HISTORY OF OBSTETRIC ANALGESIA AND ANAESTHESIA

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Janet A. Pickett
‘Should you scratch deeply enough a man of pioneering spirit, the chances are that you will draw Scottish blood’

JM Horton

The 19th January 1847 marks the beginning of obstetric anaesthesia. On this day James Young Simpson (Fig. 1.1), Professor of Midwifery at the University of Edinburgh, administered ether to a mother with a contracted pelvis undergoing a difficult delivery. Although the infant was stillborn the mother experienced no pain. Simpson wrote later, ‘whilst this agent [ether] has been used extensively, and by numerous hands, in the practice of surgery, I am not aware that any one has hitherto ventured to test its applicability to the practice of midwifery. I am induced, therefore, to hope that the few following hurried and imperfect notes, relative to its employment in obstetric cases, may not … prove uninteresting to the profession’ (Fig. 1.2).  

INHALATIONAL ANALGESIA AND ANAESTHESIA

ETHER

James Young Simpson was born in 1811 at Bathgate near Edinburgh to ‘respectable but by no means wealthy parents’. Financially assisted by elder brothers, James attended the University of Edinburgh from where he graduated in 1830 with a degree in medicine. He subsequently obtained an MD for a thesis on ‘Death from Inflammation’ from the same university. Thereafter he progressed from assistant to the Professor in Pathology to a Lecturer’s post in Midwifery. During 1839 the Chair of Midwifery at the University became vacant and the new professor was to be elected by 33 members of Edinburgh’s Town Council. Simpson campaigned vigorously, accruing election expenses of £500. In 1840 at the age of 29 years he was duly appointed to the Midwifery Chair.

Simpson was a success, ‘He was a most impressive and instructive teacher … there was no need to call the roll or take cards, as was the custom in Edinburgh, at Simpson’s lecture. Every seat was occupied by no more persuasion than the attractiveness of the lecturer … At home, his consulting rooms were crowded with patients who had heard of his fame, and who came from all quarters of the world to consult him. Medical men came from every country eager to see something of his practice, and to have the pleasure of an interview with so celebrated a man’. In 1846, 6 years after Simpson’s appointment, news quickly spread of William Morton’s successful demonstration of ether anaesthesia in Boston and of Robert...
Liston’s employment of the same for a leg amputation in London. Simpson realized the potential for his midwifery practice. He rapidly obtained apparatus for ether administration and on the 19th January 1847 Simpson gave the first ever obstetric anaesthetic. Other cases quickly followed. ‘Within the last month I have had opportunities of using the inhalation of ether in the operation of turning, in cases of the employment of the long and of the short forceps, as well as in several instances in which the labour was of a natural type’. Simpson was delighted to have found a means of reducing the agonies of labour and its consequences, ‘in modifying and obliterating the state of conscious pain, the nervous shock otherwise liable to be produced by such pain, particularly whenever it is extreme, and intensely waited for and endured, is saved to the constitution’. Protheroe Smith was the first to use ether anaesthesia for midwifery in England, ‘To Professor Simpson justly belongs the merit of first employing ether by inhalation in midwifery practice … I may perhaps, however, be allowed to observe, that I had the privilege of first exhibiting the ether in obstetric cases in England’. Reports of ether anaesthesia during labour also came quickly from France and Germany. On the 7th April 1847 Nathan Cooley Keep was the first to administer ether for obstetric practice in the USA. Walter Channing, Professor of Obstetrics at Harvard University, soon followed.

Simpson, meanwhile, had become obsessed with the alleviation of pain during childbirth. On receiving a letter of appointment as the Queen’s Physician-Accoucher in Scotland, Simpson wrote to his brother, ‘Flattery from the Queen is perhaps not common flattery but I am far less interested in it than in having delivered a woman this week without any pain, while inhaling sulphuric ether. I can think of naught else’. There were however properties of ether that Simpson disliked – the unpleasant smell, the large quantities required and the tendency to produce bronchial irritation.

CHLOROFORM

Simpson began to investigate other volatile fluids. David Waldie, a Scottish chemist working in Liverpool, directed him towards an agent known as chloroform and suggested that it possessed anaesthetic properties. At his home in Queen Street in Edinburgh, Simpson and two of his assistants, Matthews Duncan and George Keith, self-experimented during the autumn and winter of 1847 with various agents. On the evening of the 4th of November they successfully demonstrated the anaesthetic properties of chloroform. ‘In searching for another object among some loose paper after coming home very late one night my hand chanced to fall upon it [chloroform] and I poured some of the fluid into tumblers before my assistants Dr Keith and Dr Duncan and myself. Before sitting down to supper we all inhaled the fluid and were all ’under the mahogany’ in a trice to my wife’s consternation and alarm’. The energetic Simpson then wasted no time – he administered chloroform to an obstetric patient the very next day; reported its use to the Medico-Chirurgical Society of Edinburgh 5 days later and gave ‘Notice of a New Anaesthetic Agent’ on 12th November 1847. By the 20th of November he had published in the Lancet, ‘I have employed it [chloroform], with few and rare exceptions, in every case of labour that I have attended, and with the most delightful results … I have now seen an immense amount of maternal pain and agony saved by its employment’.

INITIAL REACTIONS

Medical profession

Supporters

The introduction of obstetric anaesthesia provoked a furious debate. Edward Murphy, Professor of Midwifery at the University College Hospital in London, was a staunch supporter. With reference to chloroform he wrote, ‘It is the most valuable assistant in the management of labours that has ever been discovered. The patient goes through her labour quietly, without those distressing exclamations of agony, painful to her friends and embarrassing to the practitioner, and a favourable recovery is, I might say, insured’. Walter Channing in the USA was similarly enthusiastic and published his influential ‘Treatise on etherization in childbirth’ in 1848.

Opposition

Other members of the medical profession vigorously objected to obstetric anaesthesia, particularly if it was given to ease an uncomplicated labour. Many believed that labour pains were an essential prerequisite to a successful outcome and they strongly attacked Simpson for his interference with this process. One of the most venomous critics was Robert Barnes, Lecturer in Midwifery from London, ‘We may judge, by the character of the pains, and the expression the woman gives to her sufferings, not only of the stage of labour, but also of its duration, its difficulties, and its complications … Does Dr Simpson imagine that any one rational man, accustomed to act upon calm reflection and logical deduction from facts, will thus be dragooned into adopting, in every case of natural labour, the use of a
hazardous and doubtful agent?' 13 Rankin, a surgeon from Carluke in Scotland expressed his opinion, 'Art has no portion in ordinary parturition, which, in all strictness, is a natural function … no responsible person would readily administer to a female in labour, during five or six hours, through the medium of the delicate tissues of the lungs, diluted though it be by the atmosphere, an agent [chloroform] so powerful – so fatal!' 14 Opposition also came from abroad – most importantly from Charles Delucina Meigs an eminent obstetrician at Jefferson Medical College in Philadelphia. Meigs also firmly believed that labour pains were there for a purpose and that it was unsafe to intervene. ‘Should I exhibit the remedy for pain to a thousand patients in labour, merely to prevent the physiological pain, and for no other motive – and if I should in consequence destroy only one of them, I should feel disposed to clothe me in sack cloth, and cast ashes on my head for the remainder of my days.’ 15

**Church**

‘In sorrow thou shalt bring forth children’. Simpson was concerned that he would be accused of contravening the divine will. In 1847 he published his Answer to the religious objections advanced against the employment of anaesthetic agents in midwifery and surgery 16 arguing skilfully that the Hebrew word interpreted as ‘sorrow’ in fact meant ‘labour, toil or physical exertion’ i.e. women were to work during labour rather than to experience pain. Although much has been made of the religious objections to anaesthesia for childbirth, Farr argues that searches of contemporary medical, theological and lay literature gave little evidence for this and that Simpson’s pamphlet was written to forestall religious objections which, in the event, did not arise. 17, 18

**Royal family**

Connor and Connor suggest that in 1848, Queen Victoria expressed interest in the use of chloroform for the delivery of her sixth child. The evidence comes from a report in the *Hereford Times*, ‘ACCOUPHMENT OF HER MAJESTY – Professor Simpson, the discoverer of chloroform, has received intimation that his services, in conjunction with Dr Locock, her Majesty’s physician accoucher, will be required at Buckingham Palace on an approaching interesting occasion. Professor Simpson leaves Edinburgh for London some time next month, in order to be on attendance on Her Majesty.’ 20 Simpson’s services were, in fact not used on this occasion, but 5 years later on 7th April 1853 there is no doubt that Dr John Snow, London’s premier anaesthetist, administered chloroform to Queen Victoria for the birth of her eighth child. The Queen was ‘much gratified with the effect of the chloroform’. 21

It is often suggested that this ‘royal example’ greatly influenced the acceptability of obstetric anaesthesia. Again examination of contemporary evidence does not support this. The event was largely ignored by lay newspapers, and although reported by the medical press, subsequent correspondence suggests that Queen Victoria’s use of chloroform did not influence those doctors already opposed to obstetric anaesthesia. 20

As Simpson had predicted it was the lay public who ultimately played the most important role in the acceptance of obstetric anaesthesia, ‘Obstetricians may oppose it, but I believe our patients themselves will force the use of it upon the profession’. 10

**Methods of administration**

In his original description of the use of chloroform Simpson detailed that, ‘No special kind of inhaler or instrument is necessary for its exhibition. A little of the liquid diffused upon the interior of a hollow-shaped sponge, or pocket-handkerchief, or a piece of linen or paper, and held over the mouth and nostrils, so as to be fully inhaled, generally suffices in about a minute or two to produce the desired effect’. 10 Under Simpson’s influence the administration of chloroform was conducted in this manner throughout Scotland, and in many parts of the continent. In England however the situation was different. John Snow regarded the Scottish method of administration as ‘somewhat slovenly, and not very cleanly’. 22 He designed his own inhaler for the administration of chloroform for surgical use and commented, ‘I nearly always employ, in obstetric cases, the inhaler that I use in surgical operations … I find the inhaler much more convenient of
application than a handkerchief, and it contains a supply of chloroform which lasts for some time, thereby saving the trouble of constantly pouring out more.\textsuperscript{23} Snow also questioned the depth of anaesthesia required for the parturient during labour, ‘Dr. Simpson… naturally adopted the plan which is usually followed in surgical operations, making the patient unconscious at once, and keeping her so to the end of labour… Drs Murphy and Rigby were, I believe, amongst the first to state that relief from pain may often be afforded in obstetric cases, without removing the consciousness of the patient; and I soon observed the same circumstance’.\textsuperscript{23}

**DRAWBACKS OF CHLOROFORM**

Within 3 months of the introduction of chloroform to anaesthetic practice an unexplained death had been reported. Others followed, although more commonly in relation to general surgical procedures. Simpson argued that parturients were less at risk, ‘I am not aware of any death in Scotland or elsewhere from the use of chloroform in midwifery… nor, indeed, does the obstetric patient run anything like the risk of the surgical patient; for, in midwifery, though the anaesthetic is required to be given for a far longer period, it does not require to be given so deeply as in surgery’.\textsuperscript{24} Indeed Simpson was very trusting in his administration of chloroform, ‘After once beginning its use at an obstetric case, I generally leave its exhibition to be continued by the nurse, or by any intelligent friend of the patient who may be in the room’.\textsuperscript{24} In spite of the potential hazards, the use of chloroform for labour analgesia was to continue into the 20th century. In 1911 A. Goodman Levy demonstrated the cause of the unexpected deaths – ventricular fibrillation of the heart occurring under light anaesthesia.\textsuperscript{25}

**OTHER INHALATIONAL AGENTS**

**Nitrous oxide**

Stanislav Klikovich was the first to describe the use of nitrous oxide analgesia for labour in 1880 (Fig. 1.3).\textsuperscript{26,27} He prepared nitrous oxide in his own laboratory in St. Petersburg. Oxygen was then added so that the final preparation was 80% nitrous oxide and 20% oxygen. His instructions on how a woman should inhale this mixture were quite clear, ‘She should breathe out as fully as possible and then inhale as deeply as possible from the mouthpiece. If the inspired mixture is kept for a short time in the lungs before being expelled, the effect is achieved quicker and the gas consumption is greatly reduced. The woman must be warned that she may feel intoxicated for a short time… Inhalation should begin a minute or half a minute before the expected pain… If, however, the inhalations are started late, the commencing pain will often prevent the woman from taking deep breaths and the anaesthesia will not be completely successful.’\textsuperscript{27} Sadly, Klikovich’s technique was not widely copied.

In 1912 Arthur Guedel described an inhaler for the self-administration of nitrous oxide and air for use during ‘small office surgery’.\textsuperscript{28} This was followed in 1915 by two further descriptions of the use of nitrous oxide for labour analgesia: with 0–3% oxygen when given by J. Clarence Webster, ‘Pure nitrous oxide gas or gas with oxygen (3 per cent) may be employed. The former is, perhaps, most universally applicable. It may be used in private houses as well as in hospitals, the necessary apparatus being small, compact and easily transported’;\textsuperscript{29} or with 0–10%...
oxygen when administered by Frank Lynch, ‘Gas [nitrous oxide] is the ideal drug for conducting labours. It is the most volatile of anesthetics, acts most quickly, and its effects pass away most rapidly. It is practically free from danger even when analgesia is continued for many hours’.30 In 1934 Robert James Minnitt a general practitioner and honorary anaesthetist to the Liverpool Maternity Hospital designed, with the help of Charles King, his first ‘gas (nitrous oxide)-and-air’ machine. By 1936, 400 of the machines were in use and the apparatus was approved by the Central Midwives Board.31 Minnitt described the soothing influence of gas-and-air, ‘After the administration has commenced, an obvious change occurs in the labour ward. In a place previously filled with groans, comparative peace and quiet reign’.32 The Minnitt gas-and-air apparatus was widely used for the next 25 years (Figs 1.4 and 1.5). During 1961 Tunstall of Aberdeen gave his preliminary report of a 50% nitrous oxide and 50% oxygen mixture contained in one cylinder.33 This coincided with reports of unreliability in the Minnitt apparatus and hypoxic gas mixtures (as little as 3–4% oxygen) being delivered to parturients.34–36 Tunstall’s mixture of 50% nitrous oxide and 50% oxygen (Entonox) was approved by the Central Midwives Board in 1965 and has retained an important role in inhalational obstetric analgesia up to the present day (Fig. 1.6).

Divinyl ether

This agent was first described for obstetric use in 1934 by Wesley Bourne.37 Later Bourne suggested that divinyl ether was particularly useful for obstetric anaesthesia in general practice, ‘Vinyl ether would seem to offer an opportunity for replacing the much more dangerous chloroform…almost any one can
give vinyl ether with much greater safety than when chloroform is given with special care’.38

Cyclopropane

The first report of cyclopropane for labour analgesia was again by Wesley Bourne in 1934.39 Its use was further promoted by Harold Griffith in 1935, ‘Cyclopropane gives such deep, quiet, safe anaesthesia… that it has replaced chloroform and ether in my private obstetrical practice’.40 Bonica in 1967 considered cyclopropane to be one of the best agents for inhalational analgesia in obstetrics.41

Trichloroethylene

John Elam reported favourably on trichloroethylene (trilene) analgesia in 1942 (Fig. 1.7), ‘I would especially call attention to its use in midwifery for it appears to have very little effect on the uterine muscle, and a weak mixture of trilene and air will give an analgesia similar to that obtained with gas and oxygen’.42 Freedman described the use of an inhaler for trilene and air in 1943.43 Accurate drawover inhalers were later approved for use under the supervision of midwives in 1955 – the Emotril and Tecota Mark 6 machines (Fig. 1.8).

Methoxyflurane

The first reports of the extensive use of methoxyflurane in obstetrics came from Fernando Hudon in
1961 and 1962, ‘The outstanding features of the drug are the rapidity of induction, high level of analgesia under a light plane of anaesthesia, very low incidence of vomiting, minimal depression of uterine contractions, minimal respiratory depression of the fetus, quiet and rapid recovery’.44,45 Major et al from Cardiff in 1967 reported that a fixed inhaled concentration of 0.35% methoxyflurane provided good obstetric analgesia without unacceptable side effects.46 Midwives were allowed to administer 0.35% methoxyflurane from the Cardiff inhaler from 1970 onwards.

Isoflurane

Isoflurane was first reported for labour analgesia in 1975.47 Tunstall, administering 0.75% isoflurane in oxygen with contractions for the first stage of labour, found lower pain scores than with Entonox but at the expense of increased drowsiness.48 Wee et al compared isoflurane 0.2%/Entonox with Entonox alone and found that the former provided superior analgesia with higher but not clinically significant drowsiness scores.49

Enflurane

The analgesic efficacy of enflurane 1% in air was compared with Entonox by McGuinness and Rosen in 1984—pain scores were significantly lower with enflurane, but drowsiness scores were higher.50

Desflurane

The use of desflurane 1.0–4.5% and oxygen for vaginal delivery was described by Abboud et al in 1995. Satisfactory analgesia was achieved but several mothers had amnesia for the delivery.51

THE HISTORY OF MENDELSON’S SYNDROME

In 1847 when inhalational anaesthesia was first introduced to obstetric practice, Caesarean deliveries were rarely performed. During the first half of the 20th century as the procedure became more common, one of the gravest dangers of deep inhalational anaesthesia was exposed—the acid aspiration syndrome described by Curtis Mendelson in 1946.52 Mendelson reviewed 44 016 pregnancies at the Lying-In Hospital in New York and reported 66 cases of aspiration of stomach contents into the lungs—an incidence of 0.15%. All patients had been anaeasthetized with gas/oxygen/ether. Aspiration was recorded as having definitely occurred in the delivery room in 68%. Of these cases the character of the aspirated material was solid in five and liquid in forty-five. Mendelson described the unpleasant consequences, ‘Obstructive reactions occurred in the five patients that aspirated solid material. Three of these cases had complete obstruction; two died of suffocation on the delivery table, whereas the third recovered after coughing up a large piece of meat. Two of the five patients had incomplete obstruction with massive atelectasis, and both recovered after coughing up the obstructing material…a very different type of reaction was observed in the 40 patients that aspirated liquid material. For lack of any existing description, this type of reaction may best be likened to an acute asthmatic attack. Apparently liquid gastric contents were aspirated into the lungs, while the laryngeal reflexes were abolished during general anesthesia. The actual aspiration often escaped recognition. Cyanosis, tachycardia, and dyspnoea developed…auscultation over the involved areas revealed numerous wheezes, rales, and rhonchi. High pulse and respiratory rates were common, often reaching values of 160 and 40 respectively. Evidence of cardiac failure frequently appeared, and occasionally culminated in pulmonary edema’. Mendelson subsequently performed a series of experiments using rabbit models to determine the pathology of these two distinct aspiration syndromes. ‘After aspiration of solid undigested food the picture is invariably that of obstruction…following aspiration of liquid containing hydrochloric acid the animals develop a syndrome similar in many respects to that observed in the human following liquid aspiration’. Mendelson concluded that the incidence of aspiration could be reduced by withholding oral feeding in labour and by the wider use of regional anaesthesia. He also advocated alkanization of stomach contents prior to general anaesthesia to minimize the consequences of aspiration.

OPIOID ANALGESIA AND SEDATION

OPIOID ANALGESIA

Morphine

Morphine was isolated from crude opium by Friedrich Sertürner in 1805.53 Its use in main stream obstetrics was delayed until after the invention of the hypodermic syringe and hollow needle. The German physician Kormann recommended hypodermic administration of morphine for labour analgesia, but problems with the use of narcotics for this purpose were soon recognized.54

Twilight-sleep

The administration of morphine and scopolamine in combination was introduced by von Steinbüchel
of Graz in 1902.\textsuperscript{55} Gauss of Freiburg developed the method further. He gave slightly larger doses of morphine and scopolamine, followed by repeated injections of scopolamine alone, in a regimen which became known as twilight-sleep (Dämmer Schlaf): ‘a period of amnesia results, during which time painful sensations, which may be felt, are not stored up in the memory to haunt the patient after the ordeal is over’.\textsuperscript{56} Gauss claimed to have attained complete amnesia in 80\% of his patients.\textsuperscript{57} Many members of the medical profession recognized the potentially serious side effects of the isolated administration of scopolamine – neonatal respiratory depression and restless mothers. ‘Occasionally there is an irregular movement of the hands and at times there is considerable motor restlessness, the patient moving about in bed and sometimes getting out of bed. The patient frequently talks to herself and will answer questions which have been self-given; and in about one and one-half per cent of the cases there is some mental excitation, generally of self-given; and in about one and one-half per cent of the cases there is some mental excitation, generally of a mild degree; though occasionally this may be so marked as to require restraint’.\textsuperscript{56} The women however had little recall of painful labours and therefore considered it to be an acceptable technique. In spite of the reluctance of many doctors to advocate twilight-sleep, women demanded access to it, particularly in the USA, where an organization named the National Twilight Sleep Association was formed. Two events subsequently took place which limited the success of this movement – firstly one of the associations’ leaders, Mrs Francis X Carmody, died suddenly during childbirth and secondly the outbreak of world war one diminished enthusiasm for anything ‘German’.\textsuperscript{58,59} In spite of this loss of popular support, the method further increased in popularity. The Apgar scores in the neonates, or upon length of labor the medication exerted no apparent influence upon the baby. The drug markedly reduced apprehension, and pain associated with it, blunted the memory of labor … the medication exerted no apparent influence upon Apgar scores in the neonates, or upon length of labor or anesthesia requirements’.\textsuperscript{53}

Pethidine

Pethidine was synthesized in 1939 in Germany\textsuperscript{60} and first used for labour analgesia in 1940. Compared to equipotent doses of morphine, pethidine is said to produce less neonatal respiratory depression – possibly due to morphine penetrating the fetal nervous system more easily.\textsuperscript{61} None the less the pethidine concentration in fetal blood is still about 70\% of the concentration in maternal blood\textsuperscript{62} and neonatal respiratory depression is well documented.\textsuperscript{63,64} Midwives have been allowed to prescribe and administer pethidine since 1950. This ease of availability has allowed it to develop as the most commonly used systemic opioid for labour analgesia in the UK – despite the limitations of pethidine as an effective analgesic. Holdcroft and Morgan, and Beazly et al found that 40–75\% of women receiving intramuscular pethidine during labour had ineffective pain relief.\textsuperscript{65,66} In an effort to improve analgesia, pethidine has been administered intravenously by patient controlled analgesia (PCA) systems. Adverse effects may be less than following intramuscular injection and analgesia better although reports are variable.\textsuperscript{67} Shorter acting opioids such as fentanyl, alfentanil and remifentanil have also been administered by PCA systems, usually when regional analgesia has been contraindicated.\textsuperscript{68-70} Naloxone, an opioid receptor antagonist, was introduced by Clarke in 1971\textsuperscript{71} and has proved to be an invaluable tool in the treatment of opioid induced neonatal respiratory depression.

OTHER SEDATIVES IN LABOUR

Chloral hydrate, tincture of opium and bromide was a popular mixture during the latter half of the 19th century, used to produce sleep during labour. It was replaced by the barbiturates following the introduction of barbitone by Emil Fischer and von Mering in 1903. Rectal ether, ether and oil, and antihistamines have also been used for their sedative properties.\textsuperscript{72} Bepko et al reported on the use of parenterally administered diazepam during labour in 1965, ‘Parenteral administration of 20–40 mg of diazepam to 81 women during labour produced no untoward effects upon mother or baby. The drug markedly reduced apprehension, and pain associated with it, blunted the memory of labor … the medication exerted no apparent influence upon Apgar scores in the neonates, or upon length of labor or anesthesia requirements’.\textsuperscript{73}

REGIONAL ANALGESIA AND ANAESTHESIA

SPINAL ANAESTHESIA

Carl Koller of Vienna was the first to utilize local anaesthesia for surgery – he performed an eye operation using cocaine in 1884.\textsuperscript{74} J. Leonard Corning, a neurologist from New York, accidentally produced spinal analgesia in 1885 whilst experimenting with cocaine on the spinal nerves of dogs.\textsuperscript{75} During 1891 both Quincke and Wynter were responsible for making the performance of a lumbar puncture a straightforward clinical procedure.\textsuperscript{76,77} August Bier in 1898 was the first to use planned spinal anaesthesia for surgery.\textsuperscript{78} Tuffier, of Paris, later reported on the use of spinal anaesthesia for lower abdominal procedures.\textsuperscript{79} Oscar Kreis, an assistant obstetrician at the Women’s Hospital in Basel, administered the first spinal for obstetric use in 1900 – analgesia for operative vaginal delivery.\textsuperscript{80} During the same year Marx from New York
described intrathecal cocaine for labour analgesia. Marx also discussed the importance of watching cerebrospinal fluid escape from the needle hub prior to injecting local anaesthetic solution, ‘a *sine qua non* to an absolute analgesia is the escape of subarachnoid fluid before the cocaine solution is injected, and by its escape I am in positive position to state that the needle is in the canal. There is no other guide’.81 The importance of the curves of the vertebral canal and the use of gravity in the control of the level of spinal analgesia was first realized by Arthur Barker of London in 1906, ‘it has for a long time past appeared to me that if we are to aim at localizing our spinal analgesia to any particular region of the cord we ought to employ the force of *gravity* acting upon an injected compound of greater density than that of the liquor spinalis. This would sink to the most dependent part of the canal open to it independent of any displacement of the cerebro-spinal fluid. Here it would remain more or less undiluted in contact with the structures around’.82,83

In 1907 Henry Dean was the first to describe continuous spinal anaesthesia, ‘In some cases the anaesthesia tends to disappear before the operation is completed… It is necessary, therefore, to be prepared to give another injection during the operation, and with this in view I have so arranged the exploring needle that it can be left *in situ* during the operation, so that at any moment another dose can be injected without moving the patient beyond a slight degree’.84

George Pitkin popularized spinal anaesthesia for obstetric use in the USA and described ‘controllable spinal anaesthesia’ in 1928, ‘The results were so satisfactory in 89 cases of instrumental deliveries, versions, breech cases, and prolonged labors… the technique of controlling the anaesthetic solution and limiting its contact to those strands of the cauda equina that pierce the tip of the dural sac, forming the sacral nerves is relatively simple with the use of gliadin (the mucilaginous content of wheat starch) which prevents dissemination or mixing of the anaesthetic solution with the spinal fluid until the anaesthetic agent has been absorbed’ (Fig. 1.9).85 Continuous spinal anaesthesia using a ‘ureteral catheter’ was described by Major Edward Tuohy in 1945.86

**Complications of spinal anaesthesia**

*aorta-caval compression*

Spinal analgesia and anaesthesia in obstetric practice has waxed and waned in popularity. There were early fatalities from circulatory collapse when pregnant mothers were given spinal anaesthetics for Caesarean section. Holmes in 1938 suggested that, ‘the mechanism in sudden circulatory collapse during Caesarean section under spinal analgesia is a combination of the effects of occlusion of the inferior vena cava and reduction of peripheral vascular resistance on cardiac output’. He felt that, ‘vigilant supervision will focus attention on an early decline of cardiac output, in which case…’