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Influence of alcohol on several physiological functions and its reversibility: a surgical view

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Abstract — Alcohol intake influences several physiological functions, including the haemostatic system, the cellular immune defence and the cardiac function, but to a different degree depending on the drinking habits.

Restoration of these functions after withdrawal seems time related. The haemostatic imbalance normalizes within two or three weeks of soberness while the immune system requires about two months to recover.

Recent studies have showed very increased postoperative morbidity after surgery in alcohol abusers, which may be explained by alcohol-induced physiological dysfunctions.

Theoretically, two months of abstinence before a surgical procedure would diminish the increased postoperative morbidity among alcohol abusers. However, further investigation is necessary to establish a clinical effect of preoperative withdrawal from alcohol.

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Introduction

Alcohol has numerous side effects, including suppression of many physiological functions. These dysfunctions are generally of minor importance and do not greatly influence the morbidity of the moderate alcohol user. However, recent studies of asymptomatic alcohol abusers who had undergone surgery have led to interest in the clinical relevance of these dysfunctions (1—5) and their reversibility after withdrawal of alcohol.

Definitions

In this paper, the term asymptomatic alcohol abuser is used to define the abuser with no alcohol-related sequelae, such as cirrhosis, cardiovascular disease, etc.

The definition of moderate drinking differs from one country to another, even from one author to another. The average daily consumption in Denmark is about two drinks, with 12 g of alcohol to one drink. In accordance with Danish drinking habits, 2—5 drinks is defined here as moderate consumption.

Other patterns of drinking are described for comparison. Heavy consumers, chronic abusers, and alcoholics (without liver disease) are taken as one group, defined by the consumption of at least 5 drinks a day and/or by suffering from all or most of the signs of the alcohol dependence syndrome.

Acute intoxication is often investigated in healthy volunteers drinking 12—60 g of alcohol under controlled circumstances.

The haemostatic system

This system is rather vulnerable and alcohol consumption affects it at several levels. The formation of thrombocytes from megakaryocytes, and the survival of platelets, are significantly inhibited by heavy drinking (6—7). The ability to aggregate is defective after acute (8—9), moderate (10), and heavy consumption (11). This may in part be due to a lower production or release of thromboxane A-2 (12) and/or to an alcohol-induced change in the membrane structure of the thrombocyte, as has been measured in heavy drinkers (13).

Coagulation is also disturbed by alcohol. All degrees of drinking prolong the bleeding time (9, 14), possibly because it reduces the activity of the product, thromboplastin, that starts the coagulation cascade, as has been found in acute drinking in healthy volunteers (8, 15).

Fibrinolytic activity is increased in moderate drinkers (16), whose concentration of fibrinogen is low (16). Acute drinking produces further defects, such as reduced activity of the tissue-plasminogen activator (8, 16), whereas decreased activity of antithrombin III and a high concentration of fibrinogen degradation products have been seen in animal models (17).

Surgical aspects

Defective thrombocyte function, slower coagulation processes, and increased fibrinolysis all work towards haemostatic imbalance. This may explain the increased incidence of bleeding episodes which require blood transfusion after colorectal surgery and transurethral prostatectomy in asymptomatic alcoholics (1—2).

Recovery

Abstinence from alcohol seems to reverse the haemostatic consequences quite quickly. Thrombocyte function (12, 18) and bleeding time are restored within three weeks (19—20).

However, very little is known about the reversibility of the fibrinolytic hyperactivity, and even less about recovery of haemostasis during disulfiram treatment. The latter may be of great importance, as disulfiram may increase fibrinolytic activity in healthy non-drinking volunteers (20).

The immune system

Owing to a direct toxic effect of alcohol on the bone marrow, the number of neutrophil granulocytes is reduced. Their function is also diminished because of decreased chemotaxis (21) and reduced phagocytosis (22). Mobilisation at the site of inflammation is unchanged in moderate drinkers (21), but slower in acute (23) and heavy drinkers (21).

Moderate and acute drinkers have neither lymphopenia nor a reduced number of T-cells (21, 24). The function of the T-cells and their subsets has not been investigated in moderate drinkers, but in heavy drinkers it is related to reduced proliferation and cytotoxicity (25). Delayed-type hypersensitivity is an index of cellular immune response, and it is reduced after both acute (21) and heavy consumption (26). Whereas the activity of natural killer cells may be increased by small amounts of alcohol, it is decreased in chronic drinking animals (27). This differentiation remains to be established in humans.

The humoral immune mechanisms in persons without liver disease seem less affected by alcohol intake. Only the primary antigen response of antibody production is reduced in heavy drinkers, whereas the anamnestic response is unchanged (21). Animal experiments simulating acute and moderate consumption indicate that the proliferation of B-cells is reduced (28). Experiments have also shown impairment of the soluble mediators of the immune system, the lymphokines (29).

The function of the macrophages is reduced in chronic alcoholics (30), but only animal experiments indicate slower and variations in phagocytic activity and concentration of tumour necrotising factor (31). Little is known about the changes in these cells among moderate drinkers.

Surgical aspects

Suppression of the cellular immune function may easily explain the extremely high incidence of infections seen after major and minor, elective and acute surgery on asymptomatic alcoholic men and women (1—5). Interestingly, routine cultivation of urine before and after transurethral prostatectomy showed no difference in the bacterial species between alcoholics and matched controls (2). The alcoholics did not develop unusual kinds of bacterial infection, and the infections showed no special pattern of postoperative resistance.

Recovery

Reversibility of immunity in moderate drinkers has not been investigated at all. Heavy consumers recover their cell counts and functions within two weeks (32—33), whereas their delayed-type hypersensitivity requires about two months to normalise (26). The influence of disulfiram on the immune system during withdrawal is unknown, but studies of a metabolite of disulfiram indicate an immunomodulating effect (34—35). This aspect requires further investigation.

The cardiac function

Acute and chronic alcohol intake induce hypertension. Both the diastolic and the systolic pressures are elevated (36—37).

Arrhythmia is often seen in alcoholics. The "holiday heart" is a supraventricular arrhythmia resulting from drinking binges (38). Premature atrial beats are the commonest arrhythmia found in chronic consumers (39).

Alcohol cardiomyopathy is found in several degrees from subclinical disorders (40) to fulminant insufficiency. Cardiac decompensation typically develops in men aged 30—55 years, who have consumed at least 80 g of alcohol a day for at least ten years (41). Acute intoxication raises the heart rate and reduces the left ventricular volume (42), but to a lesser degree than that seen in heavy drinkers (43).

Surgical aspects

Raised blood pressure and alcohol abuse in combination seem to be more harmful to left ventricular function than is either condition alone (44). When surgical stress is added, hypertensive problems may be inevitable.

The holiday heart syndrome and other alcohol-induced arrhythmias are often intermittent, depending on the drinking pattern, and may therefore be difficult

to diagnose. The clinical relevance of these intermittent conduction disturbances of the heart is not completely clear.

Minor degrees of cardiomyopathy also merit attention. For example the small ejection fractions found in heavy drinkers without symptoms of cardiac insufficiency (40, 45) could develop into symptomatic heart disease under surgical stress (1).

Recovery

Withdrawal may also produce intermittent hypertension, because of noradrenergic overactivity (46). However, the elevation in blood pressure, whether induced by alcohol or withdrawal from alcohol, and the increased heart rate will become normal within the first two to four weeks of abstinence (47—48).

Arrhythmia may also be aggravated by the higher concentration of catecholamine during withdrawal. The period of abstinence which is necessary for the restoration of cardiac conduction is still unknown.

Withdrawal of alcohol is associated with reversibility of cardiac depression. The ejection fraction normalises after one month of abstinence (40).

Theoretically, the alcoholic heart may also be vulnerable during the first month of withdrawal because of exaggerated noradrenergic function, so the introduction of more stress at this time may be risky.

Stress

The measurement of stress and stress-response in alcohol consumers is very difficult since both intake of and withdrawal from alcohol can cause changes.

Acute drinking may increase the resting blood pressure and heart rate, probably because of the simultaneous increases in plasma concentrations of cortisol and catecholamines reported in some (49—50), but not all, studies (51—52). Moderate consumption also results in higher blood pressure and faster heart rate, but without increased sympathoadrenal activity (53), and is comparable to the outcome of heavy drinking (54). Although plasma catecholamines and cortisol are not elevated in alcoholics during drinking, a central noradrenergic stimulation seems related to alcohol consumption (55—56). Whether the change in sympathoadrenal activity compensates for the alcohol-induced cardiac depression or whether it reflects a toxic effect on the sympathetic nerve endings is not clear. Moreover, the modulatory mechanism of the sympathoadrenal activity in alcoholics remains to be completely understood.

The response to physiological stress seems to be more pronounced in moderate and heavy drinkers than in non-drinkers (51, 54, 58). Probably because hard physiological work and test co-operation cannot be accomplished to the same degree during intoxication as in sobriety, the "true" stress response to drinking has not yet been determined.

Surgical aspects

When surgical stress is added to the stress response to drinking, the total response is considerably heightened (59). One would therefore expect the immune suppression usually seen after surgery (60) to be further aggravated. Preliminary findings appear to confirm this (61). With the added burden of the toxic effect of alcohol on the immune system, the outcome could be grave immunological defects, which may explain the severely increased incidence of infections found after surgery (1—5).

Recovery

Withdrawal of alcohol brings about overactivity of the sympathetic and dopaminergic systems and the stress level intensifies (41). Reversibility of alcohol-induced disturbances in the stress response cannot therefore be investigated independently of the withdrawal stress.

If withdrawal stress is comparable to physiological stress, further depression of the immune system can be expected (62). Its relevance is not quite clear, because the immune function is already seriously suppressed by alcohol before withdrawal.

Conclusion

The influence of alcohol ingestion on several physiological functions is an important issue. The effects of withdrawal are also of major importance, especially in the light of recent studies of operations on alcoholics. Abstinence before surgery should be recommended on medical considerations and not solely on moral grounds.

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Discussion

The problem with recruiting controls for any study of the effects of alcohol on normal physical functions was discussed. The average daily consumption of alcohol in the population seems to be in the range where several functions are affected.

There was agreement that although it might look evident that patients with alcohol-induced suppression of the immune system undergoing elective surgery should be put on Antabuse to support their abstinence from alcohol for some weeks before surgery, this cannot be recommended at present as no study has yet proved the value of a few weeks abstinence, whether achieved unsupported or with Antabuse.