Findings that shed new light on the possible pathogenesis of a disease or an adverse effect

Third-degree atrioventricular block in an adolescent following acute alcohol intoxication

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Summary

Alcohol abuse is a major problem among adolescents, and has both acute, potentially lethal, and long-term harmful effects. The authors describe an adolescent who was in a subcomatose condition after binge drinking. His serum alcohol concentration was 3.7 g/l. The next morning, before transfer to the paediatric ward, he developed a third-degree atrioventricular (AV) block without cardiac output while his infusion needle was removed. This recovered spontaneously after a precordial thump. Retrospectively, electrocardiography showed an increasing PR prolongation (200–300 ms) before the removal of the infusion needle. ECG recordings several hours later showed a first-degree AV block, which was no longer seen during follow-up, 1 month later. The authors conclude that acute alcohol poisoning has the potential to prolong the PR interval in young, healthy adolescents without pre-existing first-degree AV block and provoke a third-degree AV block after vagal stimulation. It is yet another potential danger of acute alcohol intoxication in this age group.

BACKGROUND

As mentioned in the recently published American Academy of Pediatrics Policy Statement, alcohol abuse continues to be a major problem from preadolescence through early adulthood.¹ Alcohol abuse early in life has negative effects on brain development and it is associated with an increased risk of other substance abuse, mental health disorders and social behavioural problems. In addition, alcohol abuse is an important contributor to the leading causes of adolescent death (ie, motor-vehicle crashes, homicide and suicide).^{1 2}

Besides the long-term and indirect harmful effects of alcohol consumption, adolescents are likely to practice binge drinking and are at a high risk of alcohol intoxication.² This has potential acute lethal effects, which include suppression of the gag reflex and respiratory drive.¹ Moreover, acute alcohol intoxication in otherwise healthy subjects has potential harmful effects on the heart, including an increased risk of arrhythmias.³ The occurrence of atrioventricular (AV) block following alcohol intoxication in otherwise healthy adolescents has been reported in the literature, although scarcely. In this paper, we describe a case of alcohol intoxication in an adolescent with a third-degree AV block, in order to increase the awareness among physicians of yet another potential danger of acute alcohol intoxication in this age group.

CASE PRESENTATION

A 17-year-old boy was presented in a subcomatose state to the emergency department of our hospital after binge drinking. He was hypotensive (RR 80/40–90/45 mm Hg) with a pulse rate of 90 beats/min, hypothermic (35.5°C) and he had an Glasgow Coma Score of 6 (eye 1; movements 4; verbal 1). The initial oxygen-saturation measured by pulse-oximetry was 80%, which increased to 100%

following administration of oxygen (15 l/min) with a non-rebreathing mask. He also had urinary retention for which he received a urinary catheter. He had dilated pupils, with normal light response. Investigation of the heart, lungs and abdomen revealed no abnormalities.

INVESTIGATIONS

Blood sampling revealed the following results: sodium 147 mmol/l, potassium 3.4 mmol/l, urea 6.0 mmol/l, creatinine 81 µmol/l, calcium 2.08 mmol/l, glucose 6.2 mmol/l, C reactive protein < 1 mg/l. Blood gas: pH 7.30, PCO₂ 6.0 kPa, HCO₃⁻ 22 mmol/l, base excess –4.5. Liver enzymes and complete blood count were normal. Serum alcohol concentration was 3.7 g/l.

TREATMENT

The patient was admitted to the intensive care unit where he was given intravenous fluids. He woke up after intravenous administration of 0.25 mg flumazenil, which was given because it was unclear if he had taken party drugs, for example, benzodiazepines. A few hours later, after arrangements had been made to transfer him to the paediatric ward, his infusion needle was removed. At that moment, he developed a third-degree AV block without cardiac output, which lasted for approximately 30 s. Normal cardiac activity was restored after administration of a precordial thump.

OUTCOME AND FOLLOW-UP

Retrospectively, electrocardiography showed an increasing PR prolongation (200–300 ms) before the removal of the infusion needle (figure 1A). Blood tests performed immediately after the incident showed no abnormalities. Several hours later, repeat ECG recording (figure 1B) showed no

Figure 1 (A) Electrocardiogram tracing made at the intensive care unit, showing an increasing PR prolongation resulting in a third-degree AV block. (B) Electrocardiogram made several hours after the occurrence of the third-degree AV block, showing a first-degree AV block.

abnormalities besides a PR interval of 220 ms, indicating a first-degree AV block. Further investigations revealed normal thyroid function, normal echocardiography and a normal exercise test. The ECG at 1-month follow-up showed no abnormalities, with a PR interval within the reference range (160 ms). A 24-h Holter ECG was also normal.

DISCUSSION

Arrhythmias may occur in direct relation to alcohol consumption both in alcoholics and occasional drinkers.⁴ Sinus tachycardia, secondary to an increase in sympathetic modulation and a reduction in vagal modulation of the sinus node,⁵ is very common.^{6–7} Furthermore, ventricular ectopic beats and supraventricular arrhythmia, including atrial fibrillation, are frequently observed in alcohol intoxication.^{7–9} Binge drinking, an acute and excessive consumption of alcohol, is associated with increased cardiovascular mortality in otherwise healthy individuals.¹⁰ Although deaths caused by alcohol intoxication have been reported at low serum alcohol concentrations, the majority of these deaths happen in persons with high concentrations.³

Our patient had a prolongation of the PR interval and later a third-degree AV block following alcohol intoxication. Although the exact serum alcohol concentration at the time of occurrence of the third-degree AV block was unknown, the serum level was assumed to be excessive, given the high concentration at admission. The occurrence of a third-degree AV block in relation to alcohol intoxication has only scarcely been described in the literature. Eilam *et al* reported a case of a 49-year-old comatose patient with first-degree AV block associated with alcohol intoxication that rapidly developed into a type I second-degree AV block with 4:3 to 2:1 conduction.¹¹ Brvar *et al* described a 17-year-old woman with an alcohol intoxication that developed a first-degree AV block with a PR interval of 320 ms and intermittent second- and third-degree AV blocks with up to 4-s-long pauses that appeared 15–30 s after each vomiting.¹² One month later she still had a first-degree AV block with a PR interval of 210 ms, in contrast to our patient, in the whom first-degree AV block resolved.

There are a few reports in the literature that examined the potential effects of alcohol on the conduction properties of the heart. Aasebo *et al*³ found that 71% of patients that presented with acute alcohol intoxication had longer PR intervals at admission than at discharge (mean difference 13.6 ms). No differences were found between PR intervals in moderately elevated and highly intoxicated groups (ie, serum alcohol concentration lower or higher than 2.25 g/l, respectively), and the average PR interval was within the reference range.³ Lorscheid *et al*¹⁰ performed a prospective study among 20 healthy subjects to investigate the effect of binge drinking on the conduction intervals in healthy individuals. Seventy five per cent had a longer PR interval (163 ms) with a serum alcohol concentration of 0.8 g/l than before drinking (149 ms). One individual had a PR interval >200 ms.¹⁰ In our patient, the PR interval was prolonged during the acute intoxication episode (220 ms) compared to PR interval at follow-up (160 ms). This is in line with the findings in these studies.

It is not entirely clear what causes the AV nodal conduction delay in acute alcohol intoxication in non-alcoholics¹⁰; however, it has been suggested that high serum alcohol concentrations interfere with ion channels that create action potentials in the heart.^{4–13} Furthermore, alcohol may induce dysregulation of autonomic nervous system control of cardiac activity.¹⁴

There are a few concomitant factors that could be considered as contributory to the occurrence of the third-degree AV block in our patient. To begin with, the removal of the infusion needle may have given a vagal stimulus, which has been proven to be able to mediate an AV block.^{12–15} Furthermore, our patient woke up after he received flumazenil, a benzodiazepine-antagonist. Benzodiazepines have been associated with the occurrence of first- and second-degree AV blocks,^{16–17} but our patient denied use of benzodiazepines. Flumazenil has been associated with both induction and reversal of different degrees of AV blocks in cases of benzodiazepine overdose.^{16–18} However, flumazenil is fast-acting, has a half-life of 40–60 min¹⁹ and the time span between administration of flumazenil and the

occurrence of the AV block in our patient was more than an hour. This makes it unlikely that it was the cause of the arrhythmia. Other possible causes of AV block, including structural abnormalities of the heart or thyroid function disorders, were ruled out. Therefore, we believe that alcohol intoxication caused prolongation of the PR interval and vagal stimulation caused the third-degree AV block and a life-threatening situation. This case shows one of the acute dangers of binge drinking, which is an increasingly growing problem among adolescents.

Learning points

- ▶ Adolescents are likely to practice binge drinking and are at a high risk of alcohol intoxication.
- ▶ Acute alcohol poisoning has the potential to prolong the PR interval in young, healthy adolescents without pre-existing first-degree AV block and provoke a third-degree AV block after vagal stimulation.
- ▶ AV block is yet another potential danger of acute alcohol intoxication in adolescents.

Competing interests None.

Patient consent Obtained.

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