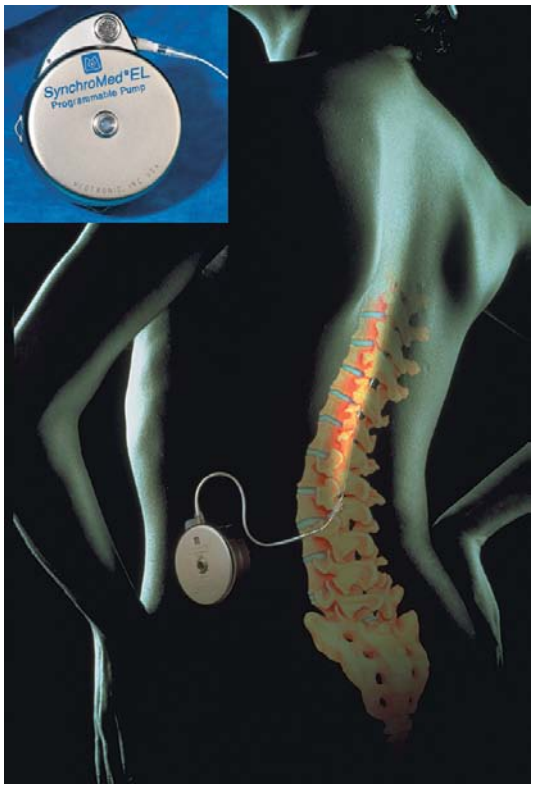
Dr R E Pope

Beneficence and Nonmaleficence
Neurosurgeon and Spine Surgeon

Spinal cord stimulation for pain

Morphine Pumps



Introduction

- In those with **Failed Back Surgery** and certain other painful conditions, infusing morphine into the spinal fluid (intrathecal space) can produce profound pain relief when maximum conservative therapy has failed.
- Maximum conservative therapy is said to have failed when severe back pain and sciatica persist despite:-
    - **A proper trial of multi-modal oral analgesia** e.g. paracetamol + NSAID + adequate doses of a morphine-based drug + amitriptyline + gabapentin
    - **A proper trial of all other interventional pain clinic, physical therapy, and complementary techniques** e.g. Acupuncture, TENS, Exercises, Manipulation, Facet Joint Injections, Ligament Sclerosants, Epidural Injections, Nerve Root Blocks, Epiduroscopy, Surgery
- Prior to implantation patients undergo an intrathecal (IT) morphine trial in the pain clinic, to help assess their suitability for the technique. Psychological screening is also advisable.
- IT morphine 1 mg per day is equivalent to oral morphine 75 mg per day. Most patients require between 1 mg and 4 mg per 24 hours intrathecally to achieve reasonable comfort. This is equivalent to between 75 - 300 mg oral morphine per day. Even with this "Rolls Royce" technique, 100% pain relief is not attainable or expected. Co-medication with paracetamol, NSAIDs, amitriptyline and gabapentin may still be necessary.
- The most commonly used system is the totally implanted, battery operated Synchromed pump made by Medtronic (see www.medtronic.com for further information). The pump head, which is about the size of the palm of your hand, is inserted

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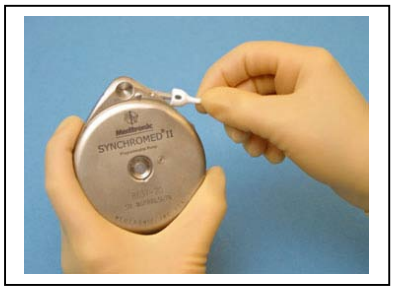
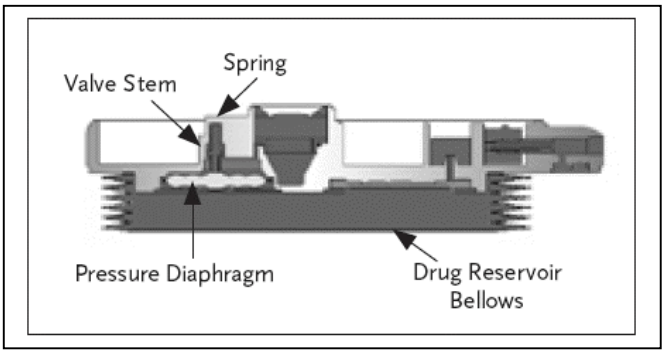
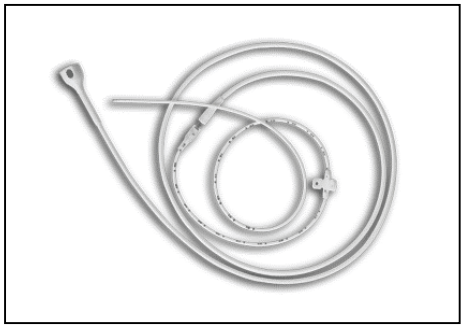
underneath the skin, in the front part of the abdomen just under the ribs. A small catheter is then tunnelled around to the back under the skin to enter the spine and spinal fluid. Preservative-free morphine is stored in the pump reservoir, and is delivered to the spine continuously in small increments. The total daily dose delivered is controlled by sensitive electronics in the pump head, and these settings can be altered by communicating with the pump using a lap top computer connected to a transmitter / receiver system.







IT Morphine Trial

- To find out whether an IT morphine pump is going to be effective, a trial with a temporary catheter connected to an externalized pump is often performed. The Synchromed system costs in excess of $30,000, and therefore this is a very important step before considering permanent implantation.
- The trial is performed as an in-patient, and may last up to 7 days.
- A narrow gauge temporary catheter is inserted into the intrathecal space in the operating theatre using local anaesthetic and intravenous sedation. This catheter is then tunnelled around to the front of the abdomen and fixed in place with a nurse-proof and patient-proof dressing. The catheter is then attached to an ambulatory battery operated infusion pump which contains the preservative free IT morphine.
- During the first 24 hours the morphine-containing oral drugs are slowly stopped, whilst the intrathecal morphine infusion is gradually increased to the point where the only morphine received is via the intrathecal route. All other pain killers which do not contain morphine may be continued as normal e.g. paracetamol, NSAIDs, amitriptyline, gabapentin etc.
- Mobilisation is encouraged the day after the procedure, and is combined with IT morphine dose adjustments to achieve reasonable relief whilst fully ambulant.
- A successful trial is one where there is obvious improvement in pain relief during a full range of normal activities e.g. walking, sitting, dressing, bending etc.
- At the end of the trial, the temporary catheter is removed, after noting the 24 hour dose of IT morphine. This helps the implanting surgeon start at the correct dose immediately post procedure.
- Other types of trial have been described:-
    - **Single shot injection of IT morphine** - the effect of the morphine lasts only 24 hours and does not allow an adequate trial of full mobilisation. Spinal headaches can also occur which confuse the issue.
    - **Epidural infusion** - there is a ten fold difference in dose requirements comparing IT and epidural infusions. Success with an epidural infusion does not guarantee success with an IT infusion and vice versa. I would always suggest comparing like with like to get a real idea about what it is like to live with an IT morphine infusion.

Surgical Implantation

- Implantation of the Synchromed system requires an in-patient stay, and general anaesthesia is required usually.
- The pump is inserted into a pocket just below the rib margin, with the catheter tubing being tunnelled around the abdomen, towards the spine, and into the spinal fluid. The permanent spinal catheter is of a much larger diameter than the temporary catheter, being much more resistant to kinking and snapping.
- As for the IT trial, afterwards there is a gradual reduction in oral morphine medication, accompanied by a gradual increase in the IT morphine dose, up to the level as discovered during the IT trial.
- As with any surgery there will be pain in the surgical wound, which usually lasts between 5 - 7 days, and will not be necessarily covered by the IT morphine infusion. Other analgesics may be required during this recovery phase.
- Initially the pump reservoir is only half filled, so that the first refill will occur earlier than 3 months.

Pump Refills

- The pump reservoir has a capacity of 20 ml. To allow for errors only 18 ml of solution is injected at any refill. The morphine solution used has a concentration of 30 mg/ml, and this means that 540 mg of morphine is injected each time (18 ml x 30 mg/ml = 540 mg).
- Morphine is stable in solution for about 90 days; therefore pump refills only need to occur about once every 3 months allowing complete freedom between times.
- Before refilling can start, the pump is switched off, and the electronic record of the volume of IT morphine solution remaining in the reservoir is noted.
- The old IT morphine solution is removed and discarded. The pump head is accessed by placing a clean needle through sterilized skin, into the filling port in the centre of the pump. The filling port is located by using a specially designed shape template placed on the skin overlying the pump head.
- The volume removed from the pump is then compared with the electronic record, so that the accuracy of the infusion can be checked. Refilling using 18ml of new IT morphine solution then occurs using the same needle and refill port.
- The filling port is made of specially designed material so that it reseals after the refill needle is removed. Using the lap top computer, the pump head programme is checked for errors, the reservoir volume record is set to 18 ml, and then the pump is switched back on again.

Complications

IT Morphine Trial Complications

- **IT Catheter Problems** - The temporary catheter can occasionally fall out or snap despite adequate fixation.
- **Post Dural Puncture (Spinal) Headache** - The temporary spinal catheter is inserted into the spinal fluid using a catheter-through-needle technique. This means that the needle is of a larger diameter than the catheter. When the needle is removed, and the catheter is left in place, there is a gap around the edge of the catheter, allowing spinal fluid to leak out. If the leak is large enough, the spinal fluid pressure drops. As the spinal fluid in the spine connects with the spinal fluid around the brain, this means that the pressure of fluid around the brain drops also, causing a low pressure headache. The headache is usually fine when lying flat, but becomes a problem in the sitting or upright position. The gap around the catheter usually closes on its own in 48 hours, allowing the headache to resolve. Low pressure headache is usually treated with IV fluids to restore CSF pressure, analgesics and anti-emetics, and sometimes an IV caffeine infusion. It is unfortunate that this form of headache occurs just at the time when the patient should be mobilising and trying out the new pain relief. This why a longer in-patient stay is required, so that adequate time can be given to trying the IT morphine with full mobilisation. Smaller gauge catheters and needles produce fewer headaches, but do not reduce the risk altogether.
- **Infection** - The commonest infection problem is at the exit point where the catheter pierces the skin of the abdomen after it has been tunnelled. If this progresses, then the whole tunnel can become infected. The least common type of infection is meningitis, caused by introduction of bacteria directly into the spinal fluid, either at the time of catheter insertion, or later from the bag containing the IT morphine.
- **Drug Side Effects** - Drowsiness, dizziness, nausea and vomiting may occur during IT morphine titration. These troublesome symptoms usually settle in a short time.
- **Respiratory depression** can occur during the period where the existing oral opioids are being withdrawn and the IT morphine is being titrated upwards.
- **Morphine withdrawal reactions** can occur during the period where the existing oral opioids are being withdrawn and the IT morphine is being titrated upwards.
- **Urinary retention** and hesitancy can occur due to IT morphine interfering with the relaxation process in the bladder neck. In most cases this resolves with time and a temporary urinary catheter. When the problem does not resolve despite adequate IT morphine dose adjustments, then the IT trial has to be abandoned including all prospects of permanent IT pump implantation.

Early Synchromed Complications

- **Post Dural Puncture (Spinal) Headache** may occur as for the IT trial above. As the spinal needle and catheter are of a larger diameter than those used for the IT trial, there is potential for a larger leak of spinal fluid, associated with a bigger headache. The gap around the edge of the catheter usually seals spontaneously with time, allowing the headache to resolve. See IT trial above for more information.
- **Infection** may affect the wound, pump head pocket, IT catheter tunnel, and rarely the pump reservoir causing spinal fluid infection with meningitis.
- **Catheter problems** may occur with leaks and kinks being the commonest problems encountered.
- **Pump Head** - the pump head can occasionally flip over 180 degrees, preventing access to the filling port. Further surgery is required to secure and reposition it.
- **Refilling** - difficulty finding the filling port may cause the IT morphine to be injected into the surrounding subcutaneous tissues. Severe respiratory depression may ensue requiring intravenous naloxone (bolus + infusion), and artificial ventilation for a period of time. Can be lethal if not treated in a timely fashion. The risk of filling errors increases with obesity.

Late Synchromed Complications

- **Infection** may rarely affect the pump reservoir causing spinal fluid infection and meningitis. Strict aseptic technique during refills is essential to prevent this.
- **Tolerance** to IT morphine with gradual increase in dose requirements. Dose increases should be resisted at all costs, as there is a maximum permissible daily IT morphine dose, above which complications may occur. Remember 100% pain relief is not possible with this system. Adjusting other co-analgesics is preferable to increasing the IT morphine dose.
- **Low battery** - sooner or later, between 3 - 6 years, the pump head battery will fail and need to be surgically replaced. At this point you will need to transfer back to slow release oral morphine to prevent "cold turkey". The oral morphine can be slowly stopped once the battery has been replaced.
- **Pump Malfunction** - very rarely the pump head electronics fail. Usually this causes the pump to stop, causing sudden onset pain and morphine withdrawal symptoms. There is a theoretical risk that the pump could go out of control, injecting excess doses of IT morphine. This situation is potentially lethal if not detected in time. High doses of IT morphine will cause drowsiness, respiratory depression and death. IT morphine overdose needs cardio-respiratory support in intensive care, plus intravenous naloxone. Naloxone is a specific morphine antagonist which is used as an IV bolus plus an infusion, until the effects of the IT morphine have worn off.
- **Refilling** - difficulty finding the filling port may cause the IT morphine to be injected into the surrounding subcutaneous tissues. Severe respiratory depression may ensue requiring intravenous naloxone (bolus + infusion), and artificial ventilation for a period of time. Can be lethal if not treated in a timely fashion. The risk of filling errors increases with obesity.