European Review for Medical and Pharmacological Sciences 1998; 2: 165-167

Editorial

Chronic alcohol abuse and nutritional status: recent acquisitions

G. ADDOLORATO

Institute of Internal Medicine, Catholic University of "Sacro Cuore" - Rome (Italy)

Introduction

Alcohol addiction is a social problem and a relatively common disease of western countries like Europe and the USA. From 20 to 40 % of subjects admitted to hospitals have alcohol-related problems[1] and in elderly people alcohol-related disorders represent as frequent a reason for hospitalization as myocardial infarction[2]. Among the diseases related to alcoholism, nutritional disorders remain one of the bigger medical problems.

The metabolic effects and nutritional value of ethanol differ in relation to the drinking patterns. In social drinkers while the intake of small quantities of alcohol seems to have no effect on body composition or metabolism[3] and ethanol can be utilized as a source of energy[4], the ingestion of acute heavy amounts of alcohol leads to lipid storage and to an increase in body weight via its lipid-oxidizing suppressive effect[5], representing a risk factor for obesity[6]. On the other hand a common feature in alcoholics is reduced body weight and malnutrition. Chronic alcohol abuse deeply affects nutritional status, firstly due to the fact that ethanol may supply more than 50% of the dietary energy in alcoholics[7,8], partly related to the high caloric content of ethanol (7.1 kcal/g) and partly due to the action of alcohol as an appetite suppressant[9], and therefore displaces normal nutrients such as folate, thiamine and other vitamins. In addition chronic intake of heavy amounts of alcohol may cause substrate maldigestion or malabsorption originated by liver[4], pancreatic[9] and small intestine complications[10], and the main mechanisms responsible for the secondary malnutrition in alcoholics are well known. Malabsorption of intestinal origin is present in more than 60% of subjects affected by alcoholism and an impairment of D-xylose tests of vitamin B_{12} absorption[9], an impairment of lactulose breath hydrogen test indicating an alteration in orocoecal transit time[10], steatorrhea by pancreatic disorders[11] and impaired hepatic metabolism of nutrients[1] are frequently present in these patients. However, it is precisely the presence of the hetrogeneicity of the alcohol-related diseases that has represented a confounding factor in the studies on the metabolic and nutritional effects of ethanol performed in alcoholics; in particular the effects of alcohol addiction on energy metabolism, substrate oxidation and body composition in humans are still not well known and it remains unclear whether weight loss and malnutrition in these patients are caused by the damage produced by ethanol on the above mentioned organs or – in addition- by alcohol per se. This topic is gaining great interest amomg researchers in alcohol addiction medicine since it could be of interest for pratictioners in alcoholism management.

Our group recently performed several studies aimed at evaluating the effect of chronic alcohol abuse on energy metabolism and substrate oxidation in alcoholics without clinical or laboratory evidence of liver diseases or malabsorption and which alcohol was not utilized as a food substitute[12,13].

In agreement with previous studies[5], alcoholic patients showed an increased resting energy expenditure (REE) related in part to the induction of microsomal ethanol oxidizing system (MEOS) caused by chronic alcohol abuse. From a metabolic point of view, for the

first time an alteration in substrate oxidation was found in alcoholics that showed a higher utilization of lipids and a lower carbohydrate oxidation as indicated by the significantly lower non-protein respiratory quotient (npRQW); our findings could explain the reduction in fat mass (FM) usually shown by alcoholics[12]. Moreover, besides a reduction in FM, an alteration in fat distibution was found, as shown by the increase in the waist-to-hip ratio (WHR) indicating a greater body fat localization in the intra-abdominal region, which is considered as "harmful fat" for hypertension and cardiovascular diseases. For the diagram of the suggested mechanism on the basis of the increased REE and lipid oxidation, reduced FM and alteration of fat distribution see reference 13; briefly, in social drinkers ethanol oxidation to acetaldheyde via the alcohol dehydrogenase system (ADH) is associated with the generation of NADH which leads to ATP synthesis and energy storage. In alcoholics ethanol is mainly oxidized via MEOS; in this case a high energy compound, NADPH, is utilized, but he reaction generates only heat and no ATP is formed. The increase in cathecolamine release by acetaldheyde and of cardiac output by acetate contribute to raising energy expenditure.

Moreover, the oxidative stress could contribute to the formation of giant mitochondria[14], with a possible adaptation and induction of mitochondrial function resulting in an increased fat oxidation.

At the same time the alteration of hormonal balance related to chronic alcohol abuse could determine an alteration of fat deposition. These findings in alcoholics without severe liver disease and malabsorption suggest that alcohol addiction per se is able to determine an impairment of nutritional status, since the metabolic patterns of alcoholics cause these patients to react to alcohol loads in a different way with respect to healthy social drinkers[13]. Our observations were supported by another research group that subsequently found the presence of malnutrition in alcoholics with no evidence of pancreatic or liver injury[15]. More recently we showed the these metabolic changes are completely reversible, at least in patients without severe alcohol-related diseases, after 3 months of alcohol abstinence without drug therapy and/or nutritional supplementation[16]. The period of abstinence could represent the minimum time necessary to obtain a normalization of the nutritional status, probably related to a regression of the alteration of the MEOS and of mitochondria. The reversibility of mitochondria functional alteration could be related to the termination of alcohol-related oxidative stress and to a recovery of the antioxidant status, as recently shown by our group in ethanol treated rats after alcohol discontinuation[17].

With respect to non-cirrhotic subjects, alcoholics affected by liver cirrhosis shows not only increased REE, preferential lipid oxidation and reduction in FM, but also a reduction in fat free mass (FFM)[18-20]. This could be due to the low protein intake with the diet in cirrhotics coupled with the catabolic state as confirmed by the higher urinary nitrogen loss usually found in these patients[18].

Finally, a further alteration in nutritional status parameters present in alcoholics is the variation in body fluid distribution; in particular, an increase in extra-cellular water (ECW) compartment related to endothelial damage was recently found in subjects with chronic alcohol abuse[21]. Since high ECW volumes positively correlated with WHR, a potential association of these 2 factors in determining an increased risk of liver disease, hypertension and cardiovascular disease could be hypothesized[21].

In conclusion several nutritional disorders are present in alcoholics both secondary to alcohol-related diseases and to alcohol addiction per se. Since malnutrition by itself is related to an increased risk of morbidity and mortality for several illnesses, including liver and cardiovascular diseases, a nutritional and metabolic assessment with the aim of recovering an optimal nutritional staus seem to be necessary and could greatly improve the quality of life for these patients.

References

1) Lieber CS. Medical disorders of alcoholism. N Engl J Med 1995; 333: 1058-1065.

2) Adams WL, Yuan Z, Barboriak JJ, Rimm AA. Alcohol-related hospitalizations of elderly people. JAMA 193; 270: 1222-1225.

3) Cordain L, Bryan ED, Melby CL, Smith MJ. Influence of moderate daily wine consumtion on

body weight regulation and metabolism in healthy free-living males. J Am Coll Nutr 1997; 16: 134-139.

4) Lieber CS. Hepatic, metabolic and toxic effects of ethanol: 1991 update. Alcohol Clin Exp Res 1991; 15: 573-592.

5) Suter PM, Schutz Y, Jequier E. The effect of ethanol on fat storage in healthy subjects. N Engl J Med 1992; 326: 983-987.

6) Salvagnini M, Martines D. Alcohol and nutrition: changing the risk from malnutrition to hypernutrition. Alcologia Eur J Alcohol Stud 1997; 9: 75-76.

7) Dennis BH, Haynes SG, Anderson JJB, Liu-Chi SB, Hosking JD, Rifkind BM. Nutrient intake amomg selected North American populations in the Lipid Research Clinics Prevalence Study: composition of energy intake. Am J Clin Nutr 1985; 41: 312-329.

8) Thomson M, Fulton M, Elton RA, Brown S, Wod DA, Olivier MF. Alcohol consumption and nutrient intake in middle-aged Scottish men. Am J Clin Nutr 1988; 47: 139-145.

9) Greco AV, Gasbarrini G. Alcoholism, malabsorption and malnutrition. Alcologia Eur J Alcohol Stud 1996; 8: 11-20.

10) Addolorato G, Montalto M, Capristo E, Certo M, Gentiloni N, Stefanini G, Gasbarrini G. Influence of alcohol on gastrointestinal motility: lectulose breath hydrogen testing in orocoecal transit time chronic alcoholics, social drinkers and teetotaler subjects. Hepatogastroenterology 1997; 44: 1076-1081.

11) Baum R, Iber FL. Alcohol, the pancreas, pancreatic inflammation and pancreatic insufficiency. Am J Clin Nutr 1973; 26: 347-351.

12) Addolorato G, Capristo E, Greco AV, Stefanini GF, Gasbarrini G. Energy expenditure, substrate oxidation, and body composition in subjects with chronic alcoholism: new findings from metabolic assessment. Alcohol Clin Exp Res 1997; 21: 962-967.

13) Addolorato G, Capristo E, Greco AV, Stefanini GF, Gasbarrini G. Influence of chronic alcohol abuse on body weight and energy metabolism: is excess ethanol consumption a risk factor for obesity or malnutrion? J Intern Med 1998; 244: 387-395.

14) Wakabayashi T, Adachi K, Matsuhashi T, Wozniak M, Antosiewicz J, Karbowsky M. Suppression of the formation of megamitochondria by scavengers for free radicals. Molec Aspects Med 1997; 18 (Suppl): s51-s61.

15) Gloria L, Cravo M, Camilo ME et al. Nutritional deficiencies in chronic alcoholics: relation to dietary intake and alcohol consumption. Am J Gastroenterol 1997; 92: 485-489.

16) Addolorato G, Capristo E, Greco AV, Caputo F, Stefanini GF, Gasbarrini G. Three months of abstinence normalizes energy expenditure and substrate oxidation in alcoholics: a longitudinal study. Am J Gastroenterol 1998; 93: 2476-2481.

17) Addolorato G, Gasbarrini A, Marcoccia S et al. Prenatal exposure to ethanol in rats: effect on liver energy level and antioxidant status in mothers, fetuses, and newborns. Alcohol 1997; 14: 569-573.

18) Addolorato G, Capristo E, Caputo F, Foschi FG, Greco AV, Gasbarrini G. The influence of chronic alcohol abuse on energy metabolism and substrate oxidation in humans: evaluation of nutritional status in subjects with and without alcoholic liver cirrhosis. Alcologia Eur J Alcohol Stud 1998; 10: 56-61.

19) Greco AV, Mingrone G, Capristo E et al. Daily energy and substrate metabolism in patients with cirrhosis. Hepatology 1998; 27: 346-350.

20) Owen OE, Trapp VE, Reichard GA et al. Nature and quantity of fuels consumed in patients with alcoholic cirrhosis. J Clin Invest 1983; 72: 1821-1832.

21) Addolorato G, Capristo E, Caputo F, Greco AV, Ceccanti M, Stefanini GF, Gasbarrini G. Nutritional status and body fluid distribution in chronic alcoholism acompared to controls. Alcohol Clin Exp Res 1999 (in press).