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ANSWER BOOK

Cholesterol, atheroma and what a risk factor means

Nutrition, digestion and health evidence · Unit B10

AQA 3.3.4.2 (risk factors and cardiovascular disease)
OCR A 3.1.2 (transport in animals, as context) · Edexcel A Topic 1.11–1.15
CAIE not examined as a topic

5 questions · 20 marks

NAVY EDITION

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SECTION B · Standard, 3 to 5 marks

B1 **B1** the endothelium lining the vessel is damaged by mechanical stress from high blood pressure, particularly where arteries branch, by chemicals in tobacco smoke, by high blood glucose or by a high LDL concentration. **B1** LDL particles pass into the wall beneath the endothelium, are retained there and are chemically modified by oxidation, so they are treated as damage rather than as cargo. **B1** monocytes adhere to the activated endothelium and migrate into the wall, where they become macrophages. **B1** the macrophages take up modified LDL through receptors that are not regulated by how much cholesterol the cell already holds, so they keep eating, fill with lipid and become foam cells, and a collection of foam cells is a fatty streak. **B1** smooth muscle cells migrate from the deeper layers, multiply and deposit collagen over the accumulating lipid, forming a fibrous cap, so the plaque bulges into the lumen and narrows it. [5]

B2 **B1** the fibrous cap tears, so collagen beneath it is exposed to the blood and platelets adhere and release thromboplastin. **B1** thromboplastin with calcium ions catalyses the conversion of prothrombin to thrombin, and thrombin catalyses the conversion of soluble fibrinogen into insoluble fibrin, which forms a mesh trapping cells. **B1** that clot can occlude the artery within minutes, so blood no longer reaches the muscle downstream of the blockage. **B1** the muscle is therefore deprived of oxygen and cannot respire aerobically, so its supply of ATP fails and the cells die, which is a myocardial infarction. [4]

B3 **B1** both are lipoproteins, with a core of cholesteryl esters and triglyceride wrapped in a single layer of phospholipid carrying apoproteins, and the cholesterol inside each is chemically the same molecule. **B1** an LDL particle is larger and cholesterol-rich with relatively little protein, whereas an HDL particle is smaller and protein-rich, and since protein is dense that is why HDL is the denser class. **B1** LDL delivers cholesterol to any cell carrying LDL receptors, which take the whole particle in by receptor-mediated endocytosis, whereas HDL accepts cholesterol from cell membranes, including from cells inside artery walls. **B1** HDL carries what it collects back to the liver, which can excrete it in bile, so the two classes of particle run in opposite directions. [4]

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B4 **B1** familial hypercholesterolaemia is caused by a fault in the gene for the LDL receptor and roughly doubles the blood LDL concentration from birth, producing heart attacks decades early, and that raised concentration was set at conception, so it cannot be a consequence of how the person lived. **B1** people carrying inactive versions of PCSK9 have lifelong LDL concentrations about a quarter lower and far less coronary heart disease, and because the variant is allocated at conception and is unrelated to income, smoking or diet the comparison behaves like a randomised trial. **B1** trials of drugs lowering LDL by unrelated mechanisms lower cardiovascular events in proportion to how much LDL they remove, so genetics, mechanism and trials all agree. **B1** for HDL only the observational association exists: drugs that raised HDL substantially did not reduce events, and genetic variants raising it are not associated with lower risk, so HDL appears to mark something protective rather than to be the protective thing itself. [4]

B5 **B1** it is a sterol, not a triglyceride: four fused carbon rings with a short hydrocarbon tail at one end and a single hydroxyl group at the other. **B1** it regulates the fluidity of every cell-surface membrane, restricting movement of the phospholipids at higher temperatures and preventing them packing too closely at lower ones. **B1** it is the precursor of the steroid hormones and of the bile salts, and the starting material for vitamin D. [3]

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