Water or sodium chloride 0.9% solution may be used initially, but because they are hypotonic to the eye there can be an increased uptake of the fluid and diffusion of the burning substance into the deeper layers of the cornea, resulting in oedema. To reduce this risk solutions with higher osmolarities have been suggested, if available, and include balanced salt solution, buffered solutions such as lactated Ringer's solution, and commercial decontamination preparations with amphoteric and chelating properties.[1,2]

For acid and alkali burns ascorbate and citrate eye drops have been tried, and ascorbate given orally, based on suggestions that ascorbate may scavenge free radicals and citrate may reduce the release of free radicals and proteolytic enzymes in burn tissue.[1] However, a retrospective analysis of 121 patients with alkali burns to the eye suggested those with less severe burns (grades 1 and 2) did not benefit from an intensive topical therapy regimen including 10% ascorbate drops and 10% citrate drops;[3] a trend to more rapid healing and better visual outcome were seen in patients with grade 3 burns but in those with the most severe damage (grade 4) the regimen made no difference. In the management of hydrofluoric acid burns of the eye, calcium gluconate has also been used after initial irrigation (see p.2322). Other general treatments that may be required include topical application of anaesthesia, corticosteroids, and antibacterials, treatment for glaucoma, and surgery.[1,2]

1. Schrage NF, *et al.* Eye burns: an emergency and continuing problem. *Burns* 2000; **26:** 689–99.
2. Kuckelkorn R, *et al.* Emergency treatment of chemical and thermal eye burns. *Acta Ophthalmol Scand* 2002; **80:** 4–10.
3. Brodovsky SC, *et al.* Management of alkali burns: an 11-year retrospective review. *Ophthalmology* 2000; **107:** 1829–35.

Osteoporosis. Potassium bicarbonate in an oral dose of 1 to 2 mmol/kg daily improved mineral balance and bone metabolism in a short-term study.[1] However, the authors cautioned against the use of bicarbonate to treat or prevent osteoporosis (p.1084) without further study.[2]

1. Sebastian A, *et al.* Improved mineral balance and skeletal metabolism in postmenopausal women treated with potassium bicarbonate. *N Engl J Med* 1994, **330:** 1776–81.
2. Sebastian A, Morris RC. Improved mineral balance and skeletal metabolism in postmenopausal women treated with potassium bicarbonate. *N Engl J Med* 1994; **331:** 279.

Renal calculi. Citrate forms soluble complexes with calcium, thereby reducing urinary saturation of stone-forming calcium salts. Potassium citrate has a hypocalciuric effect when given orally, probably due to enhanced renal calcium absorption. Urinary calcium excretion is unaffected by sodium citrate, since the alkali-mediated hypocalciuric effect is offset by a sodium-linked calciuresis.[1] Potassium citrate may be beneficial in reducing the rate of stone formation in patients with hypocitraturia[2,3] or hypercalciuria.[4] As mentioned in Uses above, sodium bicarbonate or sodium or potassium citrate may also be used for their alkalinising action, as an adjunct to a liberal fluid intake, to prevent development of uric-acid renal calculi during uricosuric therapy.

Other causes of renal calculi and their treatment are discussed on p.2181.

Urinary alkalinisation with sodium bicarbonate, sodium citrate, or potassium citrate may be useful in the management of cystine stone formation in patients with cystinuria (see under Penicillamine, p.1459).

1. Anonymous. Citrate for calcium nephrolithiasis. *Lancet* 1986; **i:** 955.
2. Pak CYC, Fuller C. Idiopathic hypocitraturic calcium-oxalate nephrolithiasis successfully treated with potassium citrate. *Ann Intern Med* 1986; **104:** 33–7.
3. Tekin A, *et al.* Oral potassium citrate treatment for idiopathic hypocitruria in children with calcium urolithiasis. *J Urol (Baltimore)* 2002; **168:** 2572–4.
4. Pak CYC, *et al.* Prevention of stone formation and bone loss in absorptive hypercalciuria by combined dietary and pharmacological interventions. *J Urol (Baltimore)* 2003; **169:** 465–9.

Preparations

BP 2008: Alginate Raft-forming Oral Suspension; Alkaline Gentian Mixture; Aromatic Magnesium Carbonate Mixture; Compound Magnesium Trisilicate Oral Powder; Compound Sodium Bicarbonate Tablets; Compound Sodium Chloride Mouthwash; Kaolin and Morphine Mixture; Kaolin Mixture; Magnesium Trisilicate Mixture; Potassium Citrate Mixture; Sodium Bicarbonate Ear Drops; Sodium Bicarbonate Eye Lotion; Sodium Bicarbonate Intravenous Infusion; Sodium Bicarbonate Oral Solution; Sodium Citrate Eye Drops; Sodium Citrate Irrigation Solution; Sodium Lactate Intravenous Infusion;
BPC 1968: Effervescent Potassium Tablets;
Ph. Eur.: Anticoagulant Acid-Citrate-Glucose Solutions (ACD); Anticoagulant Citrate-Phosphate-Glucose Solution (CPD);
USP 31: Anticoagulant Citrate Dextrose Solution; Anticoagulant Citrate Phosphate Dextrose Adenine Solution; Anticoagulant Citrate Phosphate Dextrose Solution; Anticoagulant Sodium Citrate Solution; Half-strength Lactated Ringer's and Dextrose Injection; Lactated Ringer's and Dextrose Injection; Lactated Ringer's Injection; Magnesium Carbonate and Sodium Bicarbonate for Oral Suspension; Magnesium Carbonate, Citric Acid, and Potassium Citrate for Oral Solution; Potassium and Sodium Bicarbonates and Citric Acid Effervescent Tablets for Oral Solution; Potassium Bicarbonate and Potassium Chloride Effervescent Tablets for Oral Solution; Potassium Bicarbonate and Potassium Chloride for Effervescent Oral Solution; Potassium Bicarbonate Effervescent Tablets for Oral Solution; Potassium Chloride in Lactated Ringer's and Dextrose Injection; Potassium Chloride, Potassium Bicarbonate, and Potassium Citrate Effervescent Tablets for Oral Solution; Potassium Citrate And Citric Acid Oral Solution; Potassium Citrate Extended-release Tablets; Potassium Gluconate and Potassium Citrate Oral Solution; Potassium Gluconate, Potassium Citrate, and Ammonium Chloride Oral Solution; Sodium Acetate Injection; Sodium Acetate Solution; Sodium Bicarbonate Injection; Sodium Bicarbonate Oral Powder; Sodium Bicarbonate Tablets; Sodium Citrate and Citric Acid Oral Solution; Sodium Lactate Injection; Sodium Lactate Solution; Tricitrates Oral Solution; Trikates Oral Solution.

Proprietary Preparations (details are given in Part 3)
Arg.: LTK250; Urokit; ***Austral.:*** Chlorvescent; Sodibic; Urocit-K; ***Austria:*** Oxalyt; Uralyt-U; ***Belg.:*** Uralyt-U; ***Braz.:*** Acalka†; Citrosodine†; Litocit; ***Canad.:*** Bromo Seltzer; Eno; K-Citra; K-Lyte; Polycitra-K; ***Chile:*** Acalka; Eucerin; Sal De Yasta†; ***Cz.:*** Alkaligen†; Uralyt-U; ***Fr.:*** Elgydium Bicarbonate†; Potensium gelule; ***Ger.:*** Alkala T; Apocit; bicaNorm; Blanel; Kalitrans; Kalium; Kohlensaurebad Bastian; Nephrotrans; Uralyt-U; ***Gr.:*** Citrolithin; ***Hong Kong:*** Urocit-K; ***Hung.:*** Alkaligen; ***India:*** Alkasol; Citralka; Oricitral; ***Irl.:*** Cystopurin; ***Israel:*** Babic; Uralyt-U; ***Ital.:*** Citrosodina; Uralyt-U; ***Jpn:*** Meylon; ***Malaysia:*** Urocit-K; ***Mex.:*** Betsol Z; Bicarnat; Debonal; ***Neth.:*** Citra-Lock; Hospasol; ***Norw.:*** Kajos; ***NZ:*** Citravescent; ***Philipp.:*** Acalka; ***Pol.:*** Citrolyt; Litocid; ***Port.:*** Acalka; Hospasol; Uralyt-U; ***S.Afr.:*** Crystacit; SB Gripe Water; Uralyt-U; ***Singapore:*** Gripe Water†; Urocit-K†; ***Spain:*** Acalka; Hospasol; Plurisalina; ***Swed.:*** Kajos; ***Switz.:*** Nephrotrans; Uralyt-U†; ***Thai.:*** Acalka; Uralyt-U; ***Turk.:*** Anti-Asidoz; Urocid-K; ***UK:*** Boots Gripe Mixture 1 Month Plus; Canesten Oasis; Cymalon Cranberry; Cystitis Relief; Cystocalm; Cystopurin; ***USA:*** Citra pH; K + Care†; K-Lyte; Neut; Urocit-K; ***Venez.:*** Policitra.

Multi-ingredient: numerous preparations are listed in Part 3.

Calcium

Calcio; Kalsiyum; Kalzium.
Ca = 40.078.

Description. Calcium is a cation given as various calcium-containing salts.

Incompatibility. Calcium salts have been reported to be incompatible with a wide range of drugs. Complexes may form resulting in the formation of a precipitate.

Calcium Acetate

Acetate of Lime; Calcii acetas; Calcio, acetato de; Calcium, acétate de; E263; Kalcio acetatas; Kalciumacetat; Kalcium-acetát; Kalsiumasetaatti; Kalsiyum Asetat; Lime Acetate.

$C_4H_6CaO_4$ = 158.2.
CAS — 62-54-4.
ATC — A12AA12.
ATC Vet — QA12AA12.

Pharmacopoeias. In *Eur.* (see p.vii) and *US*.
Ph. Eur. 6.2 (Calcium Acetate). A white or almost white, hygroscopic powder. Freely soluble in water; slightly soluble in alcohol. A 5% solution in water has a pH of 7.2 to 8.2. Store in airtight containers.
USP 31 (Calcium Acetate). A white, odourless or almost odourless, hygroscopic, crystalline powder. It decomposes to calcium carbonate and acetone when heated to above 160°. Freely soluble in water; slightly soluble in methyl alcohol; practically insoluble in dehydrated alcohol, in acetone, and in benzene. A 5% solution in water has a pH of 6.3 to 9.6. Store in airtight containers.

Equivalence. Each g of calcium acetate (anhydrous) represents about 6.3 mmol of calcium. Calcium acetate (anhydrous) 3.95 g is equivalent to about 1 g of calcium.

Calcium Chloride

Calcii Chloridum; Calcii chloridum dihydricum; Calcio, cloruro de; Calcium Chloratum; Calcium, chlorure de; Chlorid vápenatý; Cloreto de Cálcio; Cloruro de Calcio; E509; Kalcio chloridas; Kalciumklorid; Kalcium-klorid; Kalsiumkloridi; Kalsiyum Klorür; Wapnia chlorek.

$CaCl_2.xH_2O$ = 110.0 (anhydrous); 147.0 (dihydrate).
CAS — 10043-52-4 (anhydrous calcium chloride); 7774-34-7 (calcium chloride hexahydrate); 10035-04-8 (calcium chloride dihydrate).
ATC — A12AA07; B05XA07; G04BA03.
ATC Vet — QA12AA07; QB05XA07; QG04BA03.

Pharmacopoeias. *Chin.*, *Eur.* (see p.vii), *Jpn*, *US*, and *Viet.* include the dihydrate.
Eur. also specifies the hexahydrate.
Ph. Eur. 6.2 (Calcium Chloride Dihydrate; Calcii Chloridum Dihydricum). A white or almost white, hygroscopic, crystalline powder. Freely soluble in water; soluble in alcohol. Store in airtight containers.
Ph. Eur. 6.2 (Calcium Chloride Hexahydrate; Calcii Chloridum Hexahydricum). A white or almost white, crystalline mass or colourless crystals. Very soluble in water; freely soluble in alcohol. F.p. about 29°.
USP 31 (Calcium Chloride). White, hard, odourless fragments or granules. Is deliquescent. Soluble 1 in 0.7 of water, 1 in 0.2 of boiling water, 1 in 4 of alcohol, and 1 in 2 of boiling alcohol. pH of a 5% solution in water is between 4.5 and 9.2. Store in airtight containers.

Equivalence. Each g of calcium chloride (dihydrate) represents about 6.8 mmol of calcium and 13.6 mmol of chloride. Calcium chloride (dihydrate) 3.67 g is equivalent to about 1 g of calcium.

Each g of calcium chloride (hexahydrate) represents about 4.56 mmol of calcium and 9.13 mmol of chloride. Calcium chloride (hexahydrate) 5.47 g is equivalent to about 1 g of calcium.

Calcium Citrate

Calcio, citrato de; Tricalcium Citrate. Tricalcium 2-hydroxypropane-1,2,3-tricarboxylate tetrahydrate.

$C_{12}H_{10}Ca_3O_{14}.4H_2O$ = 570.5.
CAS — 5785-44-4.

Pharmacopoeias. In *US*.
USP 31 (Calcium Citrate). A white, odourless, crystalline powder. Slightly soluble in water; insoluble in alcohol; freely soluble in diluted 3N hydrochloric acid and in diluted 2N nitric acid.

Equivalence. Each g of calcium citrate (tetrahydrate) represents about 5.3 mmol of calcium and 3.5 mmol of citrate. Calcium citrate (tetrahydrate) 4.74 g is equivalent to about 1 g of calcium.

Calcium Glubionate *(USAN, rINN)*

Calcii Glubionas; Calcium Gluconate Lactobionate Monohydrate; Calcium Gluconogalactogluconate Monohydrate; Glubionate de Calcium; Glubionato de calcio. Calcium D-gluconate lactobionate monohydrate.

Кальция Глубионат

$(C_{12}H_{21}O_{12})_2C_6H_{11}O_7)Ca.H_2O$ = 610.5.
CAS — 31959-85-0 (anhydrous calcium glubionate); 12569-38-9 (calcium glubionate monohydrate).
ATC — A12AA02.
ATC Vet — QA12AA02.

Pharmacopoeias. *US* includes Calcium Glubionate Syrup.

Equivalence. Each g of calcium glubionate (monohydrate) represents about 1.6 mmol of calcium. Calcium glubionate (monohydrate) 15.2 g is equivalent to about 1 g of calcium.

Calcium Gluceptate

Calcium Glucoheptonate *(pINN)*; Calcii glucoheptonas; Calcium, glucoheptonate de; Glucoheptonate de Calcium; Glucoheptonato de calcio; Kalcio gliukoheptonatas; Kalciumglukoheptonat; Kalcium-glükoheptonát; Kalcium-glukoheptonát; Kalsiumglukoheptonaatti.

Кальция Глюкогептонат

$C_{14}H_{26}CaO_{16}$ = 490.4.
CAS — 17140-60-2 (anhydrous calcium gluceptate); 29039-00-7 (anhydrous calcium gluceptate).
ATC — A12AA10.
ATC Vet — QA12AA10.

Pharmacopoeias. In *Eur.* (see p.vii). *US* allows anhydrous or with varying amounts of water of hydration.
Ph. Eur. 6.2 (Calcium Glucoheptonate). A mixture in variable proportions of calcium di(D-*glycero*-D-*gulo*-heptonate) and calcium di(D-*glycero*-D-*ido*-heptonate). A white or very slightly yellow, hygroscopic, amorphous powder. Very soluble in water; practically insoluble in alcohol and in acetone. A 10% solution in water has a pH of 6.0 to 8.0. Store in airtight containers.
USP 31 (Calcium Gluceptate). It is anhydrous or contains varying amounts of water of hydration. It consists of the calcium salt of the alpha-epimer of glucoheptonic acid or of a mixture of the alpha and beta epimers of glucoheptonic acid. A white to faintly yellow amorphous powder. It is stable in air, but the hydrous forms may lose part of their water of hydration on standing. Freely soluble in water; insoluble in alcohol and in many other organic solvents. pH of a 10% solution in water is between 6.0 and 8.0.

Equivalence. Each g of calcium gluceptate (anhydrous) represents about 2 mmol of calcium. Calcium gluceptate (anhydrous) 12.2 g is equivalent to about 1 g of calcium.

Calcium Gluconate

Calcii gluconas; Calcii Gluconas Monohydricus; Calcio, gluconato de; Calcium, gluconate de; Calcium Glyconate; E578; Glukonan vápenatý monohydrát; Kalcio gliukonatas; Kalciumglukonat; Kalcium-glükonát; Kalsiumglukonaatti; Wapnia glukonian. Calcium D-gluconate monohydrate.

$C_{12}H_{22}CaO_{14}.H_2O$ = 448.4.
CAS — 299-28-5 (anhydrous calcium gluconate); 18016-24-5 (calcium gluconate monohydrate).
ATC — A12AA03; D11AX03.
ATC Vet — QA12AA03; QD11AX03.

Pharmacopoeias. In *Chin.*, *Eur.* (see p.vii), *Int.*, *Jpn*, and *Viet.* Also in *US* as the anhydrous or the monohydrate form.
Calcium borogluconate is included as an injection in *BP(Vet)*.
Ph. Eur. 6.2 (Calcium Gluconate). A white or almost white, crystalline or granular, powder. Sparingly soluble in water; freely soluble in boiling water.
USP 31 (Calcium Gluconate). It is anhydrous or contains one molecule of water of hydration. White, odourless, crystalline granules or powder. Slowly soluble 1 in 30 of water; soluble 1 in 5 of boiling water; insoluble in alcohol. Its solutions are neutral to litmus.

Equivalence. Each g of calcium gluconate (monohydrate) represents about 2.2 mmol of calcium. Calcium gluconate (monohydrate) 11.2 g is equivalent to about 1 g of calcium.