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ORIGINAL ARTICLE

Recommendations for the use of ECT in pregnancy: literature review and proposed clinical protocol

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Abstract

Psychiatric disorders are common in pregnancy, affecting 15–29% of pregnant women. Untreated depression has negative health consequences for mother and fetus. Electroconvulsive therapy (ECT) is an effective option for the treatment of severe depression, high suicide risk, catatonia, medication-resistant illness, psychotic agitation, severe physical decline, and other life-threatening conditions. To our knowledge, however, there is no literature that consolidates all the evidence on maternal and fetal risks associated with untreated depression, medications, and ECT then translating it into one cohesive protocol that could serve as a management guide and a source of reassurance to health-care providers involved in such practice. Hoping to facilitate ECT access to perinatal patients, the authors combined their multidisciplinary clinical experience (in perinatal psychiatry, neuropsychiatry and neuromodulation, and anesthesiology) at three different centers in the USA (Brigham and Women's Hospital/Harvard Medical School, The University of Chicago, and Brown University) with a careful and critical literature review and propose guidelines for the administration of ECT in pregnancy. A comprehensive review of the relevant literature regarding both ECT and psychotropic medications in pregnancy was performed, including meta-analyses of randomized controlled trials published in general medicine, anesthesiology, psychiatry, and obstetrics journals and guidelines. The indication and appropriateness of ECT in pregnancy must be carefully weighed against the risks of untreated maternal illness and those of alternative treatment options. The safety of ECT in pregnancy has been documented over the last 50 years. The adverse effects in pregnancy are similar to the risks of ECT in any individual. The most common risk to the mother is premature contractions and preterm labor, which occur infrequently and are not clearly caused by ECT. The rates of miscarriages were not significantly different from that of the general population. There have been no associations of ECT with congenital anomalies, either morphologic or behavioral, and no neurocognitive disturbances in the child. ECT is a reasonably safe and effective treatment alternative for management of many psychiatric disorders in pregnant patients. The authors provide recommendations for treatment modifications in pregnancy-based physiologic changes that occur during that period and consolidate them into a protocol that can assist clinicians in improving access and safety of ECT for pregnant patients.

Keywords Electroconvulsive therapy · Pregnancy · Maternal depression · ECT · Postpartum depression

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Introduction

It has been historically proposed that pregnancy confers a protective effect against perinatal mood disorders, an idea that has been proven inaccurate by recent studies. Research has shown that the rate of symptom recurrence in pregnancy is significantly higher among women who discontinue their medications in unipolar depression (26 vs 68%) (Cohen et al. 2006) and bipolar disorder in pregnancy (over 70%) (Viguera et al. 2007).

When performing an individual risk-benefit assessment prior to making treatment decisions in pregnancy, it is crucial to consider the risks of pervasive symptomatology from untreated maternal mental illness. ECT should be part of the treatment modalities to be considered and that also comprise psychotropic medications, psychotherapy, and behavioral interventions.

In fact, in cases of severe or refractory illness (particularly with high suicide risk), catatonia, extreme agitation, situations in which health is imperiled due to malnutrition or dehydration, or other life-threatening conditions (e.g., neuroleptic malignant syndrome) (Leiknes et al. 2015), ECT is a favorable option when speed of response and efficacy are considered (APA 2001; Kramer 1990; Anderson and Reti 2009; Bulbul et al. 2013). Despite the reassuring data on ECT in pregnancy, it is still often negatively portrayed and associated with stigma (Teh et al. 2007), and there are no published protocols or guidelines providing clear and objective recommendations for its use in pregnant patients. Resistance by hospital staff and the general public is still encountered even in large medical centers in the USA, depriving patients from receiving a potentially life-saving, efficacious, and well-tolerated treatment option. The authors combine their multidisciplinary clinical experience in performing ECT in pregnant patients with an extensive and critical review of the literature and consolidate their findings and opinions on a protocol for guidelines for its administration in that population. This is the first work on this topic to gather collaborative input from almost all the medical specialties involved in this practice (i.e., reproductive psychiatry, neuropsychiatry and neuromodulation, obstetrics and gynecology, and anesthesiology).

Psychiatric disorders in pregnancy and consequences of untreated maternal illness

Pregnancy represents a period of increased risk and vulnerability for women with psychiatric disorders, which have an estimated prevalence of 15–29% (Vesga-Lopez et al. 2008). For women, depression is the leading cause of disease-related disability (Kessler 2003). This risk increases in pregnancy and may bring profound consequences for both the mother and her future child (Murray and Stein 1989; Marmorstein et al. 2004; Flynn et al. 2004; Burke 2003).

Combined point prevalence estimates of depression during pregnancy range from 3.1 to 4.9% (Gaynes et al. 2005), approximately 14.5% of pregnant women having a new episode of depression during pregnancy (Gaynes et al. 2005). Twelve-month prevalence rates of other psychiatric disorders that can be treated with ECT in pregnancy are considerable and include bipolar disorder (2.8%), schizophrenia (1%), and other psychotic disorders (0.4%) (Vesga-Lopez et al. 2008). Approximately, half of women with schizophrenia become mothers and half of those pregnancies are unplanned. A significant number of them will ultimately lose custody of their child. Studies support that these women receive poorer prenatal care, have higher rates of alcohol consumption and illicit drug use, and are at increased risk of being abused during pregnancy.

Negative health outcomes for both mother and child that occur as a consequence of untreated mental illness also include suboptimal weight gain during pregnancy, preterm birth, decreased birth weight (Doktorchik et al. 2017; Straub et al. 2012), preeclampsia, impaired mother-infant bonding (Nonacs and Cohen 2003; Kurki et al. 2000), and suicide. Furthermore, there is a correlation between antenatal depression and an increased risk of adolescent depression (Pearson et al. 2017).

Puerperal events, such as postpartum psychosis, a major psychiatric emergency with important suicide and infanticide risks, complete the possible outcomes from untreated maternal illness. Therefore, treatment should ideally be initiated during pregnancy (Viguera et al. 2007).

Risks of pharmacotherapy in pregnancy

Pharmacotherapy during pregnancy may also carry risks for both mother and fetus. All psychotropic drugs cross the placenta and enter the fetal circulation at varying degrees based on characteristics of the drug and maternal physiology (Mirkin 1976). However, when repeated doses are administered, the drug is equally distributed between mother and fetus (Levy 1981). It is important to highlight that we currently have substantial reassuring data on the reproductive safety of numerous psychotropic medications. Some drugs, however, have maternal and fetal side effects. Valproic acid, for example, is among the greatest teratogens and has been associated with at least a 3–5% risk for neural tube defects, as well as other major malformations, including hypospadias and cardiac defects. Other anticonvulsants, commonly used as mood stabilizers, are also associated with autism and several neurocognitive deficits that persist through infancy and early childhood (Meador et al. 2009).

Benzodiazepine use later in pregnancy has been associated with preterm birth and low birth weight and may precipitate withdrawal symptoms characterized by poor feeding, jitteriness, respiratory distress, and myoclonic seizure-like activity (Vitale et al. 2016; Reis and Kallen 2008; Holland and Brown 2017; Huybrechts et al. 2017) in the newborn.

Maternal risks of ECT in pregnancy

The risks, adverse reactions, length of treatment, and response in pregnancy are similar to those of ECT in any individual (Leiknes et al. 2015), i.e., memory disruption, problems associated with anesthesia, and prolonged seizure. They are often minor and most commonly include nausea and vomiting, myalgia, and headaches. Confusion, memory loss, muscle soreness, and headache are other possible adverse effects ECT (Forssman 1955; Impastato et al. 1964; Ray-Griffith et al. 2016). In reviewing the literature, the authors noted that most studies are outdated and at times utilize techniques that were markedly different from today's procedure. Another confounder is that, when ECT is successful and uneventful, it is unlikely to be published. There have been four systematic reviews of use of ECT in pregnancy (Leiknes et al. 2015; Anderson and Reti 2009; Miller 1994; Pompili et al. 2014) and one recent meta-review (Sinha et al. 2017). Maternal and fetal adverse events (AE) in ECT have been observed in a very wide range (Leiknes et al. 2015) pointing to significant differences in study designs, methodologies, or interpretations. The authors, however, noted that a relationship of cause-effect could not be established (Anderson and Reti 2009; Sinha et al. 2017). For example, some of the AE occurred several weeks after the last ECT session, while some other complications happened in the context of serious medical comorbidities (e.g., peritonitis, pneumonia, insulin coma, hypertension, sickle cell anemia, dehydration, and hypoxia (Leiknes et al. 2015)). The most common AE to the mother were premature contractions and preterm labor, both observed more frequently in the second and third trimesters (Leiknes et al. 2015; Anderson and Reti 2009). The frequency of preterm labor was relatively low (3.5%) (Anderson and Reti 2009; Ray-Griffith et al. 2016) and not clearly increased by ECT. Rates of uterine contractions ranged from 0.6% (Miller 1994) to 24% (Leiknes et al. 2015). Two of those cases (0.6%) immediately followed ECT, but there were no significant consequences to mother or fetus (Miller 1994). Premature delivery has not been associated with ECT (Kasar et al. 2007). Vaginal bleeding occurred at a rate ranging from 0.6% (Anderson and Reti 2009) to 12% (Leiknes et al. 2015), was more common in the first trimester (Leiknes et al. 2015), and typically had spontaneous resolution and did not require emergency delivery (Ray-Griffith et al. 2016). Miscarriages were observed in 0.3% (Anderson and Reti 2009) to 7% (Leiknes et al. 2015) of pregnant women receiving ECT, which is not significantly different from the miscarriage rate in the general population, and were not directly related to ECT. The risk of death, similarly, was not found to be higher than in the non-pregnant population.

Fetal risks of ECT in pregnancy

Fetal complications occurred in 7.4% of ECT procedures, but only a minority of them was likely related to ECT (Miller 1994). The most common risk to the fetus is cardiac arrhythmia, such as irregular fetal heart rate post-ictally, fetal bradycardia during the tonic phase, or reduced heart rate variability. There have been no associations of ECT with congenital anomalies, either morphologic or behavioral. In a review of 339 cases between 1941 and 2007 by Anderson and Reti, there were only 11 complications including two deaths (Anderson and Reti 2009), one of them the result of status epilepticus after three stimuli were provided to the mother in succession, leading to a grand mal seizure that progressed for 200 s. Even though seizure activity spontaneously remitted, it resumed after several minutes and was resistant to attempts at termination (Balki et al. 2006). However, when causality was considered, all observed stillbirths and neonatal deaths were not directly related to ECT but rather to other medical conditions (Miller 1994).

Selection of anesthesia technique

General anesthesia with muscle paralysis is the method of choice for patients undergoing ECT (Nishikawa and Yamakage 2017), as it virtually eliminates the risk of bone fractures. The anesthesiologist can confirm the presence of muscle paralysis using a train-of-four monitoring (Hattori et al. 2016).

Although the literature can be controversial, pregnant patients are often considered full stomach at 12–14 gestational weeks (Deguchi et al. 2016).

Additionally, the use of oral prophylactic agents such as sodium citrate before the procedure is also recommended. Even though aspiration pneumonitis is a rare event, it has a high morbidity and mortality rate; therefore, special emphasis should be made to avoid aspiration pneumonitis.

Hypotension can also be more common in pregnant patients beyond the third trimester of gestational age (Mon et al. 2017). The enlarged uterus can compress the inferior vena cava and result in hypotension when patients are lying supine. Optimization of intravascular volume and positioning the patient in the left lateral decubitus position are effective strategies to prevent hypotension in pregnant patients (Loubert et al. 2017).

Risks of anesthesia drugs

Due to their rapid induction and fast recovery properties, common general anesthetic agents used in ECT are propofol and methohexital. Both are short-acting general anesthetics that readily cross the placental barrier (Herman et al. 2000; Jauniaux et al. 1998) and their levels in the fetus and newborn vary with maternal serum levels (Holdcroft et al. 1974; Sanchez-Alcaraz et al. 1998) but they are rapidly cleared from the fetal circulation due to their low molecular weight and lipid solubility (Pourafkari et al. 2016). The pharmacodynamic properties of propofol and methohexital are relatively constant throughout pregnancy and neither drug is associated with teratogenicity. However, maternal administration of methohexital or propofol immediately before delivery can lead to fetal heart rate slowing and temporary sedation in the newborn. These side effects can be minimized by administering low anesthetic doses, e.g., 0.5 to 1 mg/kg of methohexital or 0.75 to 1.5 mg/kg of propofol (Lee et al. 2016) (note that in the study by Anderson and Reti (Anderson and Reti 2009), the recommended dose for induction was 2 mg/kg). Given the potential for general anesthesia to sedate the fetus, obstetric fetal monitoring is advisable during ECT (Chang and Renshaw 1986).

During ECT, motor activity is limited by the administration of succinylcholine. Succinylcholine is the preferred muscle relaxant for ECT as it facilitates tracheosubmental intubation (TSI) and allows for rapid and optimal control of intubation within 45 s. It is typically given at a dose of 0.5 to 1.5 mg/kg (Abrams 2002). Although succinylcholine crosses the placenta, it does so in negligible quantities (Moya and Kvisselgaard 1961; Pacifici and Nottoli 1995) and has no known teratogenic effects. Intubation has been recommended after the first trimester (Miller 1994) but should be left at the discretion of the anesthesiologist, who should consider the medical comorbidities and pregnancy risk. It is also important to remember that succinylcholine is a potential trigger for malignant hyperthermia so appropriate treatment (e.g., dantrolene) may be used (Lu et al. 2017). In patients with personal or family history of malignant hyperthermia, the use of alternative non-depolarizing muscle relaxants (e.g., rocuronium) should be used at the discretion of the anesthesiologist (Abou-Arab et al. 2016).

Rapid sequence induction is needed in pregnant women, which is riskier than in non-full-stomach patients. In addition, pregnant women pose a higher risk for intubation difficulties as they have lower functional residual capacity of the lung and their airways are narrower. Difficult intubation has been reported in 0.45 to 5.7% of intubations in pregnant women and consequences in obstetric patients are more severe than in general population. Anesthesia-related mortality in obstetric patients is most often due to respiratory events (Braden et al. 2016; Leboulanger et al. 2014).

Obstetrical evaluation for ECT

When evaluating a pregnant patient for ECT, it is important that obstetrics be consulted (Psychiatrists RCo 2005) and special considerations be made for the risk factors for spontaneous abortion, preterm labor, abruption, and uteroplacental insufficiency (Echevarria Moreno et al. 1998; O'Reardon et al. 2011; Polster and Wisner 1999; Sherer et al. 1991). A pelvic exam can be helpful in assessing for vaginal bleeding or dilatation (Miller 1994; Heath and Yonkers 2001; Salzbrenner et al. 2011). Fetal health can be monitored by non-stress tests (The practice of electroconvulsive therapy 2002; Wise et al. 1984) or a level 2 ultrasonogram between 18 and 22 weeks (O'Reardon et al. 2011). If a patient is at high risk for preterm labor or other complications, ECT may be performed in a labor and delivery operating room or labor ward (Salzbrenner et al. 2011) with a caesarian section tray ready if possible. Some perform the procedure in the ICU (Lovas et al. 2011), although some centers list high-risk pregnancies as a relative contraindication to ECT (The practice of electroconvulsive therapy 2002; Wise et al. 1984). After the initial consult, an obstetrician should be aware of the timing of the procedure so they can timely respond if a complication occurs (The practice of electroconvulsive therapy 2002; Wise et al. 1984). All patients should be screened for the presence of a psychoactive substance use disorder and acute withdrawal from substances that may affect the efficacy of ECT and the health and well-being of mother and fetus.

Pre-procedure

Prior to the procedure, precautions should be taken to minimize the risk of aspiration pneumonia. Twenty-four hours before ECT, non-essential anticholinergic medication should be discontinued, as they may decrease lower esophageal sphincter tone, increasing aspiration risk (Miller 1994; O'Reardon et al. 2011). Gastric acidic content can be reduced by administering a non-particulate antacid, e.g., 30 mL 0.3 M sodium citrate the night before and the day of ECT (15–20 min before anesthesia (Miller 1994; Salzbrenner et al. 2011; Folk et al. 2000)) or ranitidine 50 mg (APA 2001; Psychiatrists RCo 2005; Rowe 1997) with or without metoclopramide 20 mg (30 min before induction) if there are concerns for gastroparesis (APA 2001).

Patients should fast for 8 h prior to the procedure (Lovas et al. 2011). Despite the concern for aspiration, it has not been extensively reported. (In a large review (Anderson and Reti 2009), no cases of aspiration pneumonia were observed.)

Additional precautions should be taken to decrease the risk of preterm labor or premature contractions that may happen as a consequence of NPO status or poor hydration. Patients should be given IV hydration prior to the procedure using a non-glucose containing solution, such as lactated ringer's or normal saline, preferably 12 h prior to the procedure.

Alternatively, hydration can be started immediately before ECT (APA 2001; Miller 1994; O'Reardon et al. 2011).

When in supine position, the gravid uterus can contribute to aorto-caval compression causing decreased blood flow to the placenta and increasing the risk of fetal hypoxia. Beyond 20 weeks of gestational age, elevation of the patient's right hip may be helpful to displace the uterus and maintain placental perfusion (Miller 1994; Walker and Swartz 1994; O'Reardon et al. 2011; Salzbrenner et al. 2011; The practice of electroconvulsive therapy 2002; Wise et al. 1984).

Fetal monitoring ideally should occur before, after, and sometimes during ECT, though there is significant heterogeneity in recommendations. A reasonable and common one is for fetal cardiac monitoring by Doppler immediately before and after each ECT treatment (Anderson and Reti 2009; Walker and Swartz 1994; O'Reardon et al. 2011; Heath and Yonkers 2001; Salzbrenner et al. 2011; The practice of electroconvulsive therapy 2002; Wise et al. 1984; Wisner and Perel 1998).

If fetal heart rate decreases, one should consider increasing oxygen and further displacing uterus (Miller 1994). A higher level of monitoring such as external fetal monitoring for several hours before and after ECT (The practice of electroconvulsive therapy 2002; Wise et al. 1984) or a non-stress test with tocometer before and after each treatment (Miller 1994; Walker and Swartz 1994; The practice of electroconvulsive therapy 2002) has also been suggested.

Peri-procedure

During the procedure, there should be routine maternal and fetal monitoring. Maternal electrocardiography and arterial oxygen saturation (SpO_2) should be recorded (The practice of electroconvulsive therapy 2002; Wise et al. 1984; Lovas et al. 2011).

The American Society of Anesthesiology guidelines mandate capnography on all general anesthesia cases and it should be routinely performed in every ECT treatment. If there is concern for contractions, uterine tocodynamometry may be used (Miller 1994; Walker and Swartz 1994; The practice of electroconvulsive therapy 2002; Wise et al. 1984).

Continuous fetal monitoring should be used if the pregnancy is late term or high risk (O'Reardon et al. 2011).

While hyperventilation is used in most cases immediately prior to ECT to produce a relative metabolic alkalosis, it should be avoided in pregnant patients. Patients should be pre-oxygenated, but excess hyperventilation should not occur, as pregnancy is accompanied by chronic mild hyperventilation. Excess hyperventilation could contribute to fetal hypoxia through respiratory alkalosis that hinders oxygen unloading from maternal to fetal hemoglobin (APA 2001; Miller 1994; Salzbrenner et al. 2011).

As noted, the general anesthesia technique is similar to that given in non-pregnant patients. In the third trimester, however, inhalation anesthesia may be preferred to reduce uterine contractions and potential uterine relaxation effects of anesthetics (Psychiatrists RCo 2005; Ishikawa et al. 2001).

The induction of a seizure can cause significant changes in maternal heart rate and blood pressure, which should be monitored carefully (The practice of electroconvulsive therapy 2002; Wise et al. 1984; Lovas et al. 2011). The seizure initially leads to a surge in the sympathetic tone, which can lead to hypertension and tachycardia.

Maternal bradycardia can be managed, when indicated, with glycopyrrolate 2 mg, as atropine crosses the placenta and may lead to fetal tachycardia and decreased heart rate variability, which can mask signs of fetal distress. Like atropine, it may also decrease the lower esophageal sphincter tone and therefore should be used cautiously (Miller 1994; O'Reardon et al. 2011; Salzbrenner et al. 2011; The practice of electroconvulsive therapy 2002; Wise et al. 1984).

Evaluation of maternal arterial blood gas during or after ECT (The practice of electroconvulsive therapy 2002; Wise et al. 1984) has been reported but is not routinely performed.

Multiple arterial catheterizations can increase the risk of adverse events after arterial monitoring.

Post-procedure

Immediately following ECT, the patient should be reexamined for complications. If uterine contractions are present, they can be treated with beta-2 adrenergic tocolytics (e.g., ritodrine) to suppress labor (Miller 1994; Walker and Swartz 1994) and further ECT treatments should be postponed until contractions are assessed and managed (Miller 1994). Abdominal pain has been treated with IV magnesium sulfate 4 mg diluted in 100 mL saline (Lovas et al. 2011). If there is vaginal bleeding, further treatments should be postponed until the source of bleeding is assessed (Miller 1994; Salzbrenner et al. 2011).

Repeated fetal health rate evaluation by Doppler can be performed after the procedure (Anderson and Reti 2009; Walker and Swartz 1994; Wisner and Perel 1998). If necessary, weekly non-stress tests may be ordered to ensure fetal well-being (The practice of electroconvulsive therapy 2002; Wise et al. 1984).

Nausea and vomiting are usually treated with ondansetron (Salzbrenner et al. 2011), metoclopramide, prochlorperazine, or meclizine (O'Reardon et al. 2011; Broussard and Richter 1998).

Post-ECT headache is routinely managed with acetaminophen (O'Reardon et al. 2011; Koren et al. 1998) instead of the commonly used toradol, as aspirin and non-steroidal anti-inflammatory agents may contribute to altered maternal/fetal homeostasis and to early constriction or closure of the fetal ductus arteriosus (O'Reardon et al. 2011; Committee ADRA 1998).

Anticipatory guidance should also be provided to the patient. If she develops a cough or a fever higher than 100.4°F, she should be emergently evaluated given the concern for

aspiration pneumonia. If there is decreased fetal movement, the patient should contact her obstetrician and/or seek the nearest emergency care.

Conclusions

Psychiatric disorders are common in pregnancy and predispose the mother and her developing fetus to negative consequences if left untreated. A careful individual assessment should be performed considering the inherent risks and poorer outcomes from untreated psychopathology during pregnancy and the available treatment options, which include pharmacotherapy, psychotherapy, and electroconvulsive therapy.

ECT is safe and effective for management of many psychiatric disorders in pregnancy. It allows for treatment while minimizing potential adverse effects, maternal and fetal. It is a particularly relevant treatment option when rapid alleviation of symptoms is desired, such as in the case of severe depression with suicidality or acute psychosis that causes impairment on the mother's ability to care for herself or puts her at danger to herself or others, or when the mother's symptoms are refractory to pharmacological management.

Based on changes in physiology that occur during pregnancy, the authors suggest treatment modifications for ECT in pregnancy and consolidate them into a protocol that can be implemented by clinicians to improve both access and safety of ECT for pregnant patients (see Appendix Table 1).

Limitations

The wide range of AEs led to further examination of the methodology of these studies and several confounding biases and design flaws were noticed. One of them (Leiknes et al. 2015) analyzed more case-level reports and less case series data than the other meta-analyses. Single-case reports are biased towards a remarkable or surprising outcome rather than the unremarkable outcome (in this case, a safe and uneventful procedure). Another important bias comes from the fact that uneventful procedures are unlikely to be acknowledged or published. The authors aspire to develop new, higher-quality case series that will hopefully add clarity to the actual risks of ECT in pregnancy.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

Appendix

Table 1 Summary of recommendations for the use of ECT in pregnant patients

Initial steps
- Provide psychoeducation to staff prior to performing ECT in pregnancy to reinforce the safety and effectiveness of the procedure
- Ensure that the facility where ECT is performed has the capability to treat an obstetric or neonatal complication or emergency

Evaluation for ECT
- Consult obstetrics
  - ○ Pelvic exam
  - ○ Special consideration for risk factors for spontaneous abortion, preterm labor, abruption, and uteroplacental insufficiency
- Weekly non-stress tests of fetal well-being throughout the entire treatment course or a level 2 ultrasonogram between 18 and 22 weeks of gestational age
- If a patient is at high risk for preterm labor or other complications, ECT can be performed in a labor and delivery operating room or labor ward with a caesarian section tray ready
- Obstetrician should be aware of the timing of the procedure
- Screening for psychoactive substance use disorder or signs of acute withdrawal

Pre-procedure
- Discontinue non-essential anticholinergic medications
- Avoid NSAIDs
- Night before: administer 30 mL 0.3 M sodium citrate
- NPO 8 h prior to ECT
- 15–20 min before anesthesia: administer 30 mL 0.3 M sodium citrate
- 30 min before: pre-medicate with ranitidine 50 mg or cimetidine, +/− metoclopramide 20 mg
- IV hydration 12 h prior: lactate ringer's or normal saline
- 20+ weeks: elevate right hip with foam wedge
- Fetal cardiac monitoring by Doppler ultrasound
- If fetal heart rate decreases, increase O_2 and further displace uterus
- External fetal monitoring for several hours before ECT or non-stress test with a tocometer

Peri-procedure
- Continuous maternal heart rate, EKG, SpO_2, and end-tidal carbon dioxide level monitoring
- If concern for contractions: use uterine tocodynamometry
- If late term or high risk: use continuous fetal monitoring
- Intubation, especially after the first trimester
- Pre-oxygenate but do not hyperventilate
- Induction: propofol 0.75–2 mg/kg, methohexital 0.5–1 mg/kg, or, if third trimester, consider inhalational anesthetics
- Paralysis: succinylcholine 0.5–1.5 mg/kg unless contraindicated
- Treat maternal hypertension (e.g., esmolol or remifentanil infusion)
- Treat maternal bradycardia, when indicated, with glycopyrrolate 2 mg
- If fetal heart rate decreases, increase O_2 and further displace uterus
- If significant desaturation: get maternal ABG during or after ECT

Post-procedure
- Examine patient for uterine contractions and vaginal bleeding
- If uterine contractions are present: treat with beta-2 adrenergic tocolytics (i.e., ritodrine)
- If with abdominal pain: treat with IV $MgSO_4$ 4 mg diluted in 100 mL saline
- If contractions or vaginal bleeding: postpone further ECT until etiology is revealed
- Repeat fetal cardiac monitoring by Doppler ultrasound

Table 1 (continued)

-Repeat external fetal monitoring for up to several hours as needed or non-stress test with tocometer after procedure
-If necessary: weekly fetal non-stress tests
-If nausea: treat with ondansetron, metoclopramide, prochlorperazine, or meclizine
-If headache or muscle aches: treat with acetaminophen
-Anticipatory guidance: if fever > 100.4ºF or cough, decreased fetal movement, go to nearest emergency room/ obstetrical triage

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