Preparations

Proprietary Preparations (details are given in Part 3)

Multi-ingredient: ***Braz.:*** Bromelin†; Expectoral†; ***Singapore:*** Biotene; ***UK:*** Biotene Dry Mouth; Biotene Oralbalance; ***USA:*** Biotene with Calcium.

Glucose Tests

Glucosa, pruebas de.

Profile

Several tests are available so that patients with diabetes mellitus (p.431) can monitor their disease. Tests can be employed to detect the presence of glucose in the urine and some of the preparations are used to detect several substances in the urine. These tests are easy to carry out but are not considered reliable enough for insulin-dependent patients who should ideally check their blood-glucose concentrations using one of the available blood tests. Diabetic clinics often measure the degree of haemoglobin glycosylation as an indicator of mean blood-glucose control over a period of weeks or months.

Urine tests generally use either the copper-reduction method or the glucose-oxidase method and both produce a colour change in the presence of glucose. Blood tests generally use the glucose-oxidase method; they may be read visually or by means of a meter. A meter gives the more precise reading. Patients should be properly trained in the use of these tests and in the interpretation of the results; they should be aware that concomitant drug therapy might affect the result.

Precautions. Preparations that contain, or are metabolised to, maltose (p.1956), galactose (p.1481), or xylose (p.2416) may interfere with the results from glucose tests based on dehydrogenase pyrroloquinolinequinone (GDH-PQQ) monitoring systems as these are non-specific for glucose. Overestimation of glucose results may mask hypoglycaemia, resulting in the inappropriate use of insulin.[1,2]

1. Medicines and Healthcare products Regulatory Agency. Medical device alert: ref MDA/2007/058 issued 19 July 2007. Available at: http://www.mhra.gov.uk/PrintPreview/PublicationSP/CON2031807 (accessed 01/07/08)
2. FDA. Important safety information on interference with blood glucose measurement following use of parenteral maltose/parenteral galactose/oral xylose-containing products (issued November 2005). Available at: http://www.fda.gov/cber/safety/maltose110405.htm (accessed 01/07/08)

Preparations

USP 31: Glucose Enzymatic Test Strip.

Proprietary Preparations (details are given in Part 3)

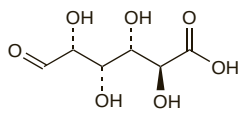
Arg.: Accu-Chek; Accutrend Glucosa; Ascensia; Betachek; Dextrostix; Diabur-Test 5000†; Diastix; Elite; Glucostix; Glucotide†; Glucotrend†; Glukotest†; Haemo-Glukotest 20-800†; One Touch; Precision Plus; Prestige†; Sure Step; ***Austral.:*** Accu-Chek; Accutrend Glucose; Advantage†; Ascensia; Betachek†; BM-Test BG; BM-Test Glycemie 20-800; Clinistix; Clinitest; Diabur-Test 5000; Diascreen Glucose†; Diastix; Esprit; ExacTech†; Glucoflex-R†; Glucometer†; Glucostix; Medi-Test Glucose; MediSense Sof-Tact†; Omnitest†; Optium†; Precision Plus†; Tes-Tape†; ***Braz.:*** Accu-Chek; Accutrend; Glico-Fita; Haemo-Glukotest; ***Canad.:*** Accu-Chek†; Accutrend GC†; Advantage; Ascensia Elite; Chemstrip uG; Clinistix; Clinitest; Diastix; One Touch; Sof-Tact; ***Chile:*** Accu-Chek; Accutrend Glucosa; Ascencia; Glukotest†; ***Fr.:*** Accu-Chek; Ascensia; BM-Test Glycemie†; Clinistix; Clinitest†; Euroflash; Glucomen; Glucotide†; Glucotrend†; Medisense; One Touch; ***India:*** Diastix; ***Irl.:*** Accu-Chek; BM-Accutest; BM-Test 1-44†; Clinistix; Clinitest; Combina Glucose; Diabur-Test 5000; Diastix; Freestyle; Glucomen; Glucometer Elite; Glucostix; Glucotide; Hypoguard†; Medisense†; One Touch; PocketScan; ***Ital.:*** Accu-Chek; Accutrend Glucose†; Ascensia; Clinistix; Clinitest; Diabur-Test 5000; Diastix; Euroflash; EZ Smart; Freestyle Papillon; Glucocard; Glucofilm†; Glucometer†; Glucosan†; Glucostix†; Glucotrend†; Glukurtest†; Haemoglukotest 20-800†; One Touch; Uni-Check; ***Mex.:*** Accu-Chek; Accutrend Glucose; Clinitest; Dextrostix; Diabur-Test 5000; Diastix; Gluco-Cinta†; Glucostix†; Glucotide†; Haemo-Glukotest 20-800; ***NZ:*** Accu-Chek Advantage; Accutrend Glucose†; BM-Test 1-44†; Clinistix; Clinitest; Diabur-5000; Diastix; Glucocard†; Glucometer Elite†; Glucometer Esprit†; Glucostix†; Precision Plus†; ***Port.:*** Clinistix; Elite†; Euroflash†; Glucocard; Glucodisk; Glucostix; Glucotouch†; One Touch; ***UK:*** Ascensia Glucodisc; BM-Accutest; BM-Test 1-44; Breeze 2; Clinistix; Clinitest; Diabur-Test 5000; Diastix; ExacTech; Freestyle; Glucomen; Glucostix†; Glucotide†; Hypoguard Supreme Plus; Medi-Test Glucose; Medi-Test Glycaemie C†; Medisense; Optium Plus; ***USA:*** Accu-Chek Advantage; Chemstrip bG; Chemstrip uG; Choice DM; Clinistix; Clinitest; Diascan; Diastix; First Choice; Glucofilm; Glucostix; One Touch.

Glucuronic Acid

D-Glucuronic acid.

$C_6H_{10}O_7$ = 194.1.

CAS — 576-37-4 (D,L-glucuronic acid); 6556-12-3 (D-glucuronic acid); 3789-97-7 (glucuronamide); 3574-23-0 (D-glucuronamide); 61914-43-0 (D-glucuronamide); 63-29-6 (glucurolactone); 32449-92-6 (glucurolactone); 14984-34-0 (sodium glucuronate).



(D-glucuronic acid)

Profile

Glucuronic acid is one of the components of hyaluronic acid (p.2320) and also has an important role in the metabolism of many endogenous substances, drugs, and toxins. It has been used topically as a potential precursor of hyaluronic acid, and has also been used as a nutritional supplement. Glucuronamide, glucurolactone (glucuronic acid lactone), diolamine glucuronate, and other glucuronates have also been used as supplements.

Preparations

Proprietary Preparations (details are given in Part 3)

Hong Kong: Guronsan†.

Multi-ingredient: ***Belg.:*** Guronsan; ***Chile:*** Neostrata†; ***Fr.:*** Detoxalgine†; Guronsan; ***Hong Kong:*** Jetepar; ***Ital.:*** Ietepar†; ***Malaysia:*** Jetepar; ***Philipp.:*** Jetepar; ***Port.:*** Guronsan; Synchrocell; Synchrovit; ***Singapore:*** Jetepar; ***Spain:*** Guronsan.

Gluten

Profile

Gluten is a mixture of 2 proteins, gliadin and glutenin, and is present in wheat flour and to a lesser extent in barley and rye. Gliadin is a prolamine, one of the 2 chief groups of plant proteins, and glutenin belongs to the other main group termed glutelins.

Gluten is of medicinal and pharmaceutical interest in that patients with coeliac disease (p.1922) are sensitive to the protein fraction of gluten contained in the normal diet. Treatment consists of the use of gluten-free diets; gluten-free foods are available.

A gluten-free diet may also be beneficial in patients with dermatitis herpetiformis (p.1578).

Glycerol *(rINN)*

E422; Glicerin; Glicerol; Glicerolis; Gliserin; Gliserol; Glisin; Glycerin; Glycerine; Glycérol; Glycerolum; Glyseroli. Propane-1,2,3-triol.

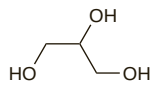
Глицерол

$C_3H_8O_3$ = 92.09.

CAS — 56-81-5.

ATC — A06AG04; A06AX01.

ATC Vet — QA06AG04; QA06AX01; QA16QA03.



Pharmacopoeias. In *Chin.*, *Eur.* (see p.vii), *Int.*, *Jpn*, *US*, and *Viet*.

Eur. and *Int.* also include Glycerol (85 per cent).

Ph. Eur. 6.2 (Glycerol). A clear, colourless or almost colourless, very hygroscopic, syrupy liquid, unctuous to the touch. Miscible with water and with alcohol; slightly soluble in acetone; practically insoluble in fixed oils and in essential oils. Store in airtight containers.

USP 31 (Glycerin). A clear, colourless, hygroscopic, syrupy liquid. Has not more than a slight characteristic odour, which is neither harsh nor disagreeable. Miscible with water and with alcohol; insoluble in chloroform, in ether, and in fixed and volatile oils. Its solutions are neutral to litmus. Store in airtight containers.

Incompatibility. Strong oxidising agents form explosive mixtures with glycerol. Black discoloration has been reported with glycerol and bismuth subnitrate or zinc oxide when exposed to light.

Adverse Effects and Precautions

The adverse effects of glycerol are primarily due to its dehydrating action.

When taken orally glycerol may cause headache, nausea, and vomiting; diarrhoea, thirst, dizziness, and mental confusion may occur less frequently. Cardiac arrhythmias have been reported.

Glycerol increases plasma osmolality resulting in the withdrawal of water from the extravascular spaces. The consequent expansion of extracellular fluid, especially if sudden, can lead to circulatory overload, pulmonary oedema, and heart failure; glycerol must therefore be used with caution in patients at risk, such as those with hypervolaemia, cardiac failure, or renal disease. Severe dehydration can occur and glycerol should be used cautiously in dehydrated patients. Patients with diabetes mellitus may additionally develop hyperglycaemia and glycosuria after metabolism of glycerol. Nonketotic hyperosmolar hyperglycaemic coma is rare, but fatalities have been reported.

Haemolysis, haemoglobinuria, and acute renal failure have also been associated with glycerol when given intravenously (see Raised Intracranial Pressure, below).

Glycerol can cause irritation when given topically or rectally. A local anaesthetic may be used before application of glycerol to the cornea to reduce the likelihood of a painful response.

For incompatibilities with glycerol, including the risk of explosive mixtures, see above.

Effects on the cardiovascular system. A 73-year-old man, free of cardiac complaints but who had previously had an acute myocardial infarction, developed severe pulmonary oedema after use of glycerol orally for elevated intra-ocular pressure.[1] The necessity for detailed cardiac evaluation before the use of oral glycerol was emphasised.

1. Almog Y, *et al.* Pulmonary edema as a complication of oral glycerol administration. *Ann Ophthalmol* 1986; **18:** 38–9.

Effects on the ears. A 56-year-old man given 100 mL of glycerol and 100 mL of sodium chloride 0.9% as part of a test for Ménière's disease developed temporary hearing loss in the non-involved ear. Two previous reports of deterioration in hearing associated with the glycerol test were reviewed by the author.[1]

1. Mattox DE, Goode RL. Temporary loss of hearing after a glycerin test. *Arch Otolaryngol* 1978; **104:** 359–61.

Effects on the eyes. Caution in applying glycerol to the cornea has been recommended. Studies in *animals*[1] and in man[2] have indicated that the topical application of glycerol to the eye can damage the endothelial cells of the cornea.

1. Sherrard ES. The corneal endothelium in vivo: its response to mild trauma. *Exp Eye Res* 1976; **22:** 347–57.
2. Goldberg MH, *et al.* The effects of topically applied glycerin on the human corneal endothelium. *Cornea* 1982; **1:** 39–44.

Hyperosmolar nonketotic coma. Hyperosmolar nonketotic coma has been associated with the oral use of glycerol[1] and deaths have occurred.[2] The most susceptible patients are maturity-onset elderly diabetics with acute or chronic disease predisposing to fluid deprivation, and in these patients oral glycerol may be best avoided.[1] If glycerol is used in patients with predisposing conditions, adequate measures should be taken to recognise the development of hyperosmolar nonketotic hyperglycaemia and prevent dehydration.[1,2]

1. Oakley DE, Ellis PP. Glycerol and hyperosmolar nonketotic coma. *Am J Ophthalmol* 1976; **81:** 469–72.
2. Sears ES. Nonketotic hyperosmolar hyperglycemia during glycerol therapy for cerebral edema. *Neurology* 1976; **26:** 89–94.

Pharmacokinetics

Glycerol is readily absorbed from the gastrointestinal tract and undergoes extensive metabolism, mainly in the liver; it may be used in the synthesis of lipids, metabolised to glucose or glycogen, or oxidised to carbon dioxide and water. It may also be excreted in the urine unchanged.

◊ References.

1. Nahata MC, *et al.* Variations in glycerol kinetics in Reye's syndrome. *Clin Pharmacol Ther* 1981; **29:** 782–7.
2. Heinemeyer G. Clinical pharmacokinetic considerations in the treatment of increased intracranial pressure. *Clin Pharmacokinet* 1987; **13:** 1–25.

Uses and Administration

Glycerol is an osmotic dehydrating agent with hygroscopic and lubricating properties. When given orally or parenterally, glycerol increases the plasma osmolality, resulting in the movement of water by osmosis from the extravascular spaces into the plasma.

Glycerol is given by mouth for the short-term reduction of vitreous volume and intra-ocular pressure before and after ophthalmic surgery, and as an adjunct in the management of acute glaucoma (p.1873). Its onset of action is rapid, with a maximal reduction in intra-ocular pressure occurring about 1 to 1⁄ hours after a dose; the duration of action is about 5 hours. The usual initial dose of glycerol is 1 to 1.8 g/kg given as a 50% solution. There can be problems of palatability when glycerol solutions are given orally; chilling or flavouring the solutions may help.

Glycerol may be applied topically to reduce corneal oedema, but as the effect is only transient its use is largely limited to an adjunct in eye examination and diagnosis. Glycerol eye drops can be painful on instillation and use of a local anaesthetic beforehand has been recommended.

Glycerol has also been given orally or intravenously to reduce intracranial pressure (see below).

Glycerol may be used rectally as suppositories or a solution in single doses to promote faecal evacuation in the management of constipation (p.1693). It usually acts within 15 to 30 minutes. Glycerol is commonly classified as an osmotic laxative but may act additionally or alternatively through its local irritant effects; it may also have lubricating and faecal softening actions.

Glycerol is used as a demulcent in cough preparations (p.1547).

Glycerol has many applications in pharmaceutical formulation; these include its use as a vehicle and solvent, as a sweetening agent, as a preservative in some liquid medications, as a plasticiser in tablet film-coating, and as a tonicity adjuster. It is often included in topical preparations such as eye drops, creams, and lotions as a lubricant and also for its moisturising properties since, when absorbed, its hygroscopic action can enhance moisture retention. Ear drops for the removal of ear wax often contain glycerol as a lubricating and softening agent.

Glycerol is also used as a cryoprotectant in cryopreservation.

Diagnosis of Ménière's disease. Glycerol has been used[1] in the diagnosis of Ménière's disease (p.564) to distinguish potentially reversible cochlear dysfunction from the relatively irreversible pathology of advanced disease, or to predict the results of endolymphatic sac surgery. Glycerol is given by mouth to