EPIDURAL AND SPINAL ANALGESIA

ANALGESIA FOR LABOR AND VAGINAL DELIVERY

DR SHAFEINIA
ANESTHESIOLOGIST
ASSISTANT PROFESSOR OF IUMS

EFFECTS OF LABOR PAIN

- Maternal hyperventillation
- Hypocarbia – Uteroplacental vasoconstriction
- ↑O2 consumption
- ↑Cardiac output, ↑BP
- ↑Maternal plasma catecholamines

- Fetal acidosis and hypoxia

METHODS OF PAIN RELIEF

- Systemic:

  Intravenous (opioid – non opioid)

  Inhalation (Entonox)

- Regional:

  Spinal

  Epidural

  CSE

GOALS OF LABOR ANALGESIA

- Dramatically reduce pain of labor
- Should allow parturients to participate in birthing experience
- Minimal motor block to allow ambulation
- Minimal effects on fetus
- Minimal effects on progress of labor

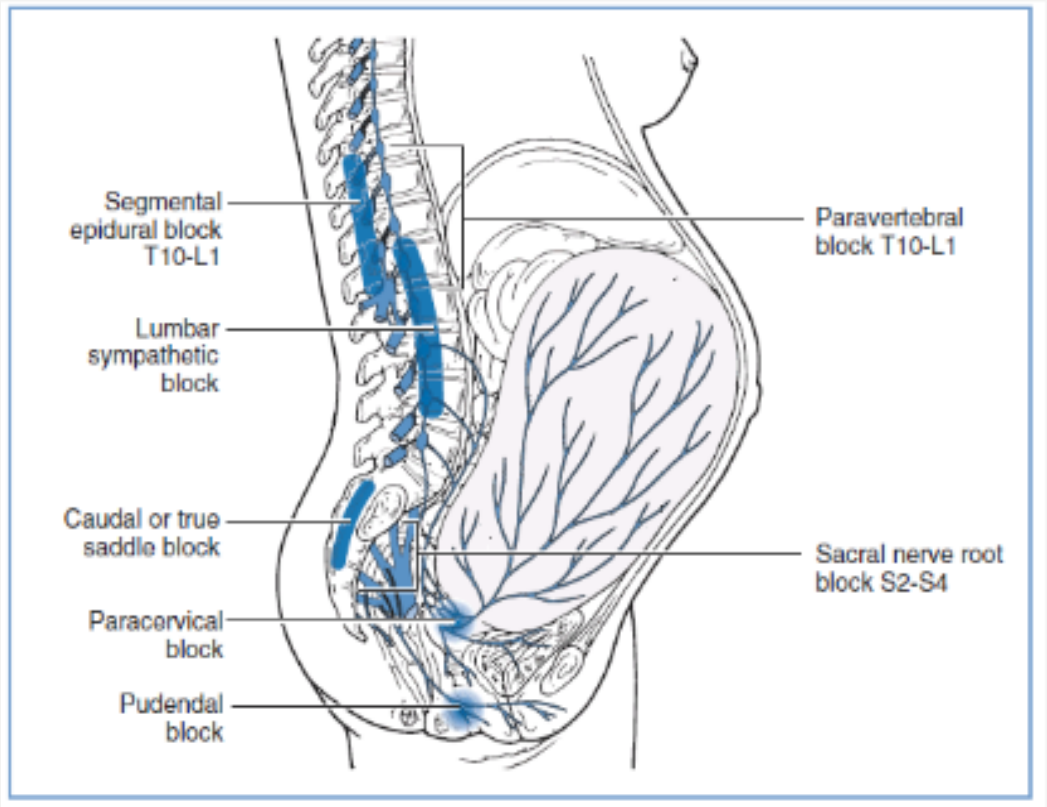
- Anesthesia providers should identify those methods of analgesia that provide the most effective pain relief without unduly increasing the risk for obstetric intervention.

- Epidural analgesia and spinal analgesia are the most effective methods of intrapartum pain relief in contemporary clinical practice.

- In a survey of 1000 consecutive women who chose a variety of analgesic techniques for labor and vaginal delivery (including nonpharmacologic methods, transcutaneous electrical nerve stimulation, intramuscular meperidine, inhalation of nitrous oxide, epidural analgesia, and a combination of these techniques), ***pain relief and overall satisfaction with the birth experience were greater in patients who received epidural analgesia.***

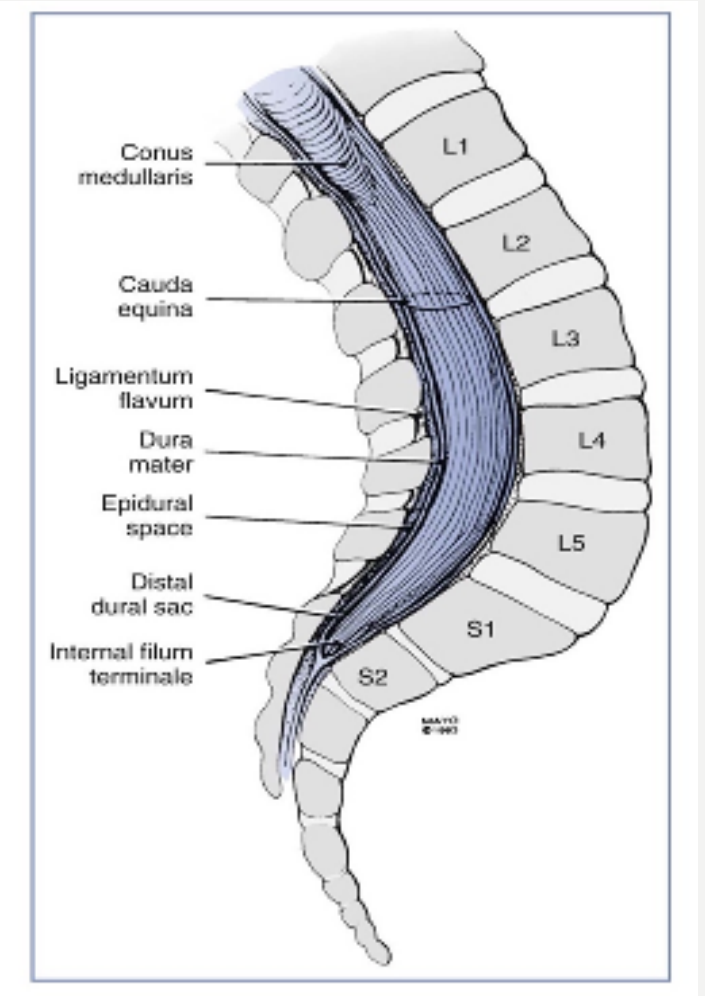
OBSTETRIC PAIN PATHWAY

- First Stage
  - Pain from lower uterine and cervix changes
  - Visceral Afferent Nerve fibers
  - T10-L1 Segments
- Second Stage
  - Pain from distension of pelvic floor, vagina, and perineum
  - Somatic Nerve fibers
  - S2-S4 Segments



OBSTETRIC ANATOMY

- Cephalad- From brain stem
- Terminates at Conus Medularis
- L1-Conus Medularis
- L2-Cauda Equina
- Membranes
  - Pia Mater
  - Subarachnoid Space
  - Subdural Space
  - Arachnoid Mater
  - Dura Mater



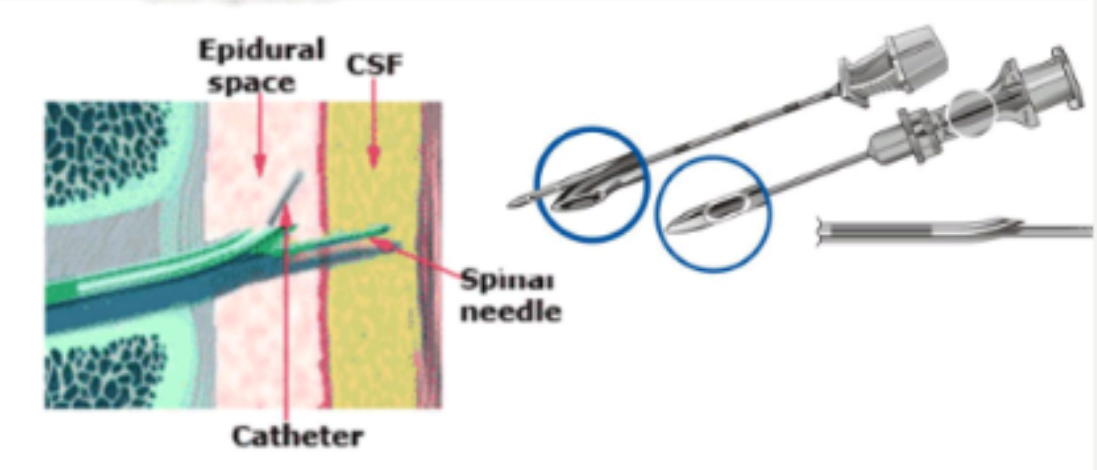
EPIDURAL ANALGESIA

- Continuous lumbar epidural analgesia has been the mainstay of neuraxial labor analgesia for several decades.

1) Placement of an epidural catheter allows analgesia to be maintained until after delivery.
2) No dural puncture is required.
3) The presence of a catheter and effective analgesia allow the conversion to epidural anesthesia should cesarean delivery be necessary.

COMBINED SPINAL-EPIDURAL ANALGESIA

- Combined spinal-epidural (CSE) analgesia has become increasingly popular in the past 15 years.
- Onset of complete analgesia is significantly faster than with epidural techniques (2 to 5 minutes versus 10 to 15 minutes, respectively).



- Cappiello et al have described a technique in which a dural puncture is made with a small-gauge spinal needle but no drug is injected into the subarachnoid space. After injection of epidural local anesthetic and opioid, blockade of sacral dermatomes occurred more frequently in parturients with a dural puncture than in those without, *presumably because of enhanced anesthetic solution migration across the dural puncture site.*

SINGLE-SHOT TECHNIQUES

- In general, single-shot techniques (spinal, lumbar epidural, or caudal) are not useful for most laboring women because of their limited duration of action.

- These techniques may be indicated for parturients who require analgesia or anesthesia shortly before anticipated vaginal delivery or in settings in which continuous epidural analgesia is not possible.

EQUIPMENT AND MONITORS

- *Resuscitation equipment, drugs*, and supplies must be immediately available for the management of serious complications of neuraxial analgesia (e. g., hypotension, total spinal anesthesia, systemic local anesthetic toxicity) .

- *Emergency airway equipment* should be checked before the administration of neuraxial analgesia.

DRUGS

- Hypnotic-amnestic agents (propofol, ketamine, midazolam)
- Succinylcholine
- Ephedrine
- Epinephrine
- Phenylephrine
- Atropine
- Calcium chloride
- Sodium bicarbonate
- Naloxone

EQUIPMENT

- Oxygen source
- Suction source with tubing and catheters
- Self-inflating bag and mask for positive-pressure ventilation
- Face masks
- Oral airways
- Laryngoscope and assorted blades
- Endotracheal tubes with stylet
- Eschmann stylet (bougie)
- Qualitative carbon dioxide detector

- During the initiation of neuraxial analgesia, the parturient's oxygen saturation is measured continuously and the blood pressure is assessed every 2 to 3 minutes for 15 to 20 minutes after the neuraxial anesthetic administration, or until the mother is hemodynamically stable .

- The FHR should be monitored before and after the initiation of neuraxial analgesia; it may be difficult to monitor the FHR during the actual procedure.

- During maintenance of neuraxial analgesia, maternal blood pressure is measured every 15 to 30 minutes, or more frequently if hypotension ensues.

- The sensory level of analgesia and the intensity of motor block are assessed after the administration of the test and therapeutic doses of local anesthetics.

INTRAVENOUS HYDRATION

- Placement of an intravenous catheter (preferably 18-gauge or larger) and correction of hypovolemia with intravenous hydration are necessary before the initiation of neuraxial analgesia to mitigate hypotension that can result from sympathetic blockade.

- Data from small studies are conflicting as to whether a fluid bolus administered immediately before the initiation of analgesia decreases the risk for nonreassuring FHR patterns.
- .

- Most anesthesia providers administer approximately 500 mL of lactated Ringer's solution (without dextrose), although the ASA Task Force on Obstetric Anesthesia has stated that a fixed volume of intravenous fluid is not required before neuraxial analgesia is initiated.

- Severe hypotension is less likely with the contemporary practice of administering a dilute solution of local anesthetic for epidural analgesia or an intrathecal opioid for spinal analgesia

CHOICE OF DRUGS

- The **ideal analgesic drug** for labor would provide rapid onset of effective analgesia with minimal motor blockade,

  minimal risk for maternal toxicity,

  and negligible effect on uterine activity and uteroplacental perfusion.

  It would undergo limited transplacental transfer and thus have minimal direct effect on the fetus.

Finally, this ideal agent would have a long duration of action.

Although this perfect analgesic drug does not exist, the ***combination of a local anesthetic with an opioid*** allows us to approach this goal.

- The combination of a local anesthetic with a lipid-soluble opioid allows for the use of lower doses of each agent, thus minimizing undesirable side effects.

- For example, when used alone without an opioid, the local anesthetic dose required for effective epidural analgesia is associated with an unacceptably high incidence of motor blockade.
- Similarly, used alone, high doses of epidural opioid are required for satisfactory analgesia during early labor, and such doses are associated with significant systemic absorption and systemic side effects.

- . Thus, contemporary epidural labor analgesia practice most often incorporates **low doses of a long-acting local anesthetic combined with a lipid-soluble opioid.**

LOCAL ANESTHETICS

BUPIVACAINE

- Traditionally, the amide local anesthetic bupivacaine has been the most commonly used agent for epidural labor analgesia.

- After epidural administration of bupivacaine (without opioid) during labor, the patient first perceives pain relief within *8 to 10 minutes*, but approximately *20 minutes* is required to achieve the peak effect. Duration of analgesia is approximately *90 minutes.*

- Bupivacaine 6.25 to 12.5 mg (e.g., **10 to 20 mL of a 0.0625% solution, or 5 to 10 mL of a 0.125% solution**) combined with fentanyl or sufentanil is adequate to initiate labor analgesia in most parturients

- these data suggest that epidural analgesia and safety are improved with the use of low concentration

- Drugs Used for Initiation of Epidural and Spinal Labor Analgesia

Drug	Epidural Analgesia*	Spinal Analgesia
Local Anesthetics†		
Bupivacaine	0.0625%-0.125%	1.25-2.5 mg
Ropivacaine	0.08%-0.2%	2.0-3.5 mg
Levobupivacaine	0.0625%-0.125%	2.0-3.5 mg
Lidocaine‡	0.75%-1.0%	NA
Opioids†		
Fentanyl	50-100 µg	15-25 µg§
Sufentanil	5-10 µg	1.5-5 µg§
Morphine‡	NA	125-250 µg§
Meperidine‡	NA	10-20 mg

ROPIVACAINE

- Ropivacaine, a relatively newer amide local anesthetic, *is similar to bupivacaine in structure and pharmacodynamics*
- Studies in vitro and in vivo have shown that ropivacaine is less cardiodepressant and arrhythmogenic than bupivacaine when doses of equal mass are compared.
- Several studies that compared equal concentrations of ropivacaine and bupivacaine given by patient-controlled epidural analgesia (PCEA) have not found any significant difference in clinical efficacy between the two local anesthetics.
- ropivacaine has a longer duration of analgesia than bupivacaine, which may offset its lesser potency when it is administered by continuous epidural infusion.
- Early clinical studies suggested that ropivacaine is associated with less motor block than bupivacaine;

OPIOIDS

- Morphine was one of the first opioids to be studied for labor analgesia. However, because of its long latency, side effects, and inconsistent analgesia, morphine has largely been *replaced by the lipid-soluble opioids fentanyl and sufentanil*

- Epidural fentanyl alone provides moderate analgesia in early labor, but the dose needed to provide complete analgesia is accompanied by significant side effects (e.g., pruritus, nausea, maternal sedation, perhaps neonatal depression). In addition, epidural administration of an opioid alone provides inadequate analgesia during the late first stage as well as the second stage of labor.

- In clinical practice, either fentanyl or sufentanil is frequently combined with a low-concentration, longacting amide local anesthetic to initiate epidural labor analgesia. Epidural opioid administration allows the anesthesia provider to use a more dilute solution of local anesthetic to provide epidural labor analgesia.

- Advantages of a lower total dose of local anesthetic include
- (1) decreased risk for local anesthetic systemic toxicity,
- (2) decreased risk for high or total spinal anesthesia,
- (3) decreased plasma concentrations of local anestheticin the fetus and neonate, and
- (4) decreased intensity of motor blockade.

SUMMARY

- Epidural labor analgesia is usually initiated with the bolus injection of a local anesthetic combined with a lipidsoluble opioid.

- The advantages of the addition of an opioid to an epidural solution of local anesthetic include
  (1) lower total dose of anesthetic,
  (2) decreased motor blockade,
  (3) reduced shivering, and
  (4) greater patient satisfaction.

- Some anesthesia providers contend that local anesthetic–opioid techniques result in a lower risk for hypotension, but this belief is unproven.

SPINAL ANALGESIA

- The onset of effective spinal analgesia occurs faster than epidural analgesia, and more women have effective analgesia at 10 minutes.

- Intrathecal opioids can provide complete analgesia during early labor when the pain stimuli are primarily visceral.

- An intrathecal local anesthetic without an opioid is not commonly used for labor analgesia. Doses high enough to provide analgesia are associated with significant motor blockade, and lower doses either do not provide satisfactory analgesia or are associated with an unacceptably short duration of analgesia.

- A lipid-soluble opioid is combined with a local anesthetic (bupivacaine, ropivacaine, or levobupivacaine) when sacral analgesia is necessary for complete analgesia (e.g., initiation of analgesia during the active first stage or the second stage of labor).

OPIOIDS

- The two opioids most commonly used for initiation of spinal labor analgesia are **fentanyl and sufentanil**.

- When administered alone in early labor, intrathecal fentanyl and sufentanil provide complete analgesia without a sympathectomy or motor blockade.

- This is a particularly useful technique for patients in whom a sudden decrease in preload (secondary to neuraxial local anesthetic–induced sympathectomy) might not be well tolerated (e.g., patient with a stenotic heart lesion).

- Intrathecal fentanyl (or sufentanil) is often co-administered with an amide local anesthetic , most commonly bupivacaine .

- The addition of a local anesthetic to intrathecal fentanyl or sufentanil markedly decreases the dose of opioid necessary to produce analgesia.

- Intrathecal fentanyl 10 to 15 µg, combined with bupivacaine 2.5 mg, provides effective analgesia for most parturients.

MAINTENANCE OF ANALGESIA EPIDURAL ANALGESIA

- Neuraxial analgesia is maintained with the intermittent or continuous administration of analgesics, usually a combination *of a long-acting amide local anesthetic and a lipid-soluble opioid.*

- By far the most common technique is administration of drugs via a catheter into the epidural space.

- In the past, epidural labor analgesia was maintained with the intermittent injection or continuous infusion of a neuraxial local anesthetic alone.

- Currently, most anesthesia providers maintain analgesia with a combination of a low-dose, long-acting amide local anesthetic and a lipidsoluble opioid

- In practice, neither lidocaine nor 2-chloroprocaine is used for maintenance of analgesia. Both have a short duration of action

Anesthetic Solutions for Maintenance of Epidural Analgesia:

Continuous Infusion or Patient- Controlled Epidural Analgesia

Drug[†]	Concentration
Local Anesthetics	
Bupivacaine	0.05-0.125%
Ropivacaine	0.08-0.2%
Levobupivacaine	0.05-0.125%
Lidocaine[‡]	0.5%-1.0%
Opioids	
Fentanyl	1.5-3 µg/mL
Sufentanil	0.2-0.4 µg/mL

INTERMITTENT BOLUS

- Before the introduction of infusion pumps, epidural analgesia was routinely maintained by the intermittent administration of an additional therapeutic bolus dose of local anesthetic when analgesia began to wane.

- When the patient began to experience recurrent pain, the anesthesia provider assessed the pain relative to the stage of labor and the extent of sensory blockade and then administered another epidural bolus of local anesthetic.
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- Analgesia was usually reestablished with the **bolus injection of 8 to 12 mL of a local anesthetic/opioid solution.**

CONTINUOUS INFUSION

- Administration of a continuous epidural infusion of a dilute solution of local anesthetic combined with an opioid is a popular technique for the maintenance of epidural analgesia during labor.

- The potential benefits of a continuous epidural infusion include the maintenance of a stable level of analgesia and a less-frequent need for bolus doses of local anesthetic, which may reduce the risk for systemic local anesthetic toxicity.
- An additional advantage is a decreased workload for the anesthesia provider.

- Published studies, however, have suggested that the continuous epidural infusion and intermittent bolus injection techniques have a comparable safety record.

PATIENT-CONTROLLED EPIDURAL ANALGESIA

- Given the same concentration of local anesthetic, analgesia maintained by infusion results in greater drug use, a higher degree of motor blockade, and a higher incidence of instrumental vaginal delivery than intermittent boluses.

- However, intermittent manual bolus administration by the anesthesia provider results in more breakthrough pain, less patient satisfaction, and more work for the anesthesia provider.

- PCEA is a method of delivering anesthetic solution to the epidural space that overcomes these disadvantages. Since its first description in 1988 by Gambling

- A meta-analysis of five studies reported in the ASA Practice Guidelines for Obstetric Anesthesia concluded that a background infusion provides better analgesia than pure PCEA without a background infusion.

- Sample Patient-Controlled Epidural Analgesia (PCEA) Settings

PCEA Technique	Basal Infusion Rate (mL/h)	Bolus Dose (mL)	Lockout Interval (min)
Without background infusion	0	8-12	10-20
With background infusion	4-8	5-8	10-15

EPIDURAL ANALGESIA AND FIRST STAGE

- A 2011 meta-analysis3 of 11 studies found no difference in the duration of the first stage of labor between women who were randomly assigned to receive epidural analgesia and those assigned to receive systemic opioid analgesia

- In summary, neuraxial analgesia appears to have a variable effect on the duration of the first stage of labor. It may shorten labor in some women and lengthen it in others.
- However, analgesia-related prolongation of the first stage of labor, if it occurs, is short, has not been shown to have adverse maternal or neonatal effects, and is probably of minimal clinical significance.

EPIDURAL ANALGESIA AND SECOND STAGE

- The effect of epidural analgesia on the progress of labor has been extensively studied.
- For example, Anim-Souman and colleagues performed a Cochrane review of epidural analgesia effects in labor using 38 trials involving 9658 parturients. Although there were no significant differences in the length of the first stage of labor, second stage was lengthened by an average 15 minutes.
- Of course, the clinical significance of such a limited prolongation is debatable.

- The effect of neuraxial analgesia on the outcome of the second stage of labor may be influenced by the density of neuraxial analgesia.

- **High concentrations** of epidural local anesthetic may cause maternal motor blockade, leading to relaxation of pelvic floor musculature, which in turn may interfere with fetal rotation during descent. Abdominal muscle relaxation may decrease the effectiveness of maternal expulsive efforts.

EPIDURAL ANALGESIA AND INSTRUMENTAL VAGINAL DELIVERY

- Most systematic reviews have concluded that epidural analgesia is associated with a higher risk for instrumental vaginal delivery than systemic analgesia.

- For example, in a 2011 meta-analysis of 23 studies (n = 7935),3 the risk ratio for instrumental vaginal delivery in women randomly assigned to receive epidural analgesia or nonepidural/no analgesia was 1.42 (95% CI, 1.28 to 1.57). Similarly, in the individual

- A systematic review of seven impact studies439 involving more than **28,000 patients** did not identify a difference in instrumental vaginal delivery rates between periods of low and periods of high epidural analgesia rates (mean change, 0.76%; 95% CI, −1.2 to 2.8).

- Obstetricians and anesthesiologists have suggested that multiple factors (e.g., station and position of the fetal vertex, maternal pain and the urge to bear down, and neuraxial analgesia–induced motor blockade) may contribute to the outcome of the second stage of labor. The contribution of these factors to the mode of vaginal delivery, and their interactions, are not well understood and these factors have not been well controlled in many studies.

EPIDURAL ANALGESIA AND RISK OF CESAREAN

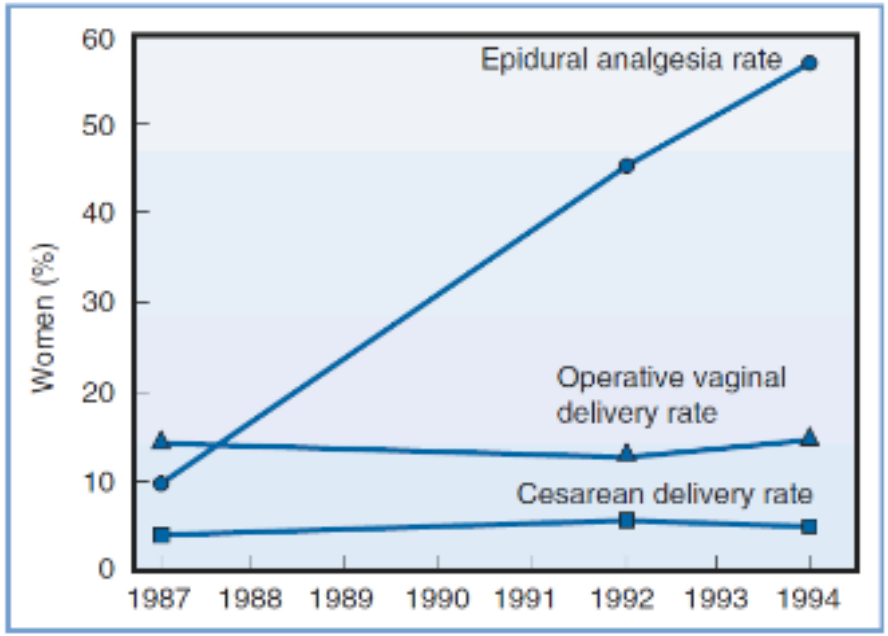

FIGURE 23-10 ■ Epidural analgesia and cesarean and instrumental vaginal delivery rates for 1000 consecutive nulliparous women in spontaneous labor at term during 3 different years at the National Maternity Hospital in Dublin, Ireland. (Modified from Impey L, MacQuillan K, Robson M. Epidural analgesia need not increase operative delivery rates. Am J Obstet Gynecol 2000; 182:358-63.)

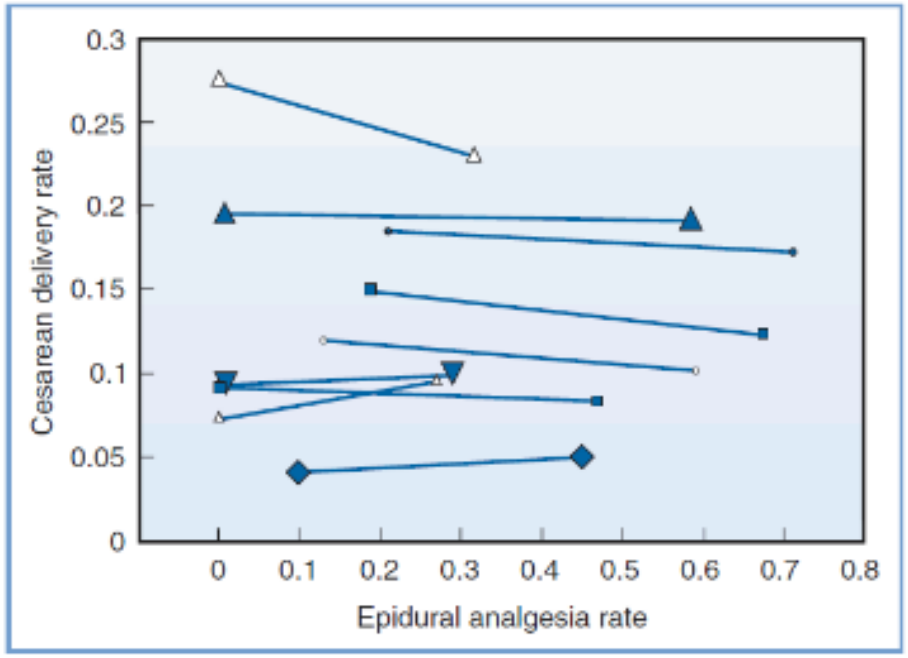

FIGURE 23-11 ■ Rates of cesarean delivery during periods of higher and lower availability of epidural analgesia in nine studies (n = 37,753) subjected to meta-analysis. Each pair of symbols shows data from one investigation (the left symbol is the epidural analgesia rate and cesarean delivery rate during the period of low epidural analgesia availability, and the right symbol is the epidural analgesia rate and cesarean delivery rate during the period of high epidural availability). The size of the plot symbol is proportional to the number of patients in the analysis. (Modified from Segal S, Su M, Gilbert P. The effect of a rapid change in availability of epidural analgesia on the cesarean delivery rate: a meta-analysis. Am J Obstet Gynecol 2000; 183:974-8.)


THANK YOU ALL