

Strategies for Managing Odontogenic Infections in Expectant Mothers: A Narrative Review

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ABSTRACT

Odontogenic infections, which originate from dental issues, can spread to fascial spaces in the head and neck, posing serious health risks. In pregnant patients, these infections are particularly challenging due to pregnancy-related physiological changes and the need to protect both the mother and the foetus. This narrative review elaborates on strategies for managing these infections in pregnant patients, highlighting the importance of a multidisciplinary approach involving Dental Professionals, Obstetricians, and Anaesthesiologists. Pregnancy induces changes such as altered immune function and increased vascularity, which can worsen the severity of infections and complicate treatment. The article discusses how these changes affect infection progression and treatment, stressing the need for early diagnosis to prevent severe complications like airway obstruction. Management strategies must balance effective infection control with foetal safety. This involves the careful selection of antibiotics, avoiding those that are contraindicated in pregnancy, and considering minimally invasive surgical techniques and local anaesthesia. Imaging is also addressed, with a preference for low-radiation methods or alternatives like ultrasound to reduce foetal exposure while ensuring accurate diagnosis. The article emphasises the importance of personalised treatment plans based on the stage of pregnancy, infection severity, and patient health. Close monitoring and follow-up care are crucial to managing potential complications during treatment. In conclusion, managing odontogenic infections in pregnant patients requires a careful, multidisciplinary approach to prioritise the health of both mother and foetus. The article offers a comprehensive overview of best practices, advocating for early intervention and tailored management to effectively safeguard both lives.

Keywords: Fascial spaces, Ludwig's angina, Pregnancy, Space infections

INTRODUCTION

In oral and maxillofacial surgery, managing pregnant patients poses unique challenges due to significant physiological changes during pregnancy that require close monitoring and substantial adjustments in treatment options. Hormonal fluctuations, vascular changes, and altered immune function during pregnancy can impact oral health, increasing the risk of gingivitis, periodontal disease, and dental caries. Ludwig's angina, facial cellulitis, deep neck infections, mediastinitis, periodontal or periapical abscesses, and cerebral abscesses are among the serious illnesses that can result from these conditions if they are not treated appropriately [1]. Despite their rarity, these situations require a tailored approach to ensure the safety of both mother and child.

The present article explores the complexities of treating pregnant patients in oral and maxillofacial surgery, highlighting the physiological changes of pregnancy, their impact on oral health, and the best treatment practices. The authors searched electronic databases for articles published between 2014 and 2024 (PubMed, Scopus, ScienceDirect, Google Scholar) using keywords such as "Pregnancy," "Odontogenic Space Infection," "Ludwig's Angina," and "Fascial Spaces." They also examined references and performed a manual search for additional studies, including case reports, due to the limited literature focusing on parameters such as surgical procedures, anaesthesia type, and adverse outcomes; the preferred articles were included. Study design was not an exclusion criterion, but Non English articles and those without full-text availability were excluded. The main objective of this literature search was to identify current methods being used and novel approaches practiced to manage pregnant patients in cases of odontogenic infections.

Pregnancy induces numerous physiological and immunological changes in women [Table/Fig-1], posing challenges for oral and maxillofacial surgeons, as it increases the risk of dental infections, which are exacerbated by treatment delays and infrequent dental check-ups [2-10].

Physiological changes during pregnancy	Clinical implications	Details
Cardiovascular [2,3]	Altered cardiac output, blood pressure, and hemodynamics	After 8 weeks, cardiac output rises by 20%, and in later stages, it rises by 40%. During the first trimester of pregnancy, BP drops and then returns to normal in the third trimester. Due to labor, cardiac output increases (15% during the initial phase and 50% throughout the subsequent phase). Supine positioning reduces venous return and it's recommended to manually displace the uterus or position the parturient using a left lateral tilt.
Haematological [3,4]	Risk of anaemia, thromboembolism, and consumptive coagulopathies	The RBC mass rises by 20% and the volume of plasma rises by 25-52% at the last stage of pregnancy. Physiological anaemia peaks at 30-32 weeks. Throughout pregnancy, most clotting factors increase; but there is a decrease in protein S and antithrombin III (Proteins that prevent coagulation)
Renal [3,5]	Changes in renal function and drug metabolism	A 50% rise in renal blood flow and glomerular filtration rate is seen including 40% reduction in serum urea and creatinine levels with increased urinary protein and glucose levels. Activation of RAA system, but significant resistance to angiotensin II leading to vasodilation.
Respiratory [2,3]	Increased oxygen demand and changes in ventilation	15% elevation in metabolic rate and 20 percent increase in consumption of oxygen. Tidal volume increases by 40 percent and respiratory rate by 15 percent. Reduced PaCO ₂ causes the oxygen-haemoglobin dissociation curve to shift to the left. Breathlessness often occurs without hypoxia, typically at rest.
Skeletal- [6]	Temporary bone loss, not linked to osteoporosis	There is little bone turnover in the first trimester, but increases in the third trimester to meet foetal calcium needs as mother's skeleton starts to support the fetus.

Endocrine (Thyroid)- [7]	Altered thyroid hormone levels, potential iodine deficiency	Increased TBG raises T4 and T3 levels. Free T3 and T4 levels slightly vary, but are typically clinically insignificant. Relative iodine deficiency; WHO recommends increasing iodine intake during pregnancy (150-200 µg/day).
Endocrine (Pituitary)- [8]	Altered hormone levels and osmoregulation	Low growth hormone secretion by the pituitary and elevated levels of serum growth due to placental production. Increased oxytocin production peaking at term. Decreased sodium concentration affects ADH release and thirst sensation.
Endocrine (Metabolism)- [9]	Insulin resistance, risk of gestational diabetes	Insulin resistance starts in second trimester and peaks in the third trimester due to diabetogenic hormones such as human placental lactogen, growth hormone, progesterone, cortisol, and prolactin. These hormones decrease insulin sensitivity in peripheral tissues like adipocytes and skeletal muscle by interfering with insulin receptor signaling
Endocrine (Adrenal) [10]	Physiological hypercortisolism, risk of hypertension, and impaired glucose tolerance	Pregnancy leads to increased levels of Adrenocorticotropic Hormone (ACTH), Corticosteroid-binding Globulin (CBG), deoxycorticosterone, cortisol, and free cortisol leading to physiological hypercortisolism which clinically presents as striae, facial plethora, elevated blood pressure, or impaired glucose tolerance

[Table/Fig-1]: Characteristics of physiological changes in gravidness [2-10].
BP: Blood pressure; RAA: Renin-angiotension system; RBC: Red blood corpuscles; TBG: Thyroxine-binding globulin; WHO: World health organisation; ADH: Aldosterone hormone

Much like the skin and other mucosal surfaces, the oral cavity harbors a diverse microbial community essential for overall health, while also making it susceptible to various infections. An odontogenic infection affects the alveolus, jaws, or face and is caused by a tooth or the structures that support it. Dental cavities, deep fillings, unsuccessful root canal therapy, pericoronitis, or periodontal disease are the most common causes of these infections. Fascial spaces, defined by Shapiro as potential spaces between fascial layers filled with connective tissue, veins, arteries, glands, and lymph nodes, can accumulate purulent exudate during an infection. Despite the fact that the incidence has decreased as a result of improved dental care, odontogenic infections can still spread to the face and neck spaces, where they can be fatal [Table/Fig-2] [11]. Moreover, these infections are further exacerbated by factors such as patient

Space	Details
Maxillary [11]	
Canine [11]	Location: Below the nasolabial fold. Bordered by: Maxilla (medially), Levatorangulioris muscle, and facial skin (laterally). Infection pathway: Maxillary canine root extends beyond muscle insertion.
Buccal [11]	Bordered by: Buccinator muscle insertion (medially) and skin (laterally). Infection Pathway: Maxillary molar root extends above muscle insertion, spreading to subcutaneous facial tissues.
Mandible [11]	Infection spread depends on the position relative to the mylohyoid line. Above Mylohyoid Line: Involves <i>sublingual space</i> . Below Mylohyoid Line: Involves <i>submandibular space</i> .
Sub-lingual [11]	Bordered by: Lingual oral mucosa (superiorly), Tongue muscles (medially), Mylohyoid muscle (inferiorly), Lingual cortex of mandible (anterolaterally).
Submandibular [11]	Bordered by: Mylohyoid muscle (superiorly), Neck skin (inferiorly), Mandible (laterally), and open posterior border. Infection Pathway: Potential spread between submandibular and sublingual spaces.
Submental [11]	Bordered by: Mylohyoid muscle (superiorly), Neck skin (inferiorly), and Anterior bellies of digastric muscles (laterally). Infection Pathway: Typically spreads from submandibular/sublingual spaces or originates from the skin.
Complications of untreated infections	Severe conditions include Ludwig's Angina, Necrotising fasciitis, and Retro/Parapharyngeal space involvement.

[Table/Fig-2]: Fascial spaces and the spread of infection [11].

neglect, antibiotic failure, immune suppression, concurrent medical conditions, or inadequate healthcare in developing countries.

When the infection reaches the buccal cortex, it can spread to the mandible along the buccal area or superficial neck tissues near the site of the platysma muscle's insertion [12]. Ludwig's angina is a rapidly developing cellulitis that can cause a bilateral infection of the sublingual, submandibular, and submental areas, leading to brawny oedema, a raised tongue, airway obstruction, and minor pus, which can be deadly and cause upper airway obstruction. Treating Ludwig's angina requires prompt diagnosis, ensuring a clear airway, intensive and extended antibiotic treatment, removal of the problematic teeth, hydration, and early surgical drainage [Table/Fig-3]. Empirical intravenous antibiotic therapy should be robust, including penicillin combined with metronidazole, clindamycin, or imipenem alone [13].

Parameters	Protocol
Assessment of the airway	Achievable through careful examination of signs such as breathlessness, tongue elevation, or pulse oximetry Assess the need for intubation
Aetiological factors	Dental radiographs are the mainstay for identification followed by the removal of the offending tooth/teeth
Surgical decompression	Reduces the pressure of edematous tissue thereby decreasing the airway embarrassment
Risk factors	Systemic medical conditions which include renal failure, diabetes mellitus, and immunocompromised individuals
Hydration and temperature	Check with blood pressure, pulse, and urine output followed by the use of antipyretics in febrile condition. Use of chest radiographs to check for pneumonia. Proper nutrition aids in faster recovery
Culture and blood reports	Adjusting the antibiotics accordingly and assessing the blood counts regularly

[Table/Fig-3]: Proposed management protocol for Ludwig's Angina [13].

Incision and drainage, in addition to the extraction of the offending tooth, was the mainstay protocol, and the state of pregnancy did not alter this modality [Table/Fig-4] [14-23]. Food and Drug Administration (FDA)-classified safe antibiotics listed under category B (research on animals has not shown a risk to the foetus, and there is insufficient, carefully monitored research on pregnant individuals) were administered with due caution. Acetaminophen/Paracetamol infusions were the preferred choice for anti-inflammatory and analgesic medication. Authors reported adverse outcomes such as foetal distress, pre-term placental abruption, and emergency lower segment Caesarean-section, drawing attention to the need for a careful and methodical approach in collaboration with the Department of Gynaecology and Obstetrics.

Author's name and the year	Intervention and anaesthesia	Adverse outcomes
Dalla Torre D et al., 2014 [14]	Incision and drainage and extraction; GA	Maternal ARDS and sepsis, foetal mortality in the uterus, and C-section at 28 weeks
Kamath AT et al., 2015 [15]	Bilateral drainage plus tooth extraction, draining of the mediastinum, and the second neck; GA	Foetal distress c-section delivered 32 weeks ahead of schedule
Akhter T et al., 2016 [16]	Incision and drainage; GA/LA	Not mentioned
Tocaciu S et al., 2017 [17]	Drainage plus extraction; GA	Maternal ICU postoperative (3 days) no insult to the fetus
Rahman T et al., 2022 [18]	Drainage plus extraction; La plus superficial cervical plexus block	Not stated
Pahwa S et al., 2021 [19]	Incision and drainage; GA	Emergency lower segment C-section
Pucci R et al., 2021 [20]	Tooth extraction and the extraoral abscess drainage; LA	Preterm placental abruption
Huang Q et al., 2022 [21]	Incision and drainage intraoral and extraoral with extraction; LA	Three patients gave birth immediately after acute inflammation control

Kaur P 2023 [22]	Extensive surgical debridement and tooth extraction	Not reported
Balaji VC and Vani K 2024 [23]	Incision and drainage in addition to the removal of the involved teeth; GA	Urgent lower-segment cesarean section was performed; no complications

[Table/Fig-4]: Review of literature of last 10 years [14–23].

ARDS: Acute respiratory distress syndrome; ICU: Intensive care unit; GA: General anaesthesia; LA: Local anaesthesia

Proposed management of healthy pregnant patients with infections of the odontogenic space: Treatment adjustments should be based on an earlier review of gravid physiology, as pregnant women run a higher risk of serious odontogenic infections due to local causes, contributing factors, and healthcare practitioners' reluctance to treat them.

Surgical exploration: The primary treatment for odontogenic abscesses includes surgical exploration and drainage. This remains true even during pregnancy. Prompt surgical intervention is typically safer than prolonged intravenous antibiotic use, which can increase the risk of the condition advancing to sepsis and multiple organ failure, posing a threat to both the mother and foetus [24].

General anaesthesia: From an anaesthetic perspective, it is important to monitor the cardiovascular changes in both the foetus and mother. To reduce the chance of postural hypotension and to lessen placental strain on the inferior vena cava caused by the placenta, the patient should be positioned in the left lateral position. The altered respiratory drive can increase the risk of hypoxia for both the mother and foetus, especially during the induction phase of anaesthesia. The nasal mucosa, being more fragile, can lead to increased bleeding during intubation. Additionally, the higher risk of gastric reflux must be carefully managed to prevent aspiration and subsequent aspiration pneumonia after surgery [25,26]. Nitrous oxide, which inactivates methionine synthetase, is the most widely used inhalation anaesthetic and may also be the most teratogenic. It converts homocysteine and methyl-tetrahydrofolate into tetrahydrofolate {needed for Deoxyribonucleic Acid (DNA) synthesis} and methionine, an important amino acid. Despite not having any clinical significance in humans, it is suggested that all patients undergoing nitrous oxide anaesthesia receive prophylactic doses of folic acid, vitamin B12, and methionine [27].

Local anaesthetics: Preliminary findings indicate that human nerve conduction velocity may slow down as pregnancy progresses [28]. Amide-type local anaesthetics, being bound to alpha-1 acid glycoprotein, readily cross the placental barrier due to a reduction in alpha-1 acid glycoprotein levels during pregnancy, leading to high plasma concentrations. However, the immediate effects of regional anaesthesia on neonates appear to be less pronounced, even at higher doses, with few statistically significant and transient effects lacking clinical significance [29].

Analgesics: Paracetamol, a first-line analgesic during pregnancy, can be used in all trimesters [30], while ibuprofen is the second choice. Non-steroidal Anti-inflammatory Drug (NSAID) use around conception might raise the chance of miscarriage, but it does not seem to increase the risk of abnormalities. Therefore, NSAIDs can be used during the first two trimesters; however, they should not be used in the later stages of pregnancy due to the possibility of premature closure of the ductus arteriosus and potential low levels of amniotic fluid [31].

Antibiotics: When treating pregnant patients with oral infections, penicillin is the recommended antibiotic. A study indicated that exposure to penicillin during the first trimester does not result in an increased risk of congenital abnormalities or other side effects [32]. Regarding cephalosporins, no teratogenic effects have been reported, but there have not been any large studies on the safety of cephalosporins during pregnancy. The macrolide family, prescribed to patients who are allergic to penicillin, crosses the placenta

minimally and has been categorised as category B by the FDA, except for clarithromycin, which is in category C. The administration of metronidazole during pregnancy is debatable because its reduced form has teratogenic properties; however, humans are unable to reduce metronidazole, so there should be no danger associated with its use [33].

Medically compromised pregnant patients with odontogenic space infections: Maternal organs during pregnancy undergo various hormonal fluctuations and vascular changes that affect the patient's overall health. Systemic conditions place an additional burden on an already overcompensating body. The spread of odontogenic infection and its management remains unchanged, as supported by existing literature; however, it is imperative to understand and recognise the different and common medical conditions during pregnancy to refer the patient for appropriate consultation with medical subspecialties.

Pre-eclampsia is a multisystemic illness specific to human pregnancy that is characterised by pre-existing hypertension and the involvement of one or more additional organ systems, as well as the foetus [34]. Seizures that occur during a woman's pregnancy or soon after giving birth are known as epileptic seizures. The management of a woman suffering from eclampsia primarily consists of maintaining a healthy weight, exercising regularly, resuscitation, controlling hypertension, preventing additional seizures, and delivering the foetus [35].

Pregnant women with diabetes require careful blood sugar management and attention to related conditions. As stated by the American Diabetes Association, the following are the recommended blood sugar levels for women who are pregnant or already have diabetes: fasting glucose at or below 95 mg/dL, 140 mg/dL or lower one hour after meals, and 120 mg/dL or lower two hours following meals [36]. For those who need medication to control their diabetes during pregnancy, treatment typically involves an intravenous insulin infusion with hourly glucose monitoring, as high maternal blood sugar levels during labour can result in neonatal hypoglycaemia and foetal distress [37].

Hypothyroidism has been associated with an increased risk of a number of problems, including postpartum haemorrhage, placental abruption, gestational hypertension, and premature delivery, as well as perinatal morbidity, mortality, and children's neuropsychological and cognitive impairment. Thyroid hormone production is stimulated by early pregnancy surges in human chorionic gonadotropin, which can result in transitory gestational hyperthyroidism, also referred to as gestational transient thyrotoxicosis, treated with antithyroid medications such as methimazole or propylthiouracil by an endocrinologist [38].

Anaemia patients have been thoroughly studied for their effects on foetal and maternal outcomes. Research indicates that severe anaemia can have significant negative impacts on both the baby and the mother, with haemoglobin levels below 6 g/dL being associated with worse pregnancy outcomes [39]. In India, a study by Kumar KJ et al., discovered that maternal anaemia is associated with poor foetal outcomes when compared to mothers who are not anaemic. These results include a 6.5% rise in the incidence of Low Birth Weight (LBW) newborns and an 11.5% increase in preterm deliveries when the mother is anaemic throughout the third trimester. Comprehensive management of an anaemic patient includes iron supplements and transfusions of Fresh Frozen Plasma (FFP) or whole blood, as recommended by the Haematologist/Gynaecologist [40].

The management of medically compromised pregnant patients with odontogenic space infections requires careful consideration of the underlying systemic conditions and their potential complications, which may exacerbate maternal and foetal risks. Early identification and intervention, along with a multidisciplinary approach involving obstetricians, endocrinologists, and dental specialists, are essential for mitigating these risks and promoting positive pregnancy outcomes.

CONCLUSION(S)

The primary concern in managing pregnant patients is the prompt identification of signs and symptoms of infection, which necessitates hospital treatment. Practitioners should keep in mind that treatment is being provided for both the mother and the foetus. All medical interventions should be carried out only after consulting with the patient's gynaecologic expert. Early recognition, prompt response, a methodical and proven approach, followed by regular monitoring, form the pillars of managing pregnant patients suffering from space infections.

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