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Case Report

An unusual case of (pseudo)hypertriglyceridaemia

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Abstract

A high concentration of glycerol in plasma is an interfering factor in the determination of triglycerides, giving rise to (pseudo)hypertriglyceridaemia. Hyperglycerolaemia may be due to the presence of exogenous glycerol or due to endogenous glycerol accumulation. In the present case report, a 57-year-old male patient with end-stage renal disease presented with a pseudohypertriglyceridaemia based on a pronounced hyperglycerolaemia. The hyperglycerolaemia was due to chronic intake of glycerol-containing alcoholic beverages in combination with a reduced glycerol clearance and glycerol kinase activity. In conclusion, an unexplained hypertriglyceridaemia in patients with an impaired renal function should raise the suspicion of hyperglycerolaemia.

Keywords: autosomal dominant polycystic kidney disease; glycerol; glycerol kinase; triglycerides

Background

Glycerol is an interfering factor in the determination of triglycerides, giving rise to (pseudo)hypertriglyceridaemia. Under physiological circumstances, plasma glycerol concentration is not sufficiently high (<1 mg/dL) to introduce a significant error. Glycerol, a by-product of alcohol fermentation, is a non-toxic compound of alcoholic beverages. Glycerol kinase (GK) catalyses the transfer of phosphate from adenosine triphosphate to glycerol, yielding glycerol 3-phosphate and adenosine diphosphate [1]. Increased serum glycerol values are rare and can be due to an X-linked glycerol kinase deficiency (GKD) or due to the presence of exogenous glycerol (e.g. food ingredients, glycerol-containing dialysis fluids and suppositories, or contamination by blood collector tubes or skin care products) [1,2]. An excess of glycerol is filtered by the glomerulus and excreted in urine.

In the present report, we present a case of (pseudo)hypertriglyceridaemia in a patient with end-stage renal disease (ESRD).

Case report

A 57-year-old male peritoneal dialysis patient with ESRD, based on an autosomal dominant polycystic kidney disease, was admitted to our hospital. He reported anorexia, malaise, vomiting and diarrhoea. He smokes one pack/day and consistently drinks a minimum of four units alcohol per day [whisky (40% alcohol volume) and Duvel®, a strong Belgian beer (8.5% alcohol volume)]. On physical examination, a grey appearance and discrete bilateral pitting oedema were noticed. Elevated serum transaminases and cholestasis parameters were found. Glomerular filtration rate was 7 mL/min. Plasma lactate was 5 mmol/L (normal = 1–2 mmol/L). An elevated plasma osmolality of 310 mOsm/kg was found (normal = 275–295 mOsm/kg) with an osmolal gap of 20 mOsm/kg. In contrast with the apparent high triglyceride value (996 mg/dL), serum lipaemic index was only 10 U, suggesting glycerol interference [3]. Repeating the analysis with a glycerol-blanked method revealed a glycerolaemia of 89.8 mg/dL (normal <2 mg/dL) and a glyceroluria of 205.5 mg/dL (normal <1 mg/dL) (Figure 1). Glycerol clearance was only 0.9 mL/min.

On a CT scan of the abdomen, a large thrombus was detected at the wall of the abdominal aorta, without occlusion. Hypodense areas along the falciform ligament suggested hepatic ischaemia. During hospitalization, liver parameters and triglyceridaemia slowly recovered.

Enzymatic analysis of triglycerides can suffer from glycerol interference. In blood, free glycerol concentration is ± 1 mg/dL, equivalent to ±10 mg/dL of triglycerides [4–6]. Increased glycerol concentrations can be caused by preanalytical factors, by the pharmacological use of glycerol and by GKD giving rise to pseudohypertriglyceridaemia [1]. As symptomatic isolated GKD is characterized by episodic vomiting, oxidation of free fatty acids and presence of ketone bodies were monitored. No hyperketonuria or hyperketonaemia was reported. Serum FFA concentrations were normal. As pseudohypertriglyceridaemia was unknown in the patient's medical history, an exogenous

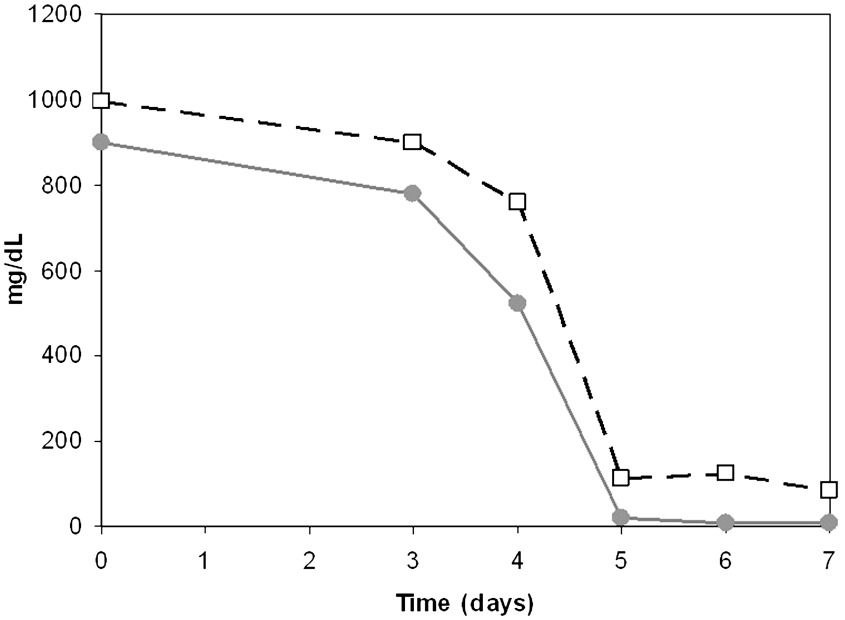

Fig. 1. Evolution of the serum concentration of triglycerides (dashed black line) and glycerol × 10 (full grey line) following admission.

Table 1. Presence of glycerol in some alcoholic beverages

Alcoholic beverages	Glycerol content (mg/dL)
White wine	468
Duvel®	227
Abbey beer	189
Lager beer	96
Red wine	85
Stout beer	68
Whisky	0

glycerol source was suspected. Carbohydrate-deficient transferrin showed a moderate elevation of 2.8% (normal <1.3%), as well as the MCV (102.8 fL; normal = 80.5–99.7 fL).

The glycerol intake of the patient was measured by assessing the triglyceride and glycerol concentrations in alcoholic beverages (Table 1). Among the beers tested, Duvel® showed a superior glycerol concentration of 228 mg/dL. No glycerol was detected in whisky.

The patient's beverages were analysed for high-molecular-weight alcohols (fusel oils) [7]. No fusel oils in the patient's serum/urine and in Duvel® were detected. However, we found 11.4 mg/dL isobutanol and 12.4 mg/dL isoamyl alcohol in the consumed whisky.

Compared with blood donors, the patient showed a significantly (median value: 152 U/L) reduced plasma GK activity (25 U/L) [8], which suggests an impaired glycerol handling capacity.

Discussion

Pseudohypertriglyceridaemia is a condition in which high concentrations of glycerol in plasma may result in an overestimation of triglycerides. Elevated serum glycerol concentrations can be exogenous, or due to GKD, a disorder which is usually detected incidentally as pseudohypertriglyceridaemia [1]. As other reasons of glycerolaemia could be excluded, a benign form of GKD was suspected. However, the hypertriglyceridaemia was transient and normalized during admission (Figure 1), which pleads against hereditary GKD. A combination of an exogenous source, a reduced renal clearance and potentially a GKD was postulated.

The patient reported a substantial intake of alcoholic beverages, with preference for Duvel® (a beer) and Scotch whisky. Analysis revealed that the beer was particularly rich in glycerol due to addition of sucrose during the brewing process in order to increase the alcohol content. Following alcohol withdrawal, serum glycerol values dropped, which suggests that the beverages were the source of exogenous glycerol. The osmolal gap (20 mOsm/kg) indicates the presence of low-molecular-mass compounds and corresponds with the measured glycerol concentration. Other potential exogenous sources of glycerol could be excluded.

Notwithstanding the increased dietary intake of glycerol, the glycerol handling capacity should normally be sufficient to maintain physiological glycerol levels. The patient's long glycerol plasma half-life following alcohol withdrawal (46 h) suggests a decreased glycerol handling capacity during the hospitalization period. The considerably reduced glycerol kinase activity is in agreement with the liver damage, confirmed on CT. Chronic alcohol intake reduces the expression of glycerol kinase [9]. The combination of liver ischaemia and the intake of considerable amounts of ethanol synergistically reduces GK activity.

A slower rate of phosphorylation of glycerol and a slower oxidation of glycerol 3-phosphate were found in ethanol-treated rats. Decreased activities of glycerol kinase and glycerol 3-phosphate dehydrogenase slow down the glycerol utilization [9].

When glycerolaemia exceeds the renal threshold, glycerol is excreted into urine. In our case, glomerular filtration rate and glycerol clearance are strongly reduced, which further contribute to hyperglycerolaemia. Glycerol-containing alcoholic beverages usually contain acetaldehyde and acetate. Concomitant with increased glycerol synthesis, increased quantities of fermentation by-products such as acetaldehyde and acetate are observed [10]. In the patient's serum and urine, increased values of acetaldehyde were demonstrated, which could partly explain the patients' poor clinical condition. The patient's low GFR contributed to an accumulation of these compounds.

In conclusion, a sudden or unexplained increase of serum triglycerides in patients with impaired renal function should raise the suspicion of hyperglycerolaemia. Exogenous sources of glycerol, a further reduction of renal function and liver impairment, or a combination of these, should be excluded.

Conflict of interest statement. None declared.

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