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Biochemical Changes Associated with Abortion: A Review

Ohiwerei Wisdom Omogbai[1*], Eseigbe Emmanuel Ebosetale[2]
[1]Mudiame University, Irrua, Edo State
[2]Ambrose Alli University, Ekpoma, Edo State
Corresponding Author: Ohiwerei Wisdom Omogbai
Ohiwereiwisdom@gmail.com

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ABSTRACT

Abortion, whether spontaneous or medically induced, triggers a range of physiological and biochemical changes in the female body. The termination of pregnancy influences hormonal balance, metabolism, and enzymatic activity, which can affect reproductive health. This review explores the biochemical impacts of abortion, including hormonal disruptions, oxidative stress, inflammatory responses, immune system alterations, neurotransmitter imbalances, and potential long-term metabolic effects

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INTRODUCTION

Abortion is the termination of pregnancy before the fetus reaches viability, occurring either naturally due to medical conditions or intentionally through medical or surgical procedures (1). It is classified into two types: spontaneous abortion (miscarriage), which often results from chromosomal abnormalities, infections, hormonal imbalances, or immune dysfunction, and induced abortion, which is performed for personal, medical, or socio-economic reasons (2).

In addition to its physical effects, abortion influences biochemical pathways that are critical for reproductive health and overall bodily balance. These changes disrupt hormonal regulation, immune function, oxidative stress levels, and neurotransmitter activity, potentially leading to both short- and long-term health effects. Research indicates that the sudden termination of pregnancy triggers a rapid decline in essential hormones such as progesterone and hCG, which can destabilize reproductive health and increase the likelihood of menstrual irregularities, fertility challenges, and mental health conditions like depression and anxiety (3,4).

Moreover, abortion has been associated with increased oxidative stress and inflammatory responses, which may contribute to cellular damage in the endometrium and reproductive tract (5). Studies suggest that undergoing multiple abortions could raise the risk of complications such as preterm labor, placental abnormalities, and implantation difficulties in subsequent pregnancies (6).

Understanding these biochemical changes is essential for effective post-abortion care. Early interventions, including hormonal therapy, antioxidant supplementation, and psychological support, can help reduce associated risks and promote better reproductive health outcomes. Continued research is necessary to improve post-abortion care strategies and further explore the biochemical mechanisms involved.

METHODOLOGY

Hormonal Changes Post-Abortion

The endocrine system undergoes notable changes following abortion, primarily affecting the levels of progesterone, estrogen, and human chorionic gonadotropin (hCG) (2). The sudden termination of pregnancy causes a rapid decline in hCG, which plays a key role in maintaining progesterone production by the corpus luteum. This abrupt drop in progesterone disrupts the luteal phase, leading to irregular menstrual cycles and potential fertility issues (3). Post-abortion fluctuations in estrogen levels can also influence mood regulation, bone density, and metabolic processes (4). Additionally, stress-related cortisol levels may rise, further exacerbating hormonal imbalances (5).

Hormonal shifts after abortion can also impact thyroid function. Since the thyroid gland is highly responsive to changes in reproductive hormones, fluctuations in estrogen and progesterone may lead to thyroid imbalances, increasing the risk of hypothyroidism or hyperthyroidism (6). These disruptions can contribute to metabolic disturbances, fatigue, and weight fluctuations (7).

Prolactin levels may also be affected post-abortion. Increased prolactin secretion can disrupt menstrual cycles and impair ovarian function (8). Elevated prolactin can suppress gonadotropin-releasing hormone (GnRH) secretion, hindering follicular development and ovulation, which may contribute to infertility concerns (9).

Another critical factor in post-abortion hormonal changes is the impact on adrenal gland function. The adrenal glands produce cortisol, a stress-related hormone, and its excessive release due to emotional and physiological stress following abortion can disrupt the hypothalamic-pituitary-adrenal (HPA) axis (10). Chronic HPA axis activation increases the risk of metabolic syndrome, insulin resistance, and cardiovascular complications (11).

Overall, the hormonal fluctuations that occur after abortion significantly influence both physiological and emotional health. These changes may have immediate and long-term consequences, emphasizing the need for medical monitoring and appropriate interventions to restore hormonal balance and reduce potential health risks.

RESULT AND DISCUSSION

Oxidative Stress and Inflammatory Responses

Abortion has been linked to increased oxidative stress and elevated inflammatory markers, which can contribute to cellular damage in reproductive tissues. Research suggests that women who undergo abortion show higher levels of reactive oxygen species (ROS) and lipid peroxidation—key indicators of oxidative stress—which may lead to complications such as endometriosis and infertility (12). Additionally, inflammatory cytokines like interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α) surge after abortion, intensifying tissue damage and increasing the risk of infections (13). Elevated prostaglandin levels further contribute to uterine contractions and cramping (14).

Post-abortion oxidative stress can also result in mitochondrial dysfunction within reproductive cells, impairing energy production and increasing apoptosis in the endometrial lining (15). This disruption can delay endometrial healing and may lead to long-term reproductive challenges, including implantation failure in future pregnancies (16). Moreover, prolonged oxidative stress has been linked to DNA damage, which may raise the risk of genetic mutations and potential malignancies in the reproductive tract (17).

The inflammatory response triggered by abortion extends beyond localized tissue damage, affecting systemic immune function. Chronic inflammation has been associated with a higher likelihood of developing autoimmune disorders, such as endometriosis and chronic pelvic inflammatory disease (18). Persistent inflammatory activity may also interfere with vascular function, potentially leading to endothelial dysfunction and an increased risk of cardiovascular complications (19).

Additionally, oxidative stress can disrupt neurotransmitter pathways, contributing to mental health concerns such as anxiety and depression following abortion. Increased ROS levels have been associated with imbalances in serotonin

and dopamine metabolism—two neurotransmitters essential for mood regulation (20). These biochemical disruptions may explain the increased risk of emotional distress and psychiatric conditions in some individuals post-abortion.

Given the crucial role of oxidative stress and inflammation in post-abortion health complications, interventions such as antioxidant therapy, dietary modifications, and lifestyle adjustments may help counteract these effects. Clinical strategies aimed at reducing inflammation and restoring oxidative balance could improve long-term reproductive and overall health outcomes.

Immune System Alterations

The immune system undergoes significant changes after an abortion, marked by increased production of pro-inflammatory cytokines and reduced regulatory T-cell activity, which may heighten the risk of autoimmune conditions (9). The disruption of immune tolerance within the reproductive system can lead to greater susceptibility to infections and implantation complications in future pregnancies (10). Research indicates that post-abortion immune dysregulation is linked to persistent inflammation, increasing the risk of autoimmune diseases such as systemic lupus erythematosus and rheumatoid arthritis (21). Additionally, imbalances in T-helper cells (Th1/Th2) and altered natural killer (NK) cell activity have been associated with a higher likelihood of recurrent pregnancy loss and implantation difficulties (22).

Beyond reproductive health, post-abortion inflammatory responses may also affect overall immune function. Prolonged elevation of cytokines like interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α) has been linked to an increased risk of cardiovascular disease, insulin resistance, and metabolic syndrome (23). Additionally, disruptions in immune cell function can reduce endometrial receptivity, making embryo implantation more difficult and increasing the risk of miscarriage in future pregnancies (24). Studies also suggest that oxidative stress resulting from immune imbalances may contribute to chronic inflammatory disorders, further compromising long-term maternal health (25).

Metabolic and Hematological Alterations

Abortion can also influence hematological parameters and metabolic processes. Research indicates that women who experience recurrent abortion often exhibit significant declines in hemoglobin levels, increasing their risk of developing anemia (11). Post-abortion anemia, commonly resulting from excessive blood loss, can cause chronic fatigue, impaired cognitive function, and weakened immunity, which may prolong recovery and elevate the risk of complications in future pregnancies (26). Additionally, disruptions in iron homeostasis following abortion have been associated with systemic oxidative stress, potentially intensifying inflammatory responses and negatively affecting vascular health (27).

Glucose metabolism is another area impacted by abortion, with studies suggesting that post-abortion alterations in insulin sensitivity may increase the likelihood of gestational diabetes in subsequent pregnancies (12). Hormonal imbalances, particularly fluctuations in estrogen and progesterone levels, can interfere with insulin regulation, heightening the risk of metabolic syndrome and type 2 diabetes later in life (28). Furthermore, post-abortion dyslipidemia—

characterized by elevated levels of low-density lipoprotein (LDL) cholesterol and triglycerides—may contribute to an increased risk of cardiovascular disease (29).

Electrolyte imbalances, particularly fluctuations in calcium, potassium, and magnesium levels, have also been reported and can significantly affect neuromuscular function and cardiovascular health (13). Hypocalcemia following abortion may lead to reduced bone density, raising the long-term risk of osteoporosis, particularly in women who have undergone multiple pregnancy terminations (30). Magnesium deficiency has been linked to heightened stress responses, muscle weakness, and an increased risk of arrhythmias, further complicating post-abortion recovery (31). Additionally, potassium imbalances may disrupt blood pressure regulation, increasing the likelihood of hypertension and cardiovascular complications (32).

Neuroendocrine and Psychological Impact

In addition to metabolic and hematological effects, abortion can lead to neuroendocrine changes that impact psychological and emotional well-being. Dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis following abortion can result in abnormal cortisol secretion patterns, which have been linked to heightened stress responses, anxiety, and depressive symptoms (33). Furthermore, alterations in neurotransmitter levels, particularly serotonin and dopamine, have been associated with an increased risk of mood disorders, including major depressive disorder and generalized anxiety disorder (34).

Sleep disturbances are also commonly reported after abortion, with hormonal imbalances and stress responses contributing to disrupted circadian rhythms, increased fatigue, and impaired cognitive function (35). Chronic stress and prolonged neuroendocrine dysfunction may further exacerbate systemic inflammation, negatively affecting reproductive health and overall well-being (36). Additionally, recent studies suggest that women who undergo abortion may have an increased susceptibility to post-traumatic stress disorder (PTSD), indicating potential long-term neurobiological consequences that require further research (37).

Implications for Future Reproductive Health

The biochemical disruptions that occur after abortion can have lasting effects on reproductive health. Hormonal imbalances may contribute to conditions such as polycystic ovary syndrome (PCOS) and endometrial dysfunction, potentially impacting fertility (16). Additionally, prolonged oxidative stress and inflammation have been associated with an increased risk of chronic reproductive disorders, including uterine fibroids and adenomyosis (17). Immune system dysregulation may further heighten the risk of recurrent pregnancy loss and implantation failure in subsequent pregnancies (18).

CONCLUSIONS AND RECOMMENDATIONS

Abortion triggers substantial biochemical changes, affecting hormonal regulation, oxidative stress levels, immune responses, neurotransmitter balance, and metabolic stability. Implementing comprehensive post-abortion care, including medical monitoring and psychological support, can help manage these

biochemical alterations and reduce the risk of reproductive health complications. Further research is essential to develop therapeutic interventions that mitigate these effects and promote long-term reproductive well-being.

FUTURE STUDY

This research still has limitations so further research is needed related to the topic of Biochemical Changes Associated with Abortion: A Review to perfect this research and increase insight for readers.

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