which the linkages between glucose units are almost exclusively α-1,6. Its weight average molecular weight is about 1000.
A white to off-white, hygroscopic powder. Very soluble in water; sparingly soluble in alcohol. pH of a 15% solution in water is between 4.5 and 7.0. Store at a temperature between 4° and 30°.

Profile
Dextran 1 is used to prevent severe anaphylactic reactions to infusions of dextran. It is reported to occupy the binding sites of dextran-reactive antibodies and so prevent the formation of large immune complexes with higher molecular weight dextrans.

Dextran 1 is given in usual doses of 20 mL of a solution containing 150 mg/mL by intravenous injection about 1 to 2 minutes before the infusion of the higher molecular weight dextran; the interval should not exceed 15 minutes. A suggested dose for children is 0.3 mL/kg. The dose of dextran 1 should be repeated if further infusions of dextran are required more than 48 hours after the initial dose.

Use. Two large multicentre studies (involving about 29 200 and 34 950 patients) have suggested that dextran 1 prevented anaphylactic reactions by hapten inhibition in a dose-dependent way.[1,2] It did not reduce the incidence of mild reactions, which are not generally mediated by antibodies. Another large study[3] comparing the effects of giving dextran 1 either 2 minutes before injection of dextran 40 or 70 or mixed with the injection, was stopped after the occurrence of 2 severe reactions in the admixture group. A comparison[4] of severe anaphylactic reactions to dextran infusion during the period 1983 to 1992 (when prophylaxis with dextran 1 was used) with reactions reported during the period 1975 to 1979 (no prophylaxis) found that the use of dextran 1 was associated with a 35-fold reduction in severe anaphylactic reactions to dextran infusion.

There were 21, 20, and 2 adverse reactions to dextran 1 in the first 3 studies respectively, including nausea, skin reactions, bradycardia, and hypotension. Apart from one patient, reactions to dextran 1 were mild and were considered to be of minor clinical importance. In the fourth study, adverse effects to dextran 1 were reported in about one case per 100 000 doses.

1. Ljungström K-G, *et al.* Prevention of dextran-induced anaphylactic reactions by hapten inhibition I: a Scandinavian multicenter study on the effects of 10 mL dextran 1, 15% administered before dextran 70 or dextran 40. *Acta Chir Scand* 1983; **149:** 341–8.
2. Renck H, *et al.* Prevention of dextran-induced anaphylactic reactions by hapten inhibition III: Scandinavian multicenter study on the effects of 20 mL dextran 1, 15% administered before dextran 70 or dextran 40. *Acta Chir Scand* 1983; **149:** 355–60.
3. Renck H, *et al.* Prevention of dextran-induced anaphylactic reactions by hapten inhibition II: a comparison of the effects of 20 mL dextran 1, 15% administered either admixed to or before dextran 70 or dextran 40. *Acta Chir Scand* 1983; **149:** 349–53.
4. Ljungström K-G. Safety of dextran in relation to other colloids - ten years experience with hapten inhibition. *Infusionsther Transfusionsmed* 1993; **20:** 206–10.

Preparations
Proprietary Preparations (details are given in Part 3)
Austral.: Promit; ***Austria:*** Praedex; Promit; ***Denm.:*** Promiten; ***Ger.:*** Promit†; ***Hung.:*** Promit; ***Neth.:*** Promiten; ***Norw.:*** Promiten; ***S.Afr.:*** Promit; ***Swed.:*** Promiten; ***Switz.:*** Promit†; ***USA:*** Promit.

Dextran 40 *(BAN, USAN, rINN)* ⊗
Dekstraani 40; Dekstran 40; Dekstranas 40; Dextrán 40; Dextranum 40; LMD; LMWD; Low-molecular-weight Dextran; LVD.

Декстран 40
CAS — 9004-54-0 (dextran).
ATC — B05AA05.
ATC Vet — QB05AA05.

Pharmacopoeias. In *Chin.*, *Jpn*, and *US*.
Eur. (see p.vii) and *Jpn* describe Dextran 40 for Injection.
Ph. Eur. 6.2 (Dextran 40 for Injection). A mixture of polysaccharides, principally of the α-1,6-glucan type, obtained by hydrolysis and fractionation of dextrans produced by fermentation of sucrose using a certain strain or substrains of *Leuconostoc mesenteroides*. The average relative molecular mass is about 40 000.
A white or almost white powder. Very soluble in water; very slightly soluble in alcohol.
USP 31 (Dextran 40). It is derived by controlled hydrolysis and fractionation of polysaccharides elaborated by the fermentative action of certain strains of *Leuconostoc mesenteroides* on a sucrose substrate. It is a glucose polymer in which the linkages between glucose units are almost entirely of the α-1:6 type. Its weight average molecular weight is in the 35 000 to 45 000 range. A 10% solution in water has a pH of 4.5 to 7.0. Store at a temperature of 25°, excursions permitted between 15° and 30°.

Incompatibility. Incompatibilities may arise from the slightly acid pH of dextran 40 preparations.

Adverse Effects, Treatment, and Precautions
As for Dextran 70, p.1059.

Rapid renal excretion of dextran 40 in patients with reduced urine flow can result in high urinary concentrations which increase urinary viscosity and may cause oliguria or acute renal failure. Therefore, infusions of dextran 40 are contra-indicated in renal disease with oliguria; should anuria or oliguria occur during treatment dextran 40 should be withdrawn. Dehydration should preferably be corrected before giving dextran 40. Dextran 40 can cause capillary oozing of wound surfaces.

Effects on the kidneys. Acute renal failure has been associated with dextran 40[1-4] and less frequently with dextran 70.[1] The mechanism of the effect is unclear but suggestions include an increase in plasma oncotic pressure that decreases filtration pressure in the glomerulus and hence decreases glomerular filtration rate,[2] obstruction within the tubules,[2,4] or a direct toxic effect on renal cells.[4] Plasmapheresis has been used successfully to remove dextran from the circulation.[2-4]

1. Feest TG. Low molecular weight dextran: a continuing cause of acute renal failure. *BMJ* 1976; **2:** 1300.
2. Tsang RKY, *et al.* Acute renal failure in a healthy young adult after dextran 40 infusion for external-ear reattachment surgery. *Br J Plast Surg* 2000; **53:** 701–3.
3. Kato A, *et al.* Complication of oliguric acute renal failure in patients treated with low-molecular weight dextran. *Ren Fail* 2001; **23:** 679–84.
4. Vos SCB, *et al.* Acute renal failure during dextran-40 antithrombotic prophylaxis: report of two microsurgical cases. *Ann Plast Surg* 2002; **48:** 193–6.

Hypersensitivity. For reports of anaphylactic reactions associated with use of dextran 40, see Dextran 70, below, and Dextran 1, above.

Pharmacokinetics
After intravenous infusion dextran 40 is slowly metabolised to glucose. About 70% of a dose is excreted unchanged in the urine within 24 hours. A small amount is excreted into the gastrointestinal tract and eliminated in the faeces.

Uses and Administration
Dextran 40 is a plasma volume expander used in the management of hypovolaemic shock (p.1183). As a 10% solution, dextran 40 exerts a slightly higher colloidal osmotic pressure than plasma proteins and thus produces a greater expansion of plasma volume than dextrans of a higher molecular weight, although the expansion may have a shorter duration because of more rapid renal excretion. Dextran 40 also reduces blood viscosity and inhibits sludging or aggregation of red blood cells. It is used in the prophylaxis and treatment of postoperative thromboembolic disorders, in conditions where improved circulatory flow is required, and as a priming solution during extracorporeal circulation.

Dextran 40 is given by intravenous infusion as a 10% solution in sodium chloride 0.9% or glucose 5%. Doses depend on the clinical condition of the patient.

In **shock**, a maximum of 20 mL/kg during the first 24 hours has been recommended; the first 10 mL/kg may be given by rapid intravenous infusion. Doses of up to 10 mL/kg may be given daily thereafter for up to 5 days. Dehydration should preferably be corrected before dextran 40 is given.

In the treatment of **thromboembolic disorders** a suggested regimen is 500 to 1000 mL over 4 to 6 hours on the first day, then 500 mL over 4 to 6 hours on the next and subsequent alternate days for not more than 10 days.

For prophylaxis of postoperative thromboembolic disorders, 500 mL over 4 to 6 hours may be given during or at the end of surgery and the dose repeated on the next day; treatment may be continued in high risk patients on alternate days for up to 10 days.

Infants may be given up to 5 mL/kg and children up to 10 mL/kg. A dose of 10 to 20 mL/kg has been added to extracorporeal perfusion fluids.

Dextran 40 is also an ingredient of artificial tears.

Post-dural puncture headache. Dextran 40 has been used in the treatment of post-dural puncture headache (p.1851) when other measures, including epidural autologous blood patch, have been ineffective. Reports[1-3] have described dextran 40 given in an epidural bolus dose of 20 mL. Sometimes this has been followed by a continuous epidural infusion of 3 to 4 mL/hour, and in these cases headache was relieved within 20 hours of starting the infusion.[1,2]

1. Aldrete JA. Persistent post-dural-puncture headache treated with epidural infusion of dextran. *Headache* 1994; **34:** 265–7.
2. Reynvoet MEJ, *et al.* Epidural dextran 40 patch for postdural puncture headache. *Anaesthesia* 1997; **52:** 886–8.
3. Souron V, Hamza J. Treatment of postdural puncture headaches with colloid solutions: an alternative to epidural blood patch. *Anesth Analg* 1999; **89:** 1333–4.

Thromboembolic disorders. Dextran 40 is only one of a variety of drugs that have been used for the prophylaxis of venous thromboembolism (p.1189) resulting from surgical operations such as hip replacement surgery. Dextran 40 may be used to prevent thromboembolic complications in some types of vascular surgery including carotid endarterectomy.[1]

1. Abir F, *et al.* Efficacy of dextran solutions in vascular surgery. *Vasc Endovascular Surg* 2004; **38:** 483–91.

Preparations
BP 2008: Dextran 40 Intravenous Infusion;
USP 31: Dextran 40 in Dextrose Injection; Dextran 40 in Sodium Chloride Injection.

Proprietary Preparations (details are given in Part 3)
Austria: Elorheo; Rheofusin†; Rheomacrodex; ***Braz.:*** Volumax D 40†; ***Canad.:*** Gentran 40; ***Cz.:*** Rheodextran†; ***Denm.:*** Rheomacrodex; ***Ger.:*** Infukoll M 40†; Longasteril 40†; Rheomacrodex†; ***Gr.:*** Rheomacrodex†; ***Hung.:*** Rheomacrodex; ***Israel:*** Rheomacrodex; ***Ital.:*** Eudextran; Plander R; Solplex 40†; ***Mex.:*** Rheomacrodex; ***Norw.:*** Rheomacrodex; ***Philipp.:*** LM Dextran; ***Port.:*** Neodextril 40; ***Rus.:*** Rheomacrodex (Реомакродекс); Rheopolydex (Реополидекс); Rheopolyglukin with Glucose (Реополиглюкин С Глюкозой); ***S.Afr.:*** Rheomacrodex; ***Spain:*** Rheomacrodex; ***Swed.:*** Perfadex; Rheomacrodex; ***Switz.:*** Rheomacrodex†; ***Thai.:*** Onkovertin; ***Turk.:*** Rheomacrodex; ***UK:*** Gentran 40; ***USA:*** Gentran 40; Rheomacrodex.

Multi-ingredient: ***Indon.:*** Otsutran; ***Port.:*** Bas-Dextrano; ***Rus.:*** Rheogluman (Реоглюман).

Dextran 60 *(BAN, rINN)* ⊗
Dekstraani 60; Dekstranas 60; Dextrán 60; Dextranum 60.

Декстран 60
CAS — 9004-54-0 (dextran).
ATC — B05AA05.
ATC Vet — QB05AA05.

Pharmacopoeias. *Eur.* (see p.vii) describes Dextran 60 for Injection.
Ph. Eur. 6.2 (Dextran 60 for Injection). A mixture of polysaccharides, principally of the α-1,6-glucan type, obtained by hydrolysis and fractionation of dextrans produced by fermentation of sucrose using a certain strain or substrains of *Leuconostoc mesenteroides*. The average relative molecular mass is about 60 000.
A white or almost white powder. Very soluble in water; very slightly soluble in alcohol.

Incompatibility. Incompatibilities may arise from the slightly acid pH of dextran 60 preparations.

Profile
Dextran 60 is a plasma volume expander with actions and uses similar to those of dextran 70 (below). It is given by intravenous infusion as a 3 or 6% solution in sodium chloride 0.9% or a mixture of electrolytes.

Dextran 60 is also used topically for dry eyes.

Preparations
Proprietary Preparations (details are given in Part 3)
Austria: Macrodex; ***Ger.:*** Macrodex†; ***Hung.:*** Macrodex; ***Mex.:*** Rescuesol†; ***Norw.:*** Plasmodex; ***Swed.:*** Plasmodex.

Dextran 70 *(BAN, USAN, rINN)* ⊗
Dekstraani 70; Dekstran 70; Dekstranas 70; Dextrán 70; Dextranum 70; Polyglucin (dextran).

Декстран 70
CAS — 9004-54-0 (dextran).
ATC — B05AA05.
ATC Vet — QB05AA05.

Pharmacopoeias. In *Chin.*, *Jpn*, and *US*.
Eur. (see p.vii) describes Dextran 70 for Injection.
Ph. Eur. 6.2 (Dextran 70 for Injection). A mixture of polysaccharides, principally of the α-1,6-glucan type, obtained by hydrolysis and fractionation of dextrans produced by fermentation of sucrose using a certain strain or substrains of *Leuconostoc mesenteroides*. The average relative molecular mass is about 70 000.
A white or almost white powder. Very soluble in water; very slightly soluble in alcohol.
USP 31 (Dextran 70). It is derived by controlled hydrolysis and fractionation of polysaccharides elaborated by the fermentative action of certain appropriate strains of *Leuconostoc mesenteroides* on a sucrose substrate. It is a glucose polymer in which the linkages between glucose units are almost entirely of the α-1:6 type. Its weight average molecular weight is in the 63 000 to 77 000 range. A 6% solution in water has a pH of 4.5 to 7.0. Store at a temperature of 25°, excursions permitted between 15° and 30°.

Incompatibility. Incompatibilities may arise from the slightly acid pH of dextran 70 preparations.

Storage. Crystals may form in solutions of dextran if they are stored at low temperatures. These may be redissolved by warming for a short time.

Adverse Effects and Treatment
Infusions of dextrans may occasionally produce hypersensitivity reactions such as fever, nasal congestion, joint pains, urticaria, hypotension, and bronchospasm. Severe anaphylactic reactions occur rarely and may be fatal. Dextran-reactive antibodies have been detected in patients who have not previously received dextran. This may possibly be in response to dietary or bacterial polysaccharides. Nausea and vomiting have also been reported. These reactions are treated symptomatically after withdrawal of the dextran.