WHL In Focus Statement

Alcohol and hypertension: Implications for management

Summary

This article presents clear-cut evidence for a pressor effect of alcohol in regular drinkers. The effect is seen in both men and women, appears to increase in magnitude with the amounts consumed daily, and is additive to that of obesity and oral contraceptive use. Alcohol may also contribute to refractoriness in anti-hypertensive drug treatment. This pressor effect is at least partially reversible by reducing the alcohol consumption. Further research is required on the mechanisms involved.

Introduction

A cause and effect relationship between regular alcohol consumption and blood pressure elevation was first suggested in 1915 by Lian (1), who described an increased prevalence of hypertension in French service men who drank more than 2,5 litres of wine per day. Since then sporadic reports linking alcohol and hypertension have continued to appear (2), but more definitive evidence on this relationship comes from a variety of sources, including population studies, cross-sectional studies on blood pressure in problem drinkers, detection of an increased prevalence of abnormal liver function tests in hypertensives, blood pressure measurements following abstention in problem drinkers, concordance studies in twins, mortality statistics for drinkers and non-drinkers, and, most recently, randomized controlled intervention trials of varying alcohol intake in normotensive and hypertensive subjects. Many of these studies have been reviewed elsewhere and all the evidence, taken together, suggests that regular alcohol consumption can now be regarded as a major contributor to blood pressure elevation in drinking communities (3-6).

Epidemiological evidence

There are now over forty population studies (3, 6) demonstrating an association between regular alcohol consumption, blood pressure levels and prevalence of hypertension. The largest of these, the Kaiser-Permanente Health Screening Survey (7), involved more than 80.000 persons aged 15 to 79 years and showed an average rise of 1 millimetre mercury systolic pressure for each standard glass of alcohol drunk per day, with an effect which was independent of age, sex, obesity, race, cigarette consumption, and educational attainment. Diastolic pressure showed a similar though less marked relationship. Those taking three or more drinks a day had roughly a twofold higher prevalence of hypertension (more than 160/95 mmHg) compared with non-drinkers. With minor variations similar data have now been produced from several continents (7-12), with the vast majority showing an independent relationship between alcohol and blood pressure levels which in some instances equalled in magnitude the relative effect of obesity (9,13) as the strongest identifiable factor contributing to blood pressure variations. A number of the studies, particularly those from North America (7. 8, 14, 15), have suggested a threshold for this effect of alcohol at around three standard drinks per day, with something of a J-shaped relation with blood pressure. However, many other studies, including those from different centres in Australia (9, 16, 17), have shown a

linear relationship throughout the entire range of alcohol consumption from one standard drink a day upwards. Possible reasons for these discrepancies are the inclusion of some heavy drinkers and ex-heavy drinkers in the so-called teetotal population and failure to adequately control for other factors such as obesity in some of the studies. There are particular difficulties in quantitating alcohol intake accurately from questionnaires, but despite this the estimated alcohol blood pressure relationships overall between many different communities remain consistent, in stark contrast with the difficulty in demonstrating within-population relationships between dietary sodium intake and blood pressure. For example, the Intersalt study of dietary factors influencing blood pressure levels in 52 populations worldwide showed a greater effect from alcohol consumption and obesity, than from salt intake. Only when the data were 'doctored' by being expressed in mmHg/year of age did a salt effect become significant (13).

Studies in Perth (Western Australia) have focused on the role of alcohol in relation to other life-style factors, and have used carefully designed 7-day retrospective diaries to assess drinking habits. In the study by Arkwright et al. (9) in 500 Caucasian men aged 20-44 years working in local government, systolic blood pressures increased progressively with increasing alcohol consumption with no obvious threshold effect, so that even those drinking 1 to 2 standard glasses of beer-equivalent per day had higher blood pressures than non-drinkers. There was an increasing prevalence of both systolic and diastolic hypertension (more than 140 mmHg and 90 mmHg, respectively) with increasing alcohol consumption, so that the 53% of the population who drank the equivalent of three or more glasses per day showed a fourfold increase in the prevalence of systolic hypertension (10.4%) compared with non-drinkers (2.5%) and a threefold excess of diastolic hypertension. The effects of body weight excess and alcohol consumption were independent but additive, while smokers had slightly lower blood pressures overall, but again showed a drinking blood pressure relationship even after adjusting for the effects of obesity.

In women the effects of alcohol use appear to be additive to that of the blood-pressure-raising effects of oral contraceptives, as demonstrated by Wallace et al. (8) in the Lipid Clinic Study in nine North American populations. Cooke et al. (16) in Sydney (Australia) examined their data specifically for the effects of lower levels of alcohol consumption in 20.000 men and women who attended health screening clinics and found a progressively linear relationship for both systolic and diastolic pressure in both men and women, with an apparent threshold for an effect of alcohol which disappeared after adjusting for the effects of age, obesity and smoking habits. Even those consuming as little as 6 standard drinks (60 grams of ethanol) a week had significantly higher blood pressures than non-drinkers.

The influence of the type of alcoholic beverage was addressed in the Lipid Clinic Prevalence Study (18) in which beer and spirit consumptions were independently associated with increasing blood pressure levels. Although most other studies were on populations drinking predominantly one type of liquor, the fact that they demonstrated an association with blood pressure levels regardless of whether the beverage consumed was mainly beer (17,19,20), wine (10), or mixed spirits, sake and beer (11), suggests that ethanol per se is the responsible agent. A specific pressure effect of ethanol has been confirmed by controlled trials in man, as discussed below. Whether other constituents of alcoholic beverages can modify this effect remains to be demonstrated.

Additional evidence

Circumstantial evidence supporting a causative effect of alcohol on hypertension comes from reports of a relatively high prevalence of abnormal liver function tests in hypertensive patients attending blood pressure clinics in Scotland (Glasgow) (21) and Sweden (22), and by similar findings in a case-controlled study of hypertensives in the Scottish Renfrew blood pressure screening surveys (23). Longitudinal studies have demonstrated an increased risk of developing hypertension in heavy drinkers (24), and the Framingham survey showed that changes in blood pressure over four years were in the same direction as changes in alcohol consumption (25).

Controlled studies

The most conclusive evidence for a direct pressor effect of regular alcohol consumption comes from the first two randomized controlled studies carried out by Puddey and colleagues in Perth. In the first (26) of these, 44 normotensive subjects were randomized into two groups for a two-period crossover trial in which alcohol consumption was varied between normal intake and 20% of normal intake by asking volunteers to consume either 5% or 0.9% ethanol beer. As the latter was a distillate of the standard beer it provided similar fluid intake and the same constituents of beer apart from ethanol per se. The subjects who had been drinking low-alcohol beer showed a highly significant independent effect of alcohol on systolic blood pressure with an average fall of around 3.4 mmHg: the effect appeared within two weeks of reducing the alcohol intake and persisted over six weeks, with a rise in blood pressure again when intake of normal beer was resumed. Changes in alcohol consumption were confirmed by corresponding changes in mean corpuscular volume, HDL cholesterol and both its sub-fractions, and gamma glutamyl transferase levels. A further trial of similar design was carried out in treated hypertensives (27) and again showed significant pressor effects of alcohol with changes in blood pressure of around 5 mmHg systolic and 2-3 mmHg diastolic with changes in alcohol consumption. Subsequent to this, similar effects have heen reported in untreated hypertensives (28) and in young normotensive student volunteers put on to programmed drinking over periods of 1-2 weeks. Potter and Beevers (30) admitted groups of drinking hypertensives to hospital and demonstrated a fall in blood pressure in eight subjects over 3-4 days following abstention, followed by a rise on resumption of their normal alcohol consumption. In all of these intervention studies the changes in blood pressure were gradual over a period of 1-2 weeks as a rule, clearly indicating that the effect of alcohol was not simply an acute withdrawal phenomenon on the morning after drinking the night before.

Unresolved issues

A number of important issues remain to be resolved. The first of these is the question of individual susceptibility to the blood-pressure-elevating effects of regular alcohol consumption. The epidemiological studies clearly showed that there are additive effects of alcohol with obesity (7, 9) and oral contraceptive use (8). The effects generally seem to be greater with increasing age (10), although the data on this are not entirely clear cut. Analysis of personality factors in the data of Arkwright et al. suggests that introverted drinkers are far more prone to blood pressure elevation than extroverts, particularly if they are non-smokers (31). The effects of factors such as family history of high blood pressure or of differences in metabolism of alcohol on the pressor effect of ethanol have not been adequately explored. It is also unclear whether short concentrated bouts of drinking, say over 1-3 days at the weekend,

are more likely to lead to hypertension, than if the same amount of alcohol is consumed evenly over the week and combined with meals.

The question of the mechanism of the blood-pressure-raising effect of alcohol is also still unresolved (32-34). There is evidence that regular drinking increases blood pressure and heart rate variability (35), possibly by an effect on baroreceptor control (36). Only a very small minority of heavy drinkers show the pseudo-Cushing syndrome (37) and in most cases cortisol metabolism appears to have been normal, as judged by crude plasma cortisol measurements or 24-hour-urine steroid excretion. Studies of matched pairs of moderate drinkers (30 grams of ethanol/day on average) compared with non-drinkers have shown no differences in plasma renin activity, angiotensin II, aldosterone, cortisol, adrenaline or noradrenaline levels (32). The relatively greater effect of alcohol on systolic compared with diastolic pressure, in younger subjects in particular, may be a clue to the mechanism and perhaps indicates a relative imbalance between the central nervous factors influencing cardiac output and the peripheral vascular effects of alcohol. Paradoxically the programmed administration of alcohol over 1 to 2 weeks in young males leads to a decreased pressor reactivity to infused noradrenaline (34-38).

The magnitude of the effects of alcohol on the prevalence of high blood pressure in different communities is difficult to evaluate, with estimates ranging from 11% (39) to 30% (40). Part of the problem is that most population studies tend to underestimate alcohol consumption, and that in most studies the pressure measurements were recorded over relatively short periods. Regular drinking also contributes indirectly to hypertension by predisposing to obesity by virtue of the additional calories provided from both alcohol and other constituents of alcoholic beverages. It is therefore likely that the overall contribution of alcohol is significantly higher than that suggested by lower estimates based on multiple regression analyses.

The influence of alcohol on hypertensive cardiovascular disease is also a crucial problem. Some of the effects of alcohol on conditions such as haemorrhagic stroke and left ventricular failure may well be masked in populations that are regularly screened for hypertension and in which treatment is introduced early. Studies from Yugoslavia (41) and USA (Honolulu) (42) suggest an increase in the incidence of stroke with higher levels of alcohol consumption. However, there are a number of studies in which people drinking up to three standard glasses a day have a lower prevalence of coronary heart deaths (43, 14) and ischaemic stroke (44) compared with so-called non-drinkers. At present it is not clear whether these observations represent a true protective effect of lower doses of alcohol against occlusive vascular disease, or whether they are spurious. Possible effects which might result in a U- or J-shaped curve relating cardiovascular mortality or stroke rates (45) and reported drinking habits are (i) misreporting of alcohol consumption, particularly denial by problem or former heavy drinkers, (ii) other differences in life-style distinguishing light drinkers from non-drinkers, e.g. with respect to excercise, diet and smoking habits, and (iii) previous reductions in drinking levels in those already informed that they havc cardiovascular or related problems (46, 47). The last point has been argued strongly by Shaper et al. (46), on the basis of a nine-year follow-up of 7000 males seen in general practice. That population as a whole showed a U-shaped relationship between cardiovascular mortality and reported drinking habits. However, this only applied to those who already had cardiovascular disease, gout or diabetes at the outset and, in contrast, the initially disease-free subjects showed a much lower mortality rate which was weakly and positively related to drinking levels. It could, however, be equally argued from these data that alcohol was protective only in those most prone to cardiovascular disease. This important problem remains unresolved.

Conclusions and recommendations

In summary, there is now clear-cut evidence for a pressor effect of alcohol in regular drinkers. This effect is probably linear throughout the entire range of alcohol consumption, but appears to increase in magnitude, particularly in those drinking three or more standard drinks a day. The effect is seen in both men and women and is additive to that of obesity and oral contraceptive use. This pressor effect is at least partially reversible over 1 to 6 weeks by reducing the alcohol consumption. Possible interactions between alcohol and other factors influencing blood pressure, such as dietary sodium, exercise and obesity (48), are of interest. Three large factorial studies in Perth suggest that only moderating the alcohol intake (but not sodium restriction (50)) or exercise training (51) lowers blood pressures in regular drinkers, at least in the relatively short term of 4-6 weeks. On the other hand, weight reduction and alcohol moderation had independent and additive effects on blood pressure over 5 months (52). For the individual hypertensive who drinks, alcohol reduction to less than three drinks a day may diminish or abolish his or her requirements for antihypertensive drug therapy. Doctors and health professionals should be aware that alcohol may be contributing to blood pressure elevation and to refractoriness in anti-hypertensive drug therapy. In addition, the problem drinker is especially likely to fail to take the prescribed treatment on a regular basis. A detailed drinking history should be recorded on all hypertensive patients as the problem is not just one for the "problem" drinker. The term "social" drinking is not adequate to describe drinking habits which may be relevant to blood pressure elevation. Laboratory investigation of mean corpuscular volume and liver enzymes, although not particularly sensitive or specific, nevertheless can help identify some heavier drinkers (22, 49) among the hypertensive population. Further research is required on the mechanisms of alcohol-related hypertension and on the question whether or not there is any protective effect from lower levels of drinking on coronary heart disease or ischaemic strokes.

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