terms of the anhydrous hydrochloride; bupivacaine hydrochloride monohydrate 10.55 mg is equivalent to about 10 mg anhydrous bupivacaine hydrochloride. In the UK the suggested general **maximum single dose** of bupivacaine hydrochloride is 150 mg with or without adrenaline followed if necessary by doses of up to 50 mg every 2 hours. In the USA the recommended maximum single dose is 175 mg of the plain preparation or 225 mg when given with adrenaline; doses may be repeated at intervals of not less than 3 hours but the total daily dose should not exceed 400 mg. The dose should be reduced in the elderly, in children, in debilitated patients, and in cardiac or hepatic disease.

A test dose of bupivacaine, preferably with adrenaline, should be given before starting epidural block to detect inadvertent intravascular injection. Subsequent doses should be given in small increments.

Solutions with or without adrenaline may be used for most **local anaesthetic techniques** and procedures apart from dental infiltration, when adrenaline is added to the solution (see below).

- For *infiltration anaesthesia* bupivacaine hydrochloride is typically used as a 0.25% solution in doses up to the recommended maximum (see above). When a longer duration of anaesthesia is required, as in dental or surgical procedures of the maxillary and mandibular area, a 0.5% solution with adrenaline 1 in 200 000 has been used but a total dose of 90 mg (18 mL) should not be exceeded over a single dental sitting.
- For *peripheral nerve block* the usual dose is 12.5 mg (5 mL) as a 0.25% solution or 25 mg (5 mL) as a 0.5% solution, although doses up to the recommended maximum single dose (see above) may also be given. A 0.75% solution has been used for *retrobulbar block* in ophthalmic surgery in a dose of 15 to 30 mg (2 to 4 mL).
- For *sympathetic nerve block* 50 to 125 mg (20 to 50 mL) as a 0.25% solution is recommended.
- For *lumbar epidural block* in surgery a 0.25% solution of bupivacaine hydrochloride may be used in a dose of 25 to 50 mg (10 to 20 mL) or as a 0.5% solution in a dose of 50 to 100 mg (10 to 20 mL). A 0.75% solution is also used for induction of lumbar epidural block in non-obstetric surgery in a single dose of 75 to 150 mg (10 to 20 mL). For *caudal block* in surgery 37.5 to 75 mg (15 to 30 mL) as a 0.25% solution or 75 to 150 mg (15 to 30 mL) as a 0.5% solution may be used. In the management of **acute pain** bupivacaine may be given as an epidural bolus or by continuous infusion. For analgesia during *labour*, doses of 15 to 30 mg (6 to 12 mL) as a 0.25% solution or 30 to 60 mg (6 to 12 mL) as a 0.5% solution have been recommended as a bolus for lumbar block. Alternatively, when given as an infusion, a dose of 10 to 15 mg (10 to 15 mL) per hour as a 0.1% solution or 10 to 15 mg (8 to 12 mL) per hour as a 0.125% solution has been recommended for lumbar block. Bupivacaine may also be given as a bolus caudal injection for labour pain; doses of 25 to 50 mg (10 to 20 mL) as a 0.25% solution or 50 to 100 mg (10 to 20 mL) as a 0.5% solution are recommended. For *postoperative pain* bupivacaine may be given as an epidural infusion in doses of 4 to 15 mg (4 to 15 mL) per hour as a 0.1% solution or 5 to 15 mg (4 to 12 mL) per hour as a 0.125% solution.
- Hyperbaric solutions of bupivacaine hydrochloride without adrenaline may be used for *spinal block*. Preparations containing 0.5% are available and are given in doses of 10 to 20 mg (2 to 4 mL).

Action. Addition of potassium chloride 0.2 mmol to 40 mL of bupivacaine 0.25% solution resulted in a more rapid onset of sensory loss than the same dose of plain bupivacaine in patients undergoing brachial plexus block for forearm or hand surgery.[1]

Hyaluronidase did not increase the speed of onset of brachial plexus block produced by bupivacaine 0.5%, with or without adrenaline, but did reduce the duration of anaesthesia.[2]

Bupivacaine encapsulated in liposomes can prolong postsurgical analgesic action without motor block.[3,4]

For a comparison of the vasoactivity of bupivacaine and some other local anaesthetics, see p.1852.

1. Parris MR, Chambers WA. Effects of the addition of potassium to prilocaine or bupivacaine: studies on brachial plexus blockade. *Br J Anaesth* 1986; **58:** 297–300.
2. Keeler JF, *et al.* Effect of addition of hyaluronidase to bupivacaine during axillary brachial plexus block. *Br J Anaesth* 1992; **68:** 68–71.
3. Boogaerts S, *et al.* Epidural administration of liposomal bupivacaine for the management of postsurgical pain. *Br J Anaesth* 1993; **70:** (suppl 1): 104.
4. Boogaerts JG, *et al.* Pharmacokinetic-pharmacodynamic specific behaviour of liposome-associated bupivacaine in humans. *Br J Anaesth* 1995; **74** (suppl 1): 74.

Administration in children. Bupivacaine 0.25% injected intra-operatively up to a maximum dose of 1.5 mg/kg with adrenaline has been used in infants for the control of postoperative pain due to pyloromyotomy and appears to attenuate some of the cardiac and respiratory effects associated with the use of general anaesthesia alone.[1] Doses of 2.5 mg of bupivacaine for each year of age, as a 0.5% solution, have been used for ilio-inguinal nerve block in children undergoing herniotomy.[2] A study[3] in infants undergoing abdominal surgery found that an epidural infusion of bupivacaine produced comparable analgesia to an intravenous infusion of morphine. It was considered that bupivacaine might be preferable to morphine in neonates and young infants who are particularly prone to respiratory depression, but older children might require additional sedation or analgesia to prevent postoperative restlessness.

1. McNicol LR, *et al.* Peroperative bupivacaine for pyloromyotomy pain. *Lancet* 1990; **335:** 54–5.
2. Smith BAC, Jones SEF. Analgesia after herniotomy in a paediatric day unit. *BMJ* 1982; **285:** 1466.
3. Wolf AR, Hughes D. Pain relief for infants undergoing abdominal surgery: comparison of infusions of IV morphine and extradural bupivacaine. *Br J Anaesth* 1993; **70:** 10–16.

Labour pain. For a discussion of the management of labour pain, including mention of the use of local anaesthetics, see p.7.

Early experience in nearly 1000 patients suggested that 8 mL of a 0.5% solution of bupivacaine with adrenaline was the optimum dose for epidural block during labour;[1] pain relief lasted for about 2 hours. Decreasing the concentration of the final dose to 0.25% reduced the persistence of sensory and motor nerve block after delivery. Others[2] found that bupivacaine 0.375% was the most suitable concentration for epidural analgesia when using a regimen of regular 'top-up' doses of 0.5 mg/kg about every 90 minutes. However, the use of low doses of bupivacaine 0.25% for epidural analgesia in primiparous women was associated with a lower incidence of forceps delivery and oxytocin augmentation.[3] Although an even lower concentration of bupivacaine (0.0625%) used with sufentanil[4] produced analgesia similar to that with 0.125% bupivacaine used alone, the duration of the second stage of labour and the incidence of instrumental and surgical delivery were not reduced. Similar results were obtained using bupivacaine 0.0625% with diamorphine 0.005%; in addition pruritus and drowsiness produced by diamorphine were considered to be troublesome in many patients.[5] However, a large UK study[6,7] compared a traditional epidural regimen using 10 mL boluses of bupivacaine 0.25% given up to every hour, with two lower-dose regimens using bupivacaine 0.1% with fentanyl 2 micrograms/mL, and found the lower dose techniques were at least as effective and were associated with a lower incidence of instrumental delivery.

Combined spinal-epidural blocks, in which an initial intrathecal injection of bupivacaine or bupivacaine with an opioid is given before starting the epidural, are also used,[6-9] and have been found to give excellent results,[7] although they may have no advantages over a low-dose epidural technique.[10]

Intrathecal injections containing bupivacaine have also been given alone[11,12] for the management of labour pain but the use of this route alone is usually associated with anaesthesia and management of postoperative pain in caesarean section. Bupivacaine has also been tried with lidocaine for epidural anaesthesia in caesarean section in order to reduce the dose of bupivacaine and minimise cardiotoxicity.[13]

1. Crawford JS. Lumbar epidural block in labour: a clinical analysis. *Br J Anaesth* 1972; **44:** 66–74.
2. Purdy G, *et al.* Continuous extradural analgesia in labour: comparison between "on demand" and regular "top-up" injections. *Br J Anaesth* 1987; **59:** 319–24.
3. Turner MJ, *et al.* Primiparous women using epidural analgesia. *BMJ* 1990; **300:** 123.
4. Auroy Y, Benhamou D. Extradural analgesia for labour: 0.125% bupivacaine vs 0.0625% bupivacaine with 0.2 micrograms mL sufentanil. *Br J Anaesth* 1995; **74** (suppl 1): 105–6.
5. Bailey CR, *et al.* Diamorphine-bupivacaine mixture compared with plain bupivacaine for analgesia. *Br J Anaesth* 1994; **72:** 58–61.
6. Comparative Obstetric Mobile Epidural Trial (COMET) Study Group UK. Effect of low-dose mobile versus traditional epidural techniques on mode of delivery: a randomised controlled trial. *Lancet* 2001; **358:** 19–23.
7. Comparative Obstetric Mobile Epidural Trial (COMET) Study Group UK. Randomized controlled trial comparing traditional with two "mobile" epidural techniques: anesthetic and analgesic efficacy. *Anesthesiology* 2002; **97:** 1567–75.
8. Stacey RGW, *et al.* Single space combined spinal-extradural technique for analgesia in labour. *Br J Anaesth* 1993; **71:** 499–502.
9. Collis RE, *et al.* Randomised comparison of combined spinal-epidural and standard epidural analgesia in labour. *Lancet* 1995; **345:** 1413–16.
10. Simmons SW, *et al.* Combined spinal-epidural versus epidural analgesia in labour. Available in The Cochrane Database of Systematic Reviews; Issue 3. Chichester: John Wiley; 2007 (accessed 01/02/08).
11. Kestin IG, *et al.* Analgesia for labour and delivery using incremental diamorphine and bupivacaine via a 32-gauge intrathecal catheter. *Br J Anaesth* 1992; **68:** 244–7.
12. McHale S, *et al.* Continuous subarachnoid infusion of 0.125% bupivacaine for analgesia during labour. *Br J Anaesth* 1992; **69:** 634–6.
13. Howell P, *et al.* Comparison of four local extradural anaesthetic solutions for elective Caesarean section. *Br J Anaesth* 1990; **65:** 648–53.

Preparations

BP 2008: Bupivacaine and Adrenaline Injection; Bupivacaine Injection; ***USP 31:*** Bupivacaine Hydrochloride in Dextrose Injection; Bupivacaine Hydrochloride Injection.

Proprietary Preparations (details are given in Part 3)

Arg.: Bupicaina; Bupigobbi; Bupinex; Caina G; Duracaine; ***Austral.:*** Marcain; ***Austria:*** Bucain; Carbostesin; Dolanaest; ***Belg.:*** Marcaine; ***Braz.:*** Bupiabbott; Bupiabbott Plus; Marcaina; Neocaina; ***Canad.:*** Marcaine; Sensorcaine; ***Chile:*** Duracaine†; ***Cz.:*** Marcaine; ***Denm.:*** Marcain; ***Fin.:*** Bicain; Marcain; ***Fr.:*** Marcaine†; ***Ger.:*** Bucain; Carbostesin; Dolanaest; ***Gr.:*** Marcaine; ***Hong Kong:*** Marcain; ***Hung.:*** Bucaine; Marcain; ***India:*** Marcain; Sensorcaine; ***Indon.:*** Bucain; Decain; Marcain; ***Irl.:*** Marcain; ***Israel:*** Kamacaine; Marcaine; ***Ital.:*** Bupibil; Bupicain; Bupiforan; Bupisen; Bupisolver; Bupixamol; Marcaina; ***Malaysia:*** Marcain; ***Mex.:*** Buvacaina; ***Neth.:*** Bupiforan; Marcaine; ***Norw.:*** Marcain; ***NZ:*** Marcain; ***Philipp.:*** Senpivac; Sensorcaine; ***Pol.:*** Marcaine; ***Port.:*** Bupinostrum; Marcaina; ***Rus.:*** Анекаин (Anekain); Bupicaine (Бупикаин)†; Marcain (Маркаин); ***S.Afr.:*** Macaine; Regibloc; ***Singapore:*** Marcain; ***Spain:*** Svedocain; ***Swed.:*** Marcain; ***Switz.:*** Carbostesin; Duracain; ***Thai.:*** Marcain; ***Turk.:*** Marcaine; ***UK:*** Marcain; ***USA:*** Marcaine; Sensorcaine; ***Venez.:*** Duracaina.

Multi-ingredient: ***Austral.:*** Marcain with Fentanyl; Marcain with Pethidine†; ***Fin.:*** Solomet c bupivacain hydrochlorid; ***NZ:*** Bupafen; Marcain with Fentanyl; ***USA:*** Duocaine.

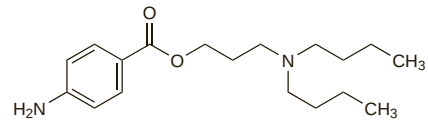
Butacaine Sulfate *(rINNM)*

Butacain. Sulph.; Butacaïne, Sulfate de; Butacaine Sulphate *(BANM)*; Butacaini Sulfas; Sulfato de butacaína. 3-Dibutylaminopropyl 4-aminobenzoate sulphate.

Бутакаина Сульфат

$(C_{18}H_{30}N_2O_2)_2,H_2SO_4$ = 711.0.

CAS — 149-16-6 (butacaine); 149-15-5 (butacaine sulfate).



(butacaine)

Profile

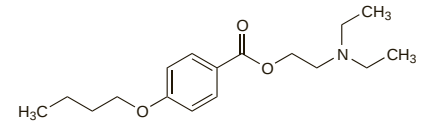
Butacaine, a para-aminobenzoic acid ester, is a local anaesthetic (p.1850) used for surface anaesthesia. It has been used topically, as the sulfate, in solutions for dental pain and in ear and nasal drops.

Butoxycaine Hydrochloride

Butoxicaína, hidrocloruro de; Butoxycaini Hydrochloridum. 2-Diethylaminoethyl-(*p*-butoxybenzoate) hydrochloride.

$C_{17}H_{27}NO_3,HCl$ = 329.9.

CAS — 3772-43-8 (butoxycaine); 2350-32-5 (butoxycaine hydrochloride).



(butoxycaine)

Profile

Butoxycaine, a para-aminobenzoic acid ester, is a local anaesthetic (p.1850) that has been used as the base or hydrochloride for surface anaesthesia.

Preparations

Proprietary Preparations (details are given in Part 3)

Multi-ingredient: ***Ger.:*** Bismolan†.