their support as antioxidant and strengthens the host defense [1-2].

One of best known pharmaconutrient Parenteral Glutamine is recommended in patients receiving parenteral nutrition, while enteral Glutamine is considered effective in alleviation of suffering in burn and trauma patients. Antioxidant selenium is considered beneficial for critical ill patients and eternal formulas enriched with fish oils are recommended in patients with acute respiratory distress syndrome. The basic mechanism of the pharmaconutrition is to modulate the inflammatory and immune responses associated with critical illness and to provide benefit in such situation. To determine the such mechanism of beneficial action of any agent, is now largely govern through concepts of modern biology in which antioxidant have prominent role. Oxidative modified biomolecules have been identified in numerous diseases and pathological conditions, from neurological and cardiovascular injury to liver and kidney dysfunctions and in modern diseases like cancer, diabetic, HIV as well as diseases rolling from one to next generation. Physiological and patho-physiological mechanism for generation of reactive oxygen species (ROS), responsible for oxidative activities has been advocated. Primarily molecules containing oxygen radicals and resultant modified biological molecules by various kinds of ROS are core of diseases state. ROS are believed to induce highly adverse processes; including oxidation of lipids, amino acid side chains, formation of protein-protein cross linkages overall leading to severe biological damage.

Sulphur represents about 25% of our body weight sulphur has been in use since early 1800s. Grandma's "spring tonic" considered mainly of sulphur and molasses and also acted as laxative. Sulphur is known as "beauty mineral" it helps the complexion and skin clear to being youthful. Sulphur is absorbed from the small intestine primarily as the sulphur containing amino acids. Sulphur containing amino acids are not present in too many forms. One of the important sulphur containing amino acids is taurine which is chemically 2-Amino

ethane sulfonic acid ($\text{NH}_2\text{-CH}_2\text{-CH}_2\text{-SO}_3\text{H}$) in which sulphur is in reduced form. Sulphur in lower oxidation state somehow protect from radiation damage. Taurine is most abundant free amino acid found in almost every mammalian tissue, a normal human of 70 Kg contains 70 gram of taurine.

Taurine is now recognized as conditional essential amino acid [3]. Its potential clinical benefits provide a label of a Meta vitamin to pharmaconutrient. With ageing taurine synthesis decreases and slowly reduced to almost negligible hence diet is the only source, taurine is rich in non-vegetarian sources, and much more is marine products. Taurine has a unique chemical structure that implies important physiological functions bile acid conjugation and cholestasis prevention, antiarrhythmic/inotropic/chronotropic effects, neuromodulation, retinal development and function endocrine metabolic effects, and antioxidant/anti-inflammatory properties [4-9]. Taurine is an essential amino acid for preterm neonates and is assured by breast milk. Specific groups of individuals are at risk for taurine deficiency and may benefit from supplementation e.g. patients requiring long term parenteral nutrition (including premature and newborn infants) [10] and those with chronic hepatic, heart or renal failure. Further studies are required to determine the benefits of replenishing taurine pools as well as the need to include taurine routinely in parenteral nutrition regiments. Nutrition is a key part of the changing and evolving patho-physiological state and nutritional substances can modify metabolism and specific biological functions. Brain also need a continual supply of amino acids and amino acid profile of the cerebral extracellular milieu is a function of its content and nature with taurine presence in high concentration, must provide its active participation in brain functioning.

Taurine actions mechanism support the involvement of taurine is several ways from antioxidant to osmoregulation and in membrane stabilization to management of calcium ions. Taurine antioxidation action is now a well establish function with sequencing of free radicals and participation in host defense [11]. Antioxidation potentials are major criteria for being a pharmaconutrient. To support taurine candidature Clinical studies has also establish the significance of taurine in premature infants with a note the during parenteral nutrition it is possible to achieve taurine levels as high as in breast fed by substituting taurine at an amount of 0.5 g taurine per kg body weight.

Subnormal taurine concentration commonly occur in malnourished post-operative cancer patients surgery further precipitates in the fall of taurine level, however plasma concentration were maintained only with taurine supplemented PN. It is also essential amino acid to prevent cholestasis in neonates and it should be part of PN. Utility of taurine under trauma patients has recorded history of more than two decade

and it was observed that taurine supplementation is essential in post injury state in trauma patients [12]. Besides this role of taurine in pharmaconutrition got strength with necessity of taurine in PN & EN amino acid profile in post operative phase of orthotopic liver transplantation [13]. In the past decade taurine has been extensively used as nutritional supplement for hypoalbuminemic hemodialysis as part of nutritional mixture having as much as 75 mg taurine daily [14]. To support taurine claim as pharmaconutrient, in postoperative case of colonic surgery development of hyperbilirubinemia has been observed which cannot be corrected alone by UFT therapy however in combination with taurine hyperbilirubinemia was successfully eliminated [15]. Adult with short bowel syndrome undergoing long term PN, it is found that taurine supplemented PN is more effective. In analogies to taurine one of its natural derivative N-Chloro taurine (NCT) has been found to be safe substitute for post-operative ear care following tympanoplasty. Antiseptic and drying effect of NCT is faster without impaired epithelialization [16]. Another taurine analogue taurolidine in coronary artery bypass grafting patient induced potent anti-inflammatory response that is associated with a significant decreases in arrhythmias, it is establish that taurolidine such beneficial action is through its metabolite taurine [17-19]. Taurine supplementation in PN also has corrective role in PN associated hepatostosis.

TPN Taurine improves small intestine mucosal thickness and villus height. Taurine deficiency during the neonatal period is associated with adverse long term neuro developmental outcome in preterm infants. Current standard practice is to supplement formula milk fed parenteral nutrition solution with taurine, insufficient taurine supply may also has detrimental effects during embryonic development, neo natal as well as in adulthood and possibly it may become constituent of diseases of generation. Hence now it can be believed that nutritional antioxidant can play a greater role in modulation of inflammation the visible evidence of diseased state. Early nutritional support providing energy and a balance mixture having indispensable as well as conditionally indispensable nutrients is life saving requirement current standard diets are less effective than new generation biotherapies and could be improved more by supplementation with specific amino acid like taurine hence must be part of effective medical therapy.

Taurine is now part of therapy for diabetes, hypertension, CHF, alcohol toxicity and damage, early recovery from muscle damage and reducing sleeping time. It is now part of several functional foods, nutraceuticals [20-22] and even in tailor made specific “designer” food. In short taurine acts as a recognized pharmacological agent, since its synthesis is almost negligible hence the only regular supply route is through nutrition and because of this, and its established beneficial action as in EN, PN, TPN as well as components of drug therapy, functional food, nutraceuticals thus it deserves to be called pharmaconutrient, of course biological science is not a fixed commodity, and chemicals are not single minded they may change their behaviour in altered conditions hence we have to always vigil to choose or accept for ever.

References

1. Télessy I. Pharmaconutrition: pharmacological approach to nutrition therapy. 2014;155(51):2021-7.
2. Ginguay A, De Bandt JP, Cynober L. Indications and contraindications for infusing specific amino acids (leucine, glutamine, arginine, citrulline and taurine) in critical illness. *Curr Opin Clin Nutr Metab Care*. 2016;19(2):161-9.
3. Loureco R, Carilo NE. Taurine a conditionally essential amino acid in Human? An over view in health and disease *Nutr*. 2002;17:262-70.
4. Gupta RC, Win T, Bittner S. Taurine analogues; A new class of Therapeutic: Retrospect and prospects. *Curr Med Chem*. 2005; 12(17):2021-39.
5. Gupta RC, Y Seki, Yosida J. Role of Taurine in Spinal cord injury. *Curr Neurovas Res*. 2006;3(3):225-35.
6. Kim SJ, Gupta RC, Lee HW. Taurine-Diabetes interaction: From involvement to protection. *Curr Diabetes Rev*. 2007;3(3):165-75.
7. Samuelsson M, Dalh ML, Gupta RC, et al. Taurine in plasma and CSF: A study in healthy male volunteers. *Aminoacids*. 2008;36(3):529-33.
8. S J Kim, Lee HW, Gupta RC. Taurine. Bone growth and Bone development. *Curr Nutr Food Sci*. 2008; 4(2):135-44.
9. Gupta RC, D'Archivio M, Masella R. Taurine as drug and functional food component. Glutathione and sulfur Amino Acids in human health and disease. 2009:543-78.
10. Verner AM, Craig JS, McGuire w. Effect of Taurine supplementation on growth and development in preterm or low birth weight infants. *Cochrane Database syst Rev*. 2007;17(4):CD006072.
11. Stapleton PP, O'Flaherty L, Redmond HP, et al. Review: Host defense-A role for the amino acid taurine? *J Parenter Enteral Nutr*. 1998;22(1):42-8.
12. Paauw JD, Davis AT. Taurine concentration in serum of critically injured age and sex matched healthy control subjects. *AM J Clin Nutr*. 1990;52(4):657-60.
13. Iapichino G, Ronzoni G, Bonetti G, et al. Determination of the best amino acid input after orthotopic liver transplantation. *Minerva Anestesiol*. 1992;58(9):503-8.
14. Kalantar-Zadeh K, Braglia A, Chow J, et al. An anti-inflammatory and antioxidant nutritional supplement for hypoalbuminemic hemodialysis patients: A pilot/feasibility study. *J Ren Nutr*. 2005;15(3):318-31.
15. Miyata K, Ikawa O, Izumi H, et al. Efficacy of the combined use of taurine for hyperbilirubinemia caused by UFT therapy after surgery for colonic cancer. 2006;33(5): 671-3.
16. Gottardi W, Nagl MJ. N-chlorotaurine, a natural antiseptic with outstanding tolerability. *Antimicrob Chemother*. 2010;65(3):399-409.
17. Schneider SM, Joly F, Gehardt MF, et al. Taurine status and response to intravenous taurine supplementation in adults with short-bowel syndrome undergoing long term parenteral nutrition: a pilot study. *Br J Nutr*. 2006;96(2): 365-70.

18. Kats S, Schönberger JP, Brands R, et al. Endotoxin release in cardiac surgery with cardiopulmonary bypass: pathophysiology and possible therapeutic strategies. An update. *Eur J Cardiothorac Surg*. 2011;39(4):451-8.
19. Doddakula KK, Neary PM, Wang JH, et al. The antiendotoxin agent taurolidine potentially reduces ischemia/reperfusion injury through its metabolite Taurine. *Surgery*. 2010;148(3):567-72.
20. Gupta RC. Selenium and Taurine: Components of functional food for sound health. *Nutr Health*. 20:1-9.
21. Gupta RC. Natural Small molecules in protection of environment and health-sulfur selenium deficiency and risk factor for man, animal and environment. 2015:83-4.
22. Gupta RC, Pinho RA, Thirupathi A, et al. Modulatory effects of taurine on parameters of metabolic and oxidative stress in an experimental model of muscle overuse. *Nutrition*. 2018.

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