Obstetric anesthesia for the patient with diabetes mellitus: A case study

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This case study describes a 30-year-old patient with an obstetrical history of gravida 3, para 1, presenting with a medical history of diabetes mellitus since childhood. The surgical procedure that was performed was an elective, low segment cesarean. The gestation age at the time of delivery was 34 weeks.

The pain and discomfort experienced by women during childbirth have been recorded since early historical times. Not until the mid-19th century did medical science introduce a management method for the pain of childbirth. Significant advances have been made in the ability to control the discomfort associated with safe labor, and to provide appropriate anesthetic modalities in situations requiring operative intervention.

Anesthetic management involves a great responsibility because two patients, the mother and the fetus, must be considered. The effect of a given agent on maternal physiology, labor, placental exchange of oxygen, and the fetal respiratory system must be carefully considered. Choice of agents, either elective or in emergency situations, is influenced by maternal attitudes as well as by the physician's preference of one approach over another.

In recent years, the number of pregnant diabetic patients has apparently increased. This is partly because, with modern management, diabetics are now able to conceive and maintain pregnancies. An additional factor is that there is presently an increased recognition of the milder forms of gestational diabetes.

The case

The author visited Mrs. G. in her room prior to her transfer to the delivery room. Upon entering the delivery room, she appeared to be in no distress. She was sitting in a semi-Fowlers position with her husband at the bedside. It was clear that the couple was experiencing some apprehension. This was the first time Mrs. G. was able to continue a pregnancy close to term.

The sequence of events that would occur in the delivery suite were explained to the couple. Events were explained slowly and clearly, including positioning, sensations to be felt during the delivery process, the father's role, and the need for sedation if requested. Mrs. G. had a perspective about the upcoming procedure from questions that she had asked the nursing staff prior to the preanesthesia visit. (Table I contains data from Mrs. G.'s preoperative evaluation.)

The preoperative medication that was given was hydroxyzine hydrochloride (Vistaril®) 75 mg IM one hour prior to surgery. Hydroxyzine hydrochloride (Figure 1) is unrelated to phenothiazine, reserpine, or meprobamate. Hydroxyzine has been shown to be a rapid acting true ataraxic with a wide margin of safety. It has been demonstrated that hydroxyzine is effective in controlling nausea.
and vomiting. When this drug is used preoperatively or prepartum, as in this case, narcotic requirements may be reduced by 50%. Therapeutic doses of hydroxyzine seldom produce impairment of mental awareness. Side effects that may be exhibited when hydroxyzine is administered include sedation and sleep; blurred vision; hypotension; bradycardia; increased gastric motility; and diarrhea. (This is not to be considered an all-inclusive list.) In addition, hydroxyzine may have an antiemetic effect.

The recommended dosage for hydroxyzine is

### Table I

<table>
<thead>
<tr>
<th>Preoperative evaluation for Mrs. G</th>
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**History and physical**

- **Admission diagnosis:** Pregnancy, history of diabetes mellitus.
- **Past medical history:** Diabetes mellitus since the age of 12. Has had all childhood diseases. Menarch at the age of 11, 2-3 days duration, q 26 days, moderate flow. Spontaneous abortion September 1976 and March 1978. Taking PZI insulin 10 units every day.
- **Family history:** Father died 2 years ago of heart attack, mother diabetic for past 40 years.
- **Social history:** Only child, registered nurse by profession, husband an accountant for large steel firm. Non-smoker, non-drinker.
- **Current medications:** Ferrous sulfate 1 capsule 1 day, PZI 10 units 1 day.
- **Vital signs:** Blood pressure 132/86, pulse 86, respirations 16.
- **General:** Patient is a 30-year-old, white female at 34 weeks gestation in no apparent distress.
- **HEENT:** Normocephalic. Pupils round and react to light. Extraocular muscles intact, conjunctival and sclerae within normal limits. The ENT exam within normal limits.
- **Neck:** Supple without any masses. No jugular vein distention, trachea midline, normal thyroid.
- **Lungs:** Clear to auscultation. No rales or rhonchi.
- **Cardiac:** Regular rhythm. No murmurs. All pulses palpable. Plus 2 edema noted.
- **Abdomen:** Large and firm. Bowel sounds present. No hepatomegaly noted. Palpable masses negative.
- **Rectal:** External hemorrhoids present. Hemo-negative.
- **Vaginal:** Membranes intact. No discharge. Cervix at 0 cm dilation. No bleeding present.
- **Extremities:** Full range of motion in all extremities.
- **Neurological:** Cranial nerves 2 through 12 intact. Gross motor and sensory exam intact. Patient has negative sciatica, plus 2 reflexes in upper and lower extremities.
- **Fetal status:** Heart sounds 120-160 beats per minute.

**Laboratory tests:**

<table>
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<tr>
<th>Blood type: O Rh Factor: Positive</th>
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<tbody>
<tr>
<td>Hematology: WBC: 8.6</td>
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<tr>
<td>RBC: 5.06</td>
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<tr>
<td>Hgb: 12.0</td>
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<tr>
<td>Hct %: 38.7</td>
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<tr>
<td>Serology (RPR): Negative</td>
</tr>
<tr>
<td>Chemistry: Sodium: 139.0</td>
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<tr>
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</tr>
<tr>
<td>Glucose: 127.6</td>
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<table>
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<tr>
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<tr>
<td>Crystals: 0</td>
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<td>Casts: 1-2</td>
</tr>
</tbody>
</table>

**Electrocardiogram:** Normal sinus rhythm—Rate: 88
25-100 mg IM in prepartum and postpartum adjunctive therapy. The dosage given Mrs. G. fell within the recommended therapeutic dose range.²

The operative procedure:
Low segment cesarean section

There are four types of cesarean section. These include: (1) the lower segment cesarean section, in which the uterus is entered through an incision in the lower segment of the abdomen; (2) the classical section, in which the incision is made directly into the wall of the body of the uterus; (3) the extraperitoneal section, in which the operation is arranged anatomically, such that the incision is made into the uterus without entering the peritoneal cavity; and (4) the cesarean-hysterectomy, which involves a cesarean section of any variety followed by removal of the uterus.

For a number of important reasons, the low segment cesarean section was the operation of choice in this case. Since the incision was made in the lower segment of the uterus, which is its thinnest portion, the operation is associated with minimal blood loss (approximately 200 cc in this case), and the incision is easy to repair. The lower segment is also the area of least uterine activity, and thus the possibility of rupture of the scar during a subsequent pregnancy is lessened.

The initial incision (after the abdominal cavity had been opened) was made transversely across the uterus peritoneum where it is attached loosely just above the bladder. The lower peritoneal flap and the bladder were dissected from the uterus, and the uterine muscle was incised transversely. The membranes were ruptured and a viable baby boy was delivered in a cephalad presentation. The 1 minute Apgar score was 7; after 5 minutes the infant was evaluated at a score of 9. After the placenta had been extracted and the uterus inspected for remaining placental tissue, the uterine incision was sutured. The peritoneum facia, fat, and then the skin, were closed. A pressure dressing was applied, and the patient was transferred to her bed.

Figure 1
Chemical composition of hydroxyzine hydrochloride (Vistaril®)

Anesthetic management:
The subarachnoid block

A subarachnoid block is defined as a reversible nerve block achieved by the injection of a local anesthetic into the subarachnoid space.

The indications for the choice of a subarachnoid anesthetic were two-fold. The first consideration is that Mrs. G. had a history of diabetes mellitus. At the time of admission, she presented with a weight gain of 45 pounds, pedal edema in both lower extremities, and a diagnosis of polyhydramnios. The second indication was the gestational age of the fetus, which was 4 weeks pre-term.

With this deficit of gestational age, the cervix is not prepared for induction of labor, thus indicating a cesarean section. Pelvimetry also showed that the opening of the pelvis would not accommodate the size of the fetus—another indication for a cesarean section.

The agent utilized in this case was 5% lidocaine with epinephrine 1:200,000. The main advantage of a subarachnoid block over other anesthesia techniques in obstetrics is that the subarachnoid block is a much simpler technique than an epidural, caudal, or general anesthesia. The onset of action with this technique is almost immediate. The latent period of approximately 20 minutes with epidural or caudal analgesia is not a factor. With the subarachnoid block, the amount of local anesthetic drug injected is so small that, if it is inadvertently injected intravascularly, minimal reaction occurs in the mother or fetus. The analgesia produced is excellent and uniform, without patchy distribution or unilateral block.⁸

The excellent abdominal relaxation produced by this block, associated with spontaneous adequate ventilation, is an asset for this type of surgical procedure.⁴ The well contracted uterus and spontaneous breathing, with the maintenance of the negative intrathoracic pressure during subarachnoid block, result in less blood loss than under general anesthesia. Airway reflexes are maintained; thus, aspiration is very rare. There is minimal interference with metabolism and minimal fetal drug depression.

There are, however, some disadvantages to this technique. Following the usual techniques of a subarachnoid block, there is complete muscle paralysis. This interferes with the ability of the mother to bear down in a vaginal delivery. Hypotension is the major disadvantage of a subarachnoid block.⁴ Compared with epidural anesthesia, a subarachnoid block causes more hypotension.
Mrs. G. was transferred from her bed to the operating room table. A 16 gauge, 2 inch angiocath was placed in her left forearm, in which 1000 cc of lactated Ringers solution was infused. A blood pressure cuff was positioned on her right arm. The initial blood pressure was 132/86. A three-lead electrocardiogram was applied. She was then placed in a left lateral decubitus position. The patient was instructed to bend her legs up to her abdomen and place her chin on her chest. The patient's back was then prepared, using a 1% povidone-iodine (Betadine®) solution with the excess being removed from the area before injection. A sterile towel was placed on the patient's side to cover the iliac crest. The highest part of the iliac crest was palpated by the anesthesiologist's fingers while his thumb felt the spinous processes in the lumbar region. The space chosen for the spinal block was L3 to L4. Local infiltration for the median approach to the subarachnoid space was performed in the midline between the two spinous processes just distal to the middle of the thumb with 2 cc of 1% lidocaine. An introducer was inserted exactly in the midline of the inter-space and directed anteriorly with slight cephalad inclination.

Following placement of the introducer, a 26 gauge spinal needle was threaded through the introducer until the needle was placed in the arachnoid space. The stylet of the spinal needle was removed and observed for traces of spinal fluid. After spinal fluid was noted in the needle, a glass syringe containing 70 mg lidocaine with 0.2 mg of epinephrine 1:200,000 was attached to this spinal needle hub. This dosage was calculated according to the height of the patient (Table II).

The plunger of the syringe was drawn back to observe for a continuous flow of spinal fluid indicating correct positioning of the needle. Once spinal fluid was again noted, the local was injected slowly. Prior to injecting the full amount, the plunger was withdrawn once more to aspirate spinal fluid for a final check of needle placement. The final amount was then injected. The spinal needle was then removed and the patient was placed in a supine position with a rubber wedge under her left hip to displace the uterus to the left. This maneuver was used to prevent vena cava compression by the uterus. Without this maneuver, there is a decrease in venous return and hypotension occurs.

The level of anesthesia was determined by using a 25 gauge needle as a pinprick test. A normal sensation was determined with the pinprick test. A normal sensation also was determined when the pinprick was applied far from the expected block. The dermatome level that was established was at level T6. (Table III shows Mrs. G.'s OB-anesthesia record).

Oxygen therapy was introduced via nasal prongs at a flow of 4 liters/minute. This improves oxygenation of the fetus, reduces nausea, and insures good oxygen supply to the patient's vital organs.

Agent. Lidocaine consists of a xylidine aromatic group, an amide intermediate chain, and a hydrophilic group consisting of a tertiary amine.² (Figure 2.) It has moderate potency and duration (1-2 hours). It is marketed in the form of a water soluble salt (hydrochloride) solution. Lidocaine (and other local anesthetics) is a weak base and the salt (hydrochloride) solution is quite acid. This condition increases the stability of the local anesthetic and any accompanying vasoconstrictor substance. Local anesthetics in the form of free base tend to be only slightly soluble and unstable in solution.

Lidocaine prevents both the conduction and generation of the nerve impulse. The main site of action is the cell membrane; there appears to be little or no effect on the axoplasm. It blocks conduction by interfering with the large transient increase in permeability of the membrane to sodium ions that is produced by a slight depolar-

<table>
<thead>
<tr>
<th>Height</th>
<th>Tetracaine</th>
<th>Lidocaine</th>
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<tbody>
<tr>
<td>5 ft.</td>
<td>6 mg</td>
<td>50 mg</td>
</tr>
<tr>
<td>5 ft. 3 in.</td>
<td>7 mg</td>
<td>60 mg</td>
</tr>
<tr>
<td>5 ft. 6 in.</td>
<td>8 mg</td>
<td>70 mg</td>
</tr>
<tr>
<td>5 ft. 9 in.</td>
<td>9 mg</td>
<td>80 mg</td>
</tr>
</tbody>
</table>

Figure 2
Chemical composition of lidocaine (Xylocaine®)
ization of the membrane. As the anesthetic action progressively develops in the nerve, the threshold for excitability gradually increases and the safety factor for conduction decreases; when this effect is sufficiently developed, conduction block is produced.

Lidocaine also blocks conduction by competing with calcium at the same receptor site that controls the permeability of the membrane. In addition, lidocaine reduces the permeability of the resting nerve to potassium and sodium ions. The exact mechanism by which a local anesthetic influences the permeability of the membrane is unknown at present.

All types of nerve fibers are affected by local anesthetics, but small fibers are more readily blocked than larger fibers. Autonomic fibers are more readily blocked, accounting for the early appearance of vasodilation in blocked areas. Loss of muscle tone is produced, probably due to interruption of the sensory side of the reflex arc.

Pharmacological effects
In the cardiovascular system, lidocaine stabilizes the membranes of damaged and excitable cells, tending to prevent the generation of automaticity in ectopic foci. It has no vagolytic action in therapeutic doses, and causes no consistent rate changes. It does not suppress conduction in Purkinje tissue; widening of the QRS complex does not occur, and there is usually no apparent myocardial depression.

In the central nervous system, after local administration, lidocaine is slowly absorbed and produces a sedative effect, depending on the total amount of the drug used.

Distribution
Local anesthetics are eventually absorbed from the site of local injection into the systemic circulation; some of the anesthetic is taken up by the tissues. In the plasma, the anesthetic is bound to plasma proteins, and a portion of it enters the red blood cells. Local anesthetics are rapidly moved from the blood by the tissues. Generally, distribution is so rapid and widespread that most of the drug has disappeared from the circulation before mixing in the blood is complete. Local anesthetics readily cross lipid barriers such as the blood-brain barrier, and therefore enter the central nervous system.

Local anesthetics in the unbound and unionized state are sufficiently lipid soluble to cross the placental barrier without difficulty by simple diffusion. Maternal concentration is the biggest influence on fetal concentration. The larger the concentration in the mother, the greater the concentration in the fetus will be.

Lidocaine is metabolized in the liver. N-deal-
kylation of the tertiary amine occurs, making it more susceptible to amide hydrolysis. An ionized drug and the water soluble products of its metabolism are rapidly excreted in the urine. A lipid soluble local anesthetic can be reabsorbed into the blood from the renal tubule. In acid urine, a local anesthetic becomes highly ionized, and its reabsorption is inhibited, as the cation cannot pass the tubule cell barrier. There is a high tissue uptake of local anesthetics; therefore, excretion is unimportant as a means of disposal of the unchanged drug.

Accessory drugs

Following delivery of the placenta, 10 mg oxytocin (Pitocin®) was diluted in 1000 cc lactated Ringer's solution, which infused over a period of 30 minutes.

Oxytocin. Uterine motility is controlled by a variety of biochemical and regulatory processes. Oxytocin appears to act by increasing the permeability of uterine myofibrilar cells to sodium, thus augmenting the number of contracting myofibrils, and thereby enabling the uterus to produce the necessary number of contractions. The effect depends on the uterine threshold of excitability. The sensitivity of the uterus to oxytocin increases gradually during gestation, then increases sharply before parturition.

Oxytocin has a marked transient direct relaxing effect on vascular smooth muscle when large amounts are administered. A decrease in systolic and especially diastolic blood pressure, flushing, and an increase in limb blood flow is observed. The distribution and fate of oxytocin in the body is much like that of antidiuretic hormone (ADH). Its half life in plasma is short (1-7 minutes).

Adverse reactions include fetal bradycardia, postpartum hemorrhage, cardiac arrhythmias, spasm, tetanic contractions or rupture of the uterus.

The dosage is dependent on uterine response. Intravenous infusion to control postpartum bleeding, 10-40 units may be added to 1000 cc of 5% dextrose and administered at a rate necessary to control uterine atony. Because Mrs. G. had a history of diabetes mellitus, oxytocin was added to plain lactated Ringer's solution. Dextrose is not added to this solution.

Intravenous therapy

Preloading with intravenous fluids was essential prior to administering the subarachnoid block. As previously stated, prior to the block a 16 gauge, 2 1/2 inch angiocath was inserted into a vessel in the left forearm with little trauma. Lactated Ringer's solution 1000 cc was then infused at an open rate. This liter bag infused within the next 20 minutes, then a second liter was started. Prior to the block, a total of 1600 cc of lactated Ringer's solution had infused. Intravenous glucose was not infused prior to the delivery due to the fact that glucose is transmitted through the placenta and thereby stimulates pancreatic secretion in the fetus with subsequent hypoglycemia in the neonatal period. An occasional problem of neonates of diabetic mothers is hypoglycemia, so reaction to the glucose administration is compounded.

As stated earlier, the pre-block blood pressure was 132/86. With the pre-loading of fluids following the block, the blood pressure never fell below a systolic pressure of 100 mmHg.

Calculation for fluid replacement was as follows:

- Patient's weight in kg: 74.8 (165 lbs.)
- First 20 kg:
  - 60 cc/hour ............ 60
  - 1 cc/each kg over 20 ... 55
- 115 cc/hour
  - (fluid replacement)

To calculate fluid deficit, the number of hours that the patient had been without fluids (10 hours) was multiplied by the fluid replacement. This total came to 1150 cc. The first hour fluid replacement was then added to the fluid deficit, and a total of 1265 cc was obtained. In her first hour, Mrs. G. received 1600 cc.

Post anesthesia survey

Following transfer to the postpartum recovery room from the delivery suite, vital signs were taken. These were: blood pressure 126/70, pulse 82, respirations 18. The surgical incision, as well as the vaginal area, were observed for excessive drainage, which was minimal. Intravenous therapy was continued postoperatively. A stat blood sugar was drawn following admission to the recovery room. This blood sugar was 106. Following these results, 100 cc D5/2 NSS was begun with 10 units of oxytocin added to increase the blood glucose levels and also to increase the tone of the uterus.

Upon admission to the recovery room, sensation and movement were evaluated in the lower extremities. Mrs. G. was able to move her toes on both feet, but was unable to move her legs. Sensation was beginning to return to her lower extremities at that time, which was one hour and thirty minutes from the time the local anesthetic was injected. Mrs. G. was then instructed not to sit up.
rapidly in bed, as doing so might predispose her to a spinal headache.

**Post operative course**

Mrs. G. was transferred 3 hours after the time of her admission. Sensation and movement had fully returned to her lower extremities. Blood pressure upon discharge from the recovery room was 120/66. No excessive drainage was noted from her abdominal dressing or vagina. The next 24 hours were uneventful. The following day, Mrs. G. was permitted to be ambulant in her room. Intravenous therapy was discontinued and blood sugar levels were well within normal limits. The infant was progressing as planned. There were no complaints of headaches or dizziness from Mrs. G.

**Discharge**

Before the mother and infant were discharged from the hospital, the physician gave Mrs. G. instructions about her care and the rate at which it was prudent for her to resume normal activities in the following weeks at home. She was told to avoid heavy work and to get as much rest as possible during the next 2 weeks. These and other instructions were given to Mrs. G. as printed material.

The morning of her discharge, Mrs. G.'s hemoglobin was 11.8, and her hematocrit was 38.0. Her 8:00 a.m. urine reduction was negative for both glucose and protein. Blood glucose level the morning of her discharge was 126. The infant was given a complete physical prior to discharge. No abnormalities in cardiac, pulmonary, neurologic, or metabolic processes were found at that time.

**REFERENCES**


**AUTHOR**

James M. Roach, CRNA, graduated from Shadyside Hospital School of Nurse Anesthesia, Pittsburgh, Pennsylvania, in 1982. He is currently a staff anesthetist at Saint Francis General Hospital, Pittsburgh, and is pursuing a BS in nurse anesthesia at LaRoche College. He was a senior nurse anesthesia student at the time this paper was written. He is currently staff nurse anesthetist at Rex Hospital in Raleigh, North Carolina.