sorption, may have exacerbated the phosphate-binding effect of the antacid. In another case[5] a dosing error resulted in the infant receiving an excessive dose of antacid for 6 months. The *BNFC* advises against the use of any aluminium-containing antacid in neonates and infants.

Aluminium accumulation resulting in osteomalacia or encephalopathy with seizures and dementia has been reported in children with renal failure (but not on dialysis) treated with aluminium-containing phosphate binders.[6-10] In an adult male patient with severe chronic renal failure who was not on dialysis, self-medication with antacids for at least 3 years resulted in aluminium toxicity associated with encephalopathy, bone disease, and microcytic anaemia.[11] Aluminium-containing antacids should therefore be used with caution in patients with chronic renal failure, especially in children.

Oral citrate salts increase the absorption of aluminium from the gastrointestinal tract[12] and patients with renal failure taking aluminium compounds should avoid citrate-containing preparations, which include many effervescent or dispersible tablets.[13,14] Ascorbic acid has also been reported to enhance aluminium absorption.[15]

1. Flaten TP, *et al*. Mortality from dementia among gastroduodenal ulcer patients. *J Epidemiol Community Health* 1991; **45:** 203–6.
2. Tsou VM, *et al*. Elevated plasma aluminum levels in normal infants receiving antacids containing aluminum. *Pediatrics* 1991; **87:** 148–51.
3. Pivnick EK, *et al.* Rickets secondary to phosphate depletion: a sequela of antacid use in infancy. *Clin Pediatr (Phila)* 1995; **34:** 73–8.
4. Shetty AK, *et al*. Rickets and secondary craniosynostosis associated with long-term antacid use in an infant. *Arch Pediatr Adolesc Med* 1998; **152:** 1243–5.
5. Robinson RF, *et al*. Metabolic bone disease after chronic antacid administration in an infant. *Ann Pharmacother* 2004 **38:** 265–8.
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7. Griswold WR, *et al.* Accumulation of aluminum in a nondialyzed uremic child receiving aluminum hydroxide. *Pediatrics* 1983; **71:** 56–8.
8. Randall ME. Aluminium toxicity in an infant not on dialysis. *Lancet* 1983; **i:** 1327–8.
9. Sedman AB, *et al.* Encephalopathy in childhood secondary to aluminum toxicity. *J Pediatr* 1984; **105:** 836–8.
10. Andreoli SP, *et al*. Aluminum intoxication from aluminum-containing phosphate binders in children with azotemia not undergoing dialysis. *N Engl J Med* 1984; **310:** 1079–84.
11. Zatta P, *et al.* A fatal case of aluminium encephalopathy in a patient with severe chronic renal failure not on dialysis. *Nephrol Dial Transplant* 2004; **19:** 2929–31.
12. Walker JA, *et al*. The effect of oral bases on enteral aluminum absorption. *Arch Intern Med* 1990; **150:** 2037–9.
13. Mees EJD, Basçi A. Citric acid in calcium effervescent tablets may favour aluminium intoxication. *Nephron* 1991; **59:** 322.
14. Main J, Ward MK. Potentiation of aluminium absorption by effervescent analgesic tablets in a haemodialysis patient. *BMJ* 1992; **304:** 1686.
15. Domingo JL, *et al.* Effect of ascorbic acid on gastrointestinal aluminium absorption. *Lancet* 1992; **338:** 1467.

Interactions

As outlined on p.1692, aluminium compounds used as antacids interact with many other drugs, both by alterations in gastric pH and emptying, and by direct adsorption and formation of complexes that are not absorbed. Interactions can be minimised by giving the aluminium compound and any other medication 2 to 3 hours apart. The absorption of aluminium from the gastrointestinal tract may be enhanced if aluminium compounds are taken with citrates or ascorbic acid (see Toxicity, above).

Pharmacokinetics

Aluminium hydroxide, given orally, slowly reacts with the hydrochloric acid in the stomach to form soluble aluminium chloride, some of which is absorbed. The presence of food or other factors that decrease gastric emptying prolongs the availability of aluminium hydroxide to react and may increase the amount of aluminium chloride formed. About 100 to 500 micrograms of the cation is reported to be absorbed from standard daily doses of an aluminium-containing antacid, leading to about a doubling of usual aluminium concentrations in the plasma of patients with normal renal function.

Absorbed aluminium is eliminated in the urine, and patients with renal failure are therefore at particular risk of accumulation (especially in bone and the CNS), and aluminium toxicity (see above).

The aluminium compounds remaining in the gastrointestinal tract, which account for most of a dose, form insoluble, poorly absorbed aluminium salts in the intestines including hydroxides, carbonates, phosphates and fatty acid derivatives, which are excreted in the faeces.

Uses and Administration

Aluminium hydroxide is used as an antacid (p.1692). It is given orally in doses of up to about 1 g, between meals and at bedtime. In order to reduce the constipating effects, aluminium hydroxide is often given with a magnesium-containing antacid, such as magnesium oxide or magnesium hydroxide.

Aluminium hydroxide binds phosphate in the gastrointestinal tract to form insoluble complexes and reduces phosphate absorption. It may thus be used to treat hyperphosphataemia in patients with chronic renal failure (although aluminium accumulation may be a problem—see Renal Osteodystrophy, p.1086) or associated secondary hyperparathyroidism (p.1087). With this use the dose must be adjusted to the individual patient's requirement but up to about 10 g daily may be given orally in divided doses with meals.

Aluminium hydroxide is also used as an adjuvant in adsorbed vaccines.

Polymyositis and dermatomyositis. Corticosteroids form the basis of the management of polymyositis (p.1510) but the calcinosis that may occur in dermatomyositis does not always respond well. Aluminium hydroxide 1.68 to 2.24 g daily produced clinical improvement with complete clearing of most calcified nodules after 1 year in a patient with calcinosis cutis complicating juvenile dermatomyositis.[1] The calcified masses are made up of hydroxyapatite and amorphous calcium phosphate and reduction in phosphate absorption by aluminium hydroxide probably helped to reverse their formation. Subsequent cases[2,3] have also reported benefit from aluminium hydroxide treatment in the management of calcinosis.

1. Wang W-J, *et al*. Calcinosis cutis in juvenile dermatomyositis: remarkable response to aluminium hydroxide therapy. *Arch Dermatol* 1988; **124:** 1721–2.
2. Nakagawa T, Takaiwa T. Calcinosis cutis in juvenile dermatomyositis responsive to aluminium hydroxide treatment. *J Dermatol* 1993; **20:** 558–60.
3. Wananukul S, *et al*. Calcinosis cutis presenting years before other clinical manifestations of juvenile dermatomyositis: report of two cases. *Australas J Dermatol* 1997; **38:** 202–5.

Preparations

BP 2008: Aluminium Hydroxide Oral Suspension; Aluminium Hydroxide Tablets; Co-magaldrox Oral Suspension; Co-magaldrox Tablets; Compound Magnesium Trisilicate Tablets;
USP 31: Alumina and Magnesia Oral Suspension; Alumina and Magnesia Tablets; Alumina and Magnesium Carbonate Oral Suspension; Alumina and Magnesium Carbonate Tablets; Alumina and Magnesium Trisilicate Oral Suspension; Alumina and Magnesium Trisilicate Tablets; Alumina, Magnesia, and Calcium Carbonate Oral Suspension; Alumina, Magnesia, and Calcium Carbonate Tablets; Alumina, Magnesia, and Simethicone Oral Suspension; Alumina, Magnesia, and Simethicone Tablets; Alumina, Magnesia, Calcium Carbonate, and Simethicone Tablets; Alumina, Magnesium Carbonate, and Magnesium Oxide Tablets; Aluminum Hydroxide Gel; Aspirin, Alumina, and Magnesia Tablets; Aspirin, Alumina, and Magnesium Oxide Tablets; Dried Aluminum Hydroxide Gel; Dried Aluminum Hydroxide Gel Capsules; Dried Aluminum Hydroxide Gel Tablets.

Proprietary Preparations (details are given in Part 3)

Arg.: Pepsamar; ***Austral.:*** Alu-Tab; ***Austria:*** Anti-Phosphat; ***Braz.:*** Aludroxil; Aziram; Biodrox†; Ductogel; Fluagel†; Gastromax; Gastrox; Gelpan†; Hidroxialiv†; Kaogel†; Mylanta Plus; Natusgel†; Noacid†; Pepsamar; Peptgel; ***Canad.:*** Alu-Tab†; Aluge!; Amphojel; Basaljel; ***Chile:*** Risthal†; ***Ger.:*** Aludrox; Anti-Phosphat; ***Gr.:*** Alu-Cap; Pepsamar; ***Hong Kong:*** Alu-Tab; ***India:*** Aludrox; Tricaine-MPS; ***Irl.:*** Aludrox; ***Israel:*** Alu-Cap; ***Ital.:*** Polisilon†; ***Malaysia:*** Alu-Tab; ***Mex.:*** Domigel; Magnalum†; ***NZ:*** Alu-Tab; Amphojel†; ***Philipp.:*** Alu-Tab; ***Pol.:*** Alusal; ***Port.:*** Gelumina†; Pepsamar; ***S.Afr.:*** Alukon; Amphojel; ***Singapore:*** Alu-Tab; ***Spain:*** Aluge!; Pepsamar; ***Switz.:*** Anti-phosphate; Gastracol; ***UK:*** Alu-Cap; Aludrox†; ***USA:*** ALternaGEL; Alu-Cap†; Alu-Tab; Amphojel; Dialume; Nephrox; ***Venez.:*** Gelidral†.

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

Used as an adjunct in: ***Arg.:*** Dristan Analgesico†; Dristan Compuesto; Truxa R†; ***Braz.:*** Analtrix†; Butazolon†; Posdrink; Redentil†; Resprax; ***Canad.:*** C2 with Codeine†; ***Chile:*** Silartrin†; ***Fr.:*** Finidol†; ***Gr.:*** Ascriptin†; ***Indon.:*** Naspro; ***Israel:*** Ascriptin†; ***Ital.:*** Ascriptin; Via Mal; ***Mex.:*** Ascriptin; Meprosona-F; ***Switz.:*** Alcacyl; Contre-Douleurs plus; Contre-Douleurs†; ***USA:*** Arthritis Pain Formula; Ascriptin; Asprimox; Cama Arthritis Pain Reliever; Cope; Magnaprin†; Vanquish; ***Venez.:*** Ascriptin.

Aluminium Hydroxide-Magnesium Carbonate Co-dried Gel

F-MA 11; Hidróxido de aluminio y carbonato de magnesio desecado, gel de.

Profile

Aluminium hydroxide-magnesium carbonate co-dried gel is a co-precipitate of aluminium hydroxide and magnesium carbonate dried to contain a proportion of water for antacid activity. It is an antacid with general properties similar to those of aluminium hydroxide (above) and magnesium carbonate (p.1743). It has been given in oral doses of about 450 to 900 mg, usually 3 times daily after meals and before bedtime.

Preparations

Proprietary Preparations (details are given in Part 3)

Denm.: Link; ***Fin.:*** Link; РееНоо†; ***Gr.:*** Regla pH†; ***Indon.:*** Stomacain; Veragel; ***Mex.:*** Gelasim; ***Neth.:*** Regla pH; Remegel; ***Norw.:*** Link; ***Swed.:*** Link; ***UK:*** Dijex†.

Multi-ingredient: ***Belg.:*** Barexal; Nozid†; Regla pH Forte†; Syngel; ***Braz.:*** Andursil; ***Canad.:*** Diovol; Diovol Plus; Gastrocalm; Thunas Hyperacidity Tablets†; ***Chile:*** Algicote; Disfrutab; Ditopax; ***Fr.:*** Gastropulgite; ***Ger.:*** Colina Spezial; Duoventrinetten N; ***Hong Kong:*** Diovol Plus; Simeco†; Veragel; ***Indon.:*** Aludonna; Di-Gel; Farmacrol; Gastran; Oskamag; Polycrol; Simeco; ***Irl.:*** Algicon†; ***Israel:*** Silain; ***Mex.:*** Algicon†; Ditopax; Ditopax-F; ***Neth.:*** Algicon; Muthesa N; Rigoletten; ***Port.:*** Di-Gel; Di-Gel Forte†; ***Rus.:*** Gastal (Гастал); ***Singapore:*** Meclosil; Veragel DMS; ***Spain:*** Acilene†; Acylene†; ***Switz.:*** Anacidol†; Andursil; Gastropulgite†; Refluxine†; ***Thai.:*** Defomil; Diovol; Kremil; Kremil-S; Machto; Simeco; Veragel; ***UK:*** Algicon†; Simeco; ***Venez.:*** Ditosil.

Used as an adjunct in: ***Indon.:*** Rheumapill.

Aluminium Phosphate

Aliuminio fosfatas; Alumiinifosfaatti; Aluminii phosphas; Aluminio, fosfato de; Aluminium, phosphate d'; Aluminiumfosfat; Alumínium-foszfát; Aluminum Phosphate; Fosfato de aluminio; Fosforečnan hlinitý; Glinu fosforan; Glinu fosforanu.

Алюминия Фосфат

CAS — 7784-30-7 ($AlPO_4$).

ATC — A02AB03.

ATC Vet — QA02AB03.

Pharmacopoeias. In *Viet.*

Eur. (see p.vii) includes hydrated aluminium phosphate and also a gel. *US* includes as a gel.

Ph. Eur. 6.2 (Aluminium Phosphate, Hydrated; Aluminii Phosphas Hydricus; Dried Aluminium Phosphate BP 2008). A white or almost white powder. Very slightly soluble in water; practically insoluble in alcohol. It dissolves in dilute solutions of alkali hydroxides and mineral acids. A 4% suspension in water has a pH of 5.5 to 7.2. Store in airtight containers.

Ph. Eur. 6.2 (Aluminium Phosphate Gel; Aluminii Phosphatis Liquamen). It is aluminium phosphate in gel form containing 19 to 21% of $AlPO_4$. Practically insoluble in water, in alcohol, and in dichloromethane. It dissolves in dilute solutions of mineral acids. pH 6.0 to 8.0. Store in airtight containers.

USP 31 (Aluminum Phosphate Gel). A 4 to 5% suspension of aluminium phosphate ($AlPO_4$) in water and has a pH of 6.0 to 7.2. It is a white viscous suspension from which small amounts of water separate on standing. Store in airtight containers.

Profile

Aluminium phosphate is an antacid with general properties similar to those of aluminium hydroxide (p.1706), but it does not produce phosphate depletion.

Aluminium phosphate is also used as an adjuvant in adsorbed vaccines.

Preparations

USP 31: Aluminum Phosphate Gel.

Proprietary Preparations (details are given in Part 3)

Austria: Phosphalugel; ***Belg.:*** Phosphalugel†; ***Cz.:*** Gasterin†; ***Fr.:*** Phosphalugel; ***Ger.:*** Phosphalugel; ***Ital.:*** Fosfalugel; ***Port.:*** Phosphalugel; ***Rus.:*** Phosphalugel (Фосфалюгель); ***Switz.:*** Phosphalugel†.

Multi-ingredient: ***Austria:*** Phoscortil; ***Fr.:*** Moxydar; Seroxydar.

Aluminium Sodium Silicate

E554; Natrii aluminii silicas; Silicato de sodio y de aluminio; Sodium Aluminium Silicate; Sodium Aluminosilicate; Sodium et aluminium, silicate de; Sodium Silicoaluminate.

Алюмосиликат Натрия

CAS — 1344-00-9.

Profile

Aluminium sodium silicate is an antacid with general properties similar to those of aluminium hydroxide (p.1706). Aluminium silicate has been used similarly. They are also used as food additives.

Preparations

Proprietary Preparations (details are given in Part 3)

Fr.: Sulfuryl; ***Port.:*** Acnoil Free.

Multi-ingredient: ***Austria:*** Diphlogen; ***Fr.:*** Anti-H†; Cerat Inalterable; Sulfuryl; ***Ger.:*** Enelbin-Paste N; Sulfredox†; ***Hong Kong:*** Epilon; ***Port.:*** Mucal†; ***Thai.:*** Ulgastrin.