Volume of dead space and equivalent units of insulin in five syringes

Type of syringe	Volume of dead space (ml)	Equivalent units of insulin
Old BS 1619 2 ml glass insulin syringe (U20 insulin) + 26 gauge, 0.5 inch needle (Everett)	0.063	1.26 (U20), 2.52 (U40)
New BS 1619 1 ml glass insulin syringe (U100 insulin) + 26 gauge, 0.5 inch needle (Rand Rocket)	0.051	5.1 (U100)
New BS 1619 0.5 ml glass insulin syringe (U100 insulin) + 26 gauge, 0.5 inch needle (Rand Rocket)	0.05	5 (U100)
BD Plastipak 1 ml plastic disposable syringe (U100 insulin) with integral 27 gauge, 0.5 inch needle	0.011	1.1 (U100)

Comment

The importance of dead space may be seen from the following example. A patient prescribed a mixture of 10 units of neutral insulin and 20 units of insulin zinc suspension and using a U100 glass syringe, which has a dead space equivalent to 5 units, will draw into the syringe 15 units of neutral insulin and 20 units of insulin zinc suspension (assuming the usual protocol is followed whereby first clear and then cloudy insulin is drawn up); he will inject around 13.5 units of neutral insulin and 16.5 units of insulin zinc suspension. The inaccuracy of such a typical regimen could certainly cause a hypoglycaemic episode.

The error produced by dead space obviously varies with the total dose, the proportions, and the order of mixing the insulins. If a patient's condition is stabilised with a particular technique and syringe there should not be any problem, but when the syringe and possibly the technique are changed, as in the changeover to U100 insulin, there may be an appreciable change in control of diabetes.

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Can amiodarone induce hyperglycaemia and hypertriglyceridaemia?

Amiodarone is an iodinated derivative of benzofuran and is structurally similar to thyroxine. Its long term use has caused thyroid gland dysfunction,¹ corneal microdeposits and cutaneous pigmentation,² pneumonitis and pulmonary fibrosis,³ neuropathy,⁴ and potentiation of anticoagulation with warfarin.⁵ We report on three patients treated with amiodarone who presented with abnormalities of carbohydrate and lipid metabolism but normal thyroid function.

Case reports

Case 1—A 71 year old woman who was taking digoxin and frusemide 25 mg every other day for heart failure had blood glucose, triglyceride, and cholesterol concentrations in the normal range. She was given oral amiodarone 200 mg every other day for rapid atrial fibrillation. One year later she developed hyperglycaemia, glycosuria (0.28 mol (50 g)/24 h), hypercholesterolaemia, and hypertriglyceridaemia (table). Serum concentrations of triiodothyronine, thyroxine, and thyroid stimulating hormone were in the normal range (2.2 nmol/l (142 ng/100 ml), 98 nmol/l (7.5 µg/100 ml), and 7.2 mU/l respectively). Amiodarone was stopped, but treatment with diuretics was not changed. Twenty days later she showed normal fasting and postprandial blood glucose concentrations and reduced cholesterol and triglyceride concentrations (table); she did not need further treatment with insulin.

Case 2—A 62 year old man was taking digoxin, diuretics (amiloride 5 mg, and hydrochlorothiazide 50 mg daily), and nifedipine for hypertensive

cardiomyopathy with angina pectoris. His triglyceride and cholesterol concentrations were in the normal range (table), but he had a slightly increased fasting blood glucose concentration and gave a borderline response to an oral glucose tolerance test. He was treated for ventricular arrhythmias with oral amiodarone 200 mg daily after a loading dose. Treatment with other drugs was not changed. Seven months later he had hyperglycaemia, glycosuria (0.28 mol (50 g)/24 h), hypertriglyceridaemia, and a borderline cholesterol concentration (table). Serum triiodothyronine and thyroxine concentrations were in the normal range (2.3 nmol/l (149 ng/100 ml) and 80 nmol/l (6.2 µg/100 ml) respectively). Amiodarone was stopped, and 45 days later he had normal cholesterol and triglyceride concentrations and only slight hyperglycaemia (table), for which he needed minimal further treatment.

Case 3—A 58 year old man was admitted to hospital for an anterior myocardial infarction with subsequent ventricular aneurysm complicated by three episodes of ventricular fibrillation and peripheral emboli. He was given coumarins, diuretics (spironolactone 25 mg and hydrochlorothiazide 25 mg daily), dipyridamole 75 mg, isosorbide dinitrate 50 mg, and mexiletine 50 mg all thrice daily, and oral amiodarone 1.6 g weekly after a loading dose. Before treatment he had normal cholesterol, triglyceride, and fasting blood glucose concentrations. We were unable subsequently to stop treatment with amiodarone despite a progressive moderate increase in triglyceride concentration. Cholesterol, fasting blood glucose, serum triiodothyronine (1.3 nmol/l (85 ng/100 ml)) and thyroxine (124 nmol/l (9.6 µg/100 ml)) concentrations remained normal (table) without any change in dosage of diuretics. One month after the dosage of amiodarone was reduced to 1.0 g weekly, however, the triglyceride concentration had decreased to 2.3 mmol/l (207 mg/100 ml) and cholesterol concentration to 5 mmol/l (193 mg/100 ml) without any change in fasting blood glucose concentration.

Fasting blood glucose and lipid concentrations and presence of glycosuria before, during, and after treatment with amiodarone in three patients

	Blood glucose (mmol/l)	Blood cholesterol (mmol/l)	Blood triglycerides (mmol/l)
		<i>Case 1</i>	
Before	5	4.7	1.8
During*	24	11.6	14.7
After	5.3	4.6	1.7
		<i>Case 2</i>	
Before	6	5.7	1.9
During*	12.2	6.3	7.8
After	8.8	5.7	2.2
		<i>Case 3</i>	
Before	5.2	4.1	1.6
During	5.3	6.2	3.8
After	5.2	5	2.3

*Glycosuria developed during treatment.

Conversion: SI to traditional units—Glucose: 1 mmol/l ≈ 18 mg/100 ml. Cholesterol: 1 mmol/l ≈ 38.7 mg/100 ml. Triglycerides: 1 mmol/l ≈ 88.6 mg/100 ml.

Comment

Even though one of our patients (case 2) already had slightly impaired glucose tolerance before treatment and in another (case 3) we were unable to withdraw amiodarone to show complete reversal of hypertriglyceridaemia, our findings indicate that hyperglycaemia and hypertriglyceridaemia are possible side effects of treatment with amiodarone.

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