further depress cardiac function and cause clinically significant deterioration.

Verapamil hydrochloride is used for the treatment of hypertension and arrhythmias. However, it is no longer first-line treatment for arrhythmias in children because it has been associated with fatal collapse especially in infants under 1 year; adenosine p. 84 is now recommended for first-line use.

Verapamil hydrochloride is a highly negatively inotropic calcium channel-blocker and it reduces cardiac output, slows the heart rate, and may impair atrioventricular conduction. It may precipitate heart failure, exacerbate conduction disorders, and cause hypotension at high doses and should **not** be used with beta-blockers. Constipation is the most common side-effect.

Nifedipine relaxes vascular smooth muscle and dilates coronary and peripheral arteries. It has more influence on vessels and less on the myocardium than does verapamil hydrochloride and unlike verapamil hydrochloride has no anti-arrhythmic activity. It rarely precipitates heart failure because any negative inotropic effect is offset by a reduction in left ventricular work. Short-acting formulations of nifedipine may be used if a modified-release preparation delivering the appropriate dose is not available or if a child is unable to swallow (a liquid preparation may be prepared using capsules). Nifedipine may also be used for the management of angina due to coronary artery disease in Kawasaki disease or progeria and in the management of Raynaud's syndrome.

Nicardipine hydrochloride has similar effects to those of nifedipine and may produce less reduction of myocardial contractility; it should only be used for the treatment of life-threatening hypertension in paediatric intensive care settings and in postoperative hypertension.

Amlodipine also resembles nifedipine and nicardipine hydrochloride in its effects and does not reduce myocardial contractility or produce clinical deterioration in heart failure. It has a longer duration of action and can be given once daily. Nifedipine and amlodipine are used for the treatment of hypertension. Side-effects associated with vasodilatation such as flushing and headache (which become less obtrusive after a few days), and ankle swelling (which may respond only partially to diuretics) are common.

Nimodipine is related to nifedipine but the smooth muscle relaxant effect preferentially acts on cerebral arteries. Its use is confined to prevention and treatment of vascular spasm following aneurysmal subarachnoid haemorrhage.

Diltiazem hydrochloride is a peripheral vasodilator and also has mild depressor effects on the myocardium. It is used in the treatment of Raynaud's syndrome.

Calcium-channel blockers

- **DRUG ACTION** Calcium-channel blockers (less correctly called 'calcium-antagonists') interfere with the inward displacement of calcium ions through the slow channels of active cell membranes. They influence the myocardial cells, the cells within the specialised conducting system of the heart, and the cells of vascular smooth muscle. Thus, myocardial contractility may be reduced, the formation and propagation of electrical impulses within the heart may be depressed, and coronary or systemic vascular tone may be diminished.
- **SIDE-EFFECTS**
  - **Common or very common** Abdominal pain · dizziness · drowsiness · flushing · headache · nausea · palpitations · peripheral oedema · skin reactions · tachycardia · vomiting
  - **Uncommon** Angioedema · depression · erectile dysfunction · gingival hyperplasia · myalgia · paraesthesia · syncope

Overdose Features of calcium-channel blocker poisoning include nausea, vomiting, dizziness, agitation, confusion, and coma in severe poisoning. Metabolic acidosis and hyperglycaemia may occur. In overdose, the dihydropyridine calcium-channel blockers cause severe hypotension secondary to profound peripheral vasodilatation.For details on the management of poisoning, see Calcium-channel blockers, under Emergency treatment of poisoning p. 891.

- **HEPATIC IMPAIRMENT** In general, manufacturers advise caution (risk of increased exposure).
- **TREATMENT CESSATION** There is some evidence that sudden withdrawal of calcium-channel blockers may be associated with an exacerbation of myocardial ischaemia.

F above

Amlodipine

03-Mar-2020

- **DRUG ACTION** Amlodipine is a dihydropyridine calcium-channel blocker.

- **INDICATIONS AND DOSE**

Hypertension

- BY MOUTH
- Child 1 month-11 years: Initially 100–200 micrograms/kg once daily; increased if necessary up to 400 micrograms/kg once daily, adjusted at intervals of 1–2 weeks; maximum 10 mg per day
- Child 12-17 years: Initially 5 mg once daily, then increased if necessary up to 10 mg once daily, adjusted at intervals of 1–2 weeks

DOSE EQUIVALENCE AND CONVERSION

- Tablets from various suppliers may contain different salts (e.g. amlodipine besilate, amlodipine maleate, and amlodipine mesilate) but the strength is expressed in terms of amlodipine (base); tablets containing different salts are considered interchangeable.

- **UNLICENSED USE** Not licensed for use in children under 6 years.

IMPORTANT SAFETY INFORMATION

SAFE PRACTICE

Amlodipine has been confused with nimodipine and atenolol; care must be taken to ensure the correct drug is prescribed and dispensed.

- **CONTRA-INDICATIONS** Cardiogenic shock · significant aortic stenosis · unstable angina
- **INTERACTIONS** → Appendix 1: calcium channel blockers
- **SIDE-EFFECTS**
  - **Common or very common** Asthenia · constipation · diarrhoea · dyspepsia · dyspnoea · gastrointestinal disorders · joint disorders · muscle cramps · oedema · vision disorders
  - **Uncommon** Alopecia · anxiety · arrhythmias · chest pain · cough · dry mouth · gynaecomastia · hyperhidrosis · hypotension · insomnia · malaise · mood altered · numbness · pain · rhinitis · taste altered · tinnitus · tremor · urinary disorders · weight changes
  - **Rare or very rare** Confusion · hepatic disorders · hyperglycaemia · hypersensitivity · leucopenia · muscle tone increased · myocardial infarction · pancreatitis · peripheral neuropathy · photosensitivity reaction · Stevens-Johnson syndrome · thrombocytopenia · vasculitis
  - **Frequency not known** Extrapyramidal symptoms · pulmonary oedema
- **PREGNANCY** No information available—manufacturer advises avoid, but risk to fetus should be balanced against risk of uncontrolled maternal hypertension.
- **BREAST FEEDING** Manufacturer advises avoid—no information available.