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Research Article

Maternal and Fetal Outcome of COVID Positive Antenatal Women Treated With Tocilizumab in a Tertiary Care Center an Observational Cohort Study

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Abstract: Tocilizumab, an IL-6 receptor inhibitor, halts the inflammatory stage of the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection. However, there is little information on Tocilizumab's effects on antenatal women and new born. This study aims to assess the effects of Tocilizumab in treating antenatal women with severe COVID infection. To assess and compare the maternal and fetal outcomes of COVID positive antenatal women of severe disease category who have been treated with Tocilizumab. A prospective observational cohort study was conducted at a tertiary care center from May 1st to October 31st 2021, involving 48 antenatal women with confirmed severe COVID-19 disease. Of these, 24 received Tocilizumab after multidisciplinary team consultation and informed consent, forming the case group, while 24 similar women, who did not give consent for Tocilizumab, served as controls. Disease severity and progression was assessed clinically and biochemically and the maternal and fetal outcomes of both the groups were compared. In this study of 48 pregnant women with severe COVID-19, 24 (50%) received Tocilizumab. Notably, 92% of severe COVID-19 pregnant women were non-vaccinated. Tocilizumab group showed significantly shorter oxygen support (2.6 vs. 4.0 days, p value-0.03) and ICU stays (8.9 days vs. 11.5 days, p-0.01), lower steroid use (1876.8 mg vs. 2895 mg, p value-0.03) and higher pregnancy continuation (25% vs. 17%) than controls. Biochemical markers (Serum Ferritin, LDH, CRP) also improved after Tocilizumab therapy. Over a median follow up of 30 days, 16 patients (66.7 %) had no clinical evidence of disease on day 30, with 5 reported deaths. This study shows that Tocilizumab is beneficial in managing severe COVID-19 in pregnant women, leading to reduced oxygen and steroid use, shorter ICU and ventilator stays, improved SpO2, decreased biochemical markers and increased likelihood of continuing their pregnancies.

Keywords: Tocilizumab, COVID-19, Antenatal, Maternal Outcomes, Fetal Outcome

Introduction

COVID-19, caused by SARS-CoV-2, posed significant challenges in managing pregnant women with severe pneumonia due to limited data on maternal-fetal outcomes. The disease's progression involves an initial viral replication followed by a host inflammatory response, often leading to a "cytokine storm" in critical patients, characterized by excessive cytokine production causing long-term damage and ARDS.

COVID-19 disease severity was categorised for treatment purpose as per Kerala treatment protocol (COVID-19, 2021):

- Mild-Asymptomatic, Respiratory Rate <24/min, SpO2>94 on room air

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- Moderate-Dyspnea and/or Hypoxia, Respiratory rate between 24-29, SpO2 between 91-94 on room air
- Severe-Dyspnea and/or Hypoxia, Respiratory Rate ≥ 30, SpO2 < 90 on room air

IL-6 is a key proinflammatory cytokine implicated in the Cytokine-Release Syndrome (CRS) of severe COVID-19. Tocilizumab, a recombinant humanized monoclonal antibody, targets the interleukin-6 (IL-6) receptor, potentially preventing disease progression and reducing mortality (Mehta et al., 2020).

The indications for use of Tocilizumab have been modified based on the RECOVERY and REMAP-CAP trail (Launched in March 2020) (Abani et al., 2021; The REMAP-CAP Investigators, 2021) and decision for the same was made on a case-by-case basis by a multidisciplinary team with informed consent.

The indications for Tocilizumab in COVID positive antenatal women are:

- Recently hospitalized patients who have been admitted to ICU within the prior 24 hours and who require invasive mechanical ventilation, NIV or HFNC [>0.4 FiO2/ 30L/min of oxygen flow]
  OR
- Recently hospitalized patients with rapidly increasing oxygen needs who require NIV or HFNC and have significantly increased markers of inflammation [CRP >75 mg/L]

Tocilizumab was considered for those patients with:

1. Severe disease -preferably within 24-48 hours of onset of severe disease / ICU admission (Clinical staging of severity was done as per Kerala federation of obstetrics and gynecology guidelines on COVID-19 care in pregnancy (Table 1)
2. Significantly raised inflammatory markers CRP and/or IL-6 (RECOVERY TRIAL cut off> 75mg/L) (Abani et al., 2021)
3. Not improving despite use of steroids
4. No active bacterial / fungal / tubercular infection

Controlling the cytokine storm early is crucial in improving patient outcomes. While data on Tocilizumab is still insufficient to delineate all potential risks, Jorgensen and Lapinsky (2022) show no serious safety concerns and some studies by Isaac et al. (2023) suggest Tocilizumab can be considered as an adjuvant treatment for critically ill pregnant women in their second and third trimesters. This study may help in giving further guidance to health care professionals in the use of Tocilizumab in pregnancy.

Methodology

The study was conducted as an observational cohort study in a tertiary care centre, from May 1st, 2021 to October 31st, 2021 after obtaining approval of Institutional Research Committee and Human Ethics Committee. The study population comprised of all COVID-19 positive antenatal women, disease confirmed either by molecular methods or rapid antigen tests. The study population were given a standard care of treatment with steroids, antiviral, antimicrobial and therapeutic anticoagulation.

Inclusion Criteria: All antenatal women with severe COVID-19 diagnosed based on positive RT-PCR or RAT and have given informed consent.

Exclusion Criteria: All antenatal women with severe COVID-19 who did not give consent for the study were excluded.

All eligible antenatal women with severe COVID-19 infection during the study period were taken consecutively. Antenatal patients with severe COVID-19 disease who gave consent for Tocilizumab were taken as cases. They were administered with Tocilizumab as a single dose 8mg/kg intravenous infusion as per Kerala State guidelines. COVID-19 (2021) Antenatal patients with severe COVID-19 disease who did not give consent for tocilizumab were taken as controls. Both the cases and controls group were comparable in terms of demographic and obstetric Variables. Disease severity and progression was assessed in both groups clinically and biochemically.

A total of 24 exposed cases and 24 controls were studied. Data with regard to demographic variables, clinical and biochemical determinants of both groups were collected using a qualitatively validated structured questionnaire. Privacy and confidentiality of the patients were maintained throughout the study period. The data were coded and analyzed using IBM SPSS statistics for Windows version 25 software. A descriptive analysis of the study participants was done. Categorical variables were expressed as numbers (%) and compared by the χ^2 test. Quantitative variables were expressed as mean and SD. Non parametric tests - Mann-whitney U test was used. Statistical significance was assigned as $p<0.05$.

Table 1: Clinical and laboratory parameters used for disease severity assessment

Clinical parameters	Laboratory parameters
Tachycardia PR >125 /min, Hypotension -BP < 90/60 mmHg, Dyspnea and or hypoxia Hypoxia SpO2 ≤ 90% on room air, Respiratory distress RR > 30 / min, Alteration of sensorium, PAO2 /FiO2 < 300mmHg	CRP > 5mg /L, LDH > 400 U /L, Ferritin > 300 mcg / ml,

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Results

During the 6 month study period, 1st May 2021 to 31st October, a total of 48 antenatal women with confirmed severe COVID-19 infections had been admitted in the tertiary care.

Among the 48 patients, 24 patients (50%) received Tocilizumab and 24 (50 %) did not.

The age distribution was comparable in both the case and the control groups (mean age ≈ 29.5+/-6.6 years vs 28.13+/-6.08 years, p-0.56). Parity distribution among Tocilizumab recipients was evenly split between primigravida and multigravidas, while the control group had more multigravidas (66.67%). 66.67% of severe cases were in the 3rd trimester and among these 42.2% received Tocilizumab and 57.6% did not receive. Of these patients with severe disease, 92% were not vaccinated. 83.3 % of patients who have received Tocilizumab were non vaccinated and patients who have not received Tocilizumab were all nonvaccinated. Diabetes mellitus (pregestational and gestational) was a preexisting condition in 50% of the patients with severe disease and 70.8% of those treated with Tocilizumab. (Table 2).

The study population was given a standard treatment with steroids, therapeutic anticoagulation, antimicrobials and Remdesivir (as per indication) (Table 3).

Table 2: Comparison of maternal characteristics in cases and controls

Maternal Characteristics	Cases Number (Percentage)	Controls Number (Percentage)	P value
AGE in years			0.562
<30	14 (58.3)	12 (50)	
≥30	10 (41.7)	12 (50)	
OBSTETRIC SCORE			0.24
Primigravida	12 (50.0)	8 (33.3)	
Multigravida	12 (50.0)	16 (66.67)	
GESTATIONAL AGE			0.220
Second trimester	10 (41.7)	6 (25)	
Third trimester	14 (58.3)	18 (75)	
BMI			0.771
Normal	13 (54.2)	14 (58.3)	
Overweight /obese	11 (45.8)	10 (41.6)	
SARS-CoV-2 VACCINATION STATUS			0.036
Vaccinated	4 (16.7)	0 (0.0)	
Unvaccinated	20 (83.3)	24 (100)	
LUNG DISEASE			0.382
Yes	4 (16.7)	2 (8.33)	
No	20 (83.3)	22 (91.97)	
AUTOIMMUNE DISEASE			0.382
Yes	4 (16.7)	2 (8.33)	
No	20 (83.3)	22 (91.97)	
DIABETES MELLITUS			0.009
Yes	17 (70.8)	8 (33.3)	
No	7 (29.2)	16 (66.6)	
HYPERTENSION			0.329
Yes	8 (33.3)	5 (21)	
No	16 (66.7)	19 (79)	
D DIMER Before Tocilizumab			1
<2.5 mg/dl	10 (41.7)	10 (41.7)	
≥ 2.5 mg/dl	14 (58.3)	14 (58.3)	
LDH BEFORE Tocilizumab			0.551
< 400 IU/L	8 (33.3)	10 (41.67)	
≥400 IU/ L	16 (66.7)	14 (58.33)	
CRP Before Tocilizumab			0.056
<5mg/dl	10 (41.7)	4 (16.67)	
≥5mg /dl	14 (58.3)	20 (83.33)	
Ferritin Before Tocilizumab			0.771
<300ng/ml	10 (41.7)	11(45.83)	
>300ng/ml	14 (58.3)	13 (54.17)	
White blood cell count			0.562
Elevated	12 (50.0)	10 (41.67)	
Not elevated	12 (50.0)	14 (58.33)	

Table 3: Usage of concomitant drugs in treatment of Severe COVID -19

Group		No	Percent
Tocilizumab	Steroid; Therapeutic anticoagulation; Antimicrobials	1	4.2
	Steroid; Therapeutic anticoagulation; Remdesivir	2	8.3
	Steroid; Therapeutic anticoagulation; Remdesivir; Antimicrobials	21	87.5
	Total	24	100.0
Control	Steroids, Remdesivir. heparin, antimicrobials	24	100.0

Table 4: Comparison of treatment outcome variables among cases and controls

Outcome variable	Tocilizumab group	Control group	P value
	Mean (Standard Deviation)	Mean (Standard Deviation)	
SPO2 Value-Lowest Value	91.54 (2.587)	86.2 (4.978)	<0.001
Lowest P/F IN ABG	199.33 (51.72)	158.79 (60.49)	0.00694
Cumulative Dose of Steroids/MG	1876.8 (1439.8)	2975 (1768.87)	0.0394
O2 Support Days	2.58 (1.86)	4.08 (2.34)	0.03846
NIV Days	2.375 (3.076)	4.95 (2.789)	0.00174
Ventilator Days	0.5 (1.25)	3.58 (5.91)	0.136
ICU Days	8.58 (3.978)	12 (4.78)	0.01174
Hospital stay in days	12.5 (4.916)	15.5 (6.199)	0.0688

The indications for Tocilizumab among study group were NIV/ HFNC need (66.7%), increasing oxygen demand (12.5%), no improvement with steroids (8.3%), rising CRP (4.2%) and severe disease with SpO2<90 and Respiratory rate >30(8.3%).

Patients who had received Tocilizumab had a shorter mean hospital stay (12.5 vs 15.5 days, p value- 0.068) and shorter ICU stay (8.9 days vs 12 days, p value-0.01) compared to control group. Patients who received Tocilizumab also showed lesser days of O2 support (2.58 days vs 4.08 days, p value:0.038), shorter NIV days (2.37 +/- 3.07 vs 4.95+/-2.78, p value -0.001) than control group which were statistically significant (Table 4).

The study also showed that, within 48 hours of Tocilizumab administration, biochemical markers of disease activity showed a decreasing trend. Serum Ferritin and LDH normalized in 75% patients and CRP normalized in 79.2% patients. (Table 5).

Among the tocilizumab recipients, 66.7% (16) of patients had shown no clinical evidence of disease by day 30 and 5 patients (20.8%) with multiple comorbidities died over a median follow up period of 30 days due to ARDS. While in the control group, 6 patients (23.07%) succumbed to death due to ARDS.

Pregnancy outcomes differed between Tocilizumab treated patients and controls. Pregnancy continuation was higher with Tocilizumab (25% vs. 17%). Vaginal delivery rates were slightly higher in Tocilizumab group (8.3%) than controls (4%) Cesarean section rates were similar, with 66.7% of Tocilizumab treated patients and 79% of controls undergoing CS. (p value-0.75). Out of the 48 newborns ,6 (12.5%) had tested positive for COVID-19, 26 (54.16%) had tested negative and 16 (33.3%) newborns had no documentation (Table 6).

Table 5: Comparison of biochemical markers before and after Tocilizumab

Biochemical Markers	Before administration of Tocilizumab	After administration of Tocilizumab (48 hrs)
C- Reactive Protein		
<5	10 (41.7%)	19 (79.2%)
>5	14 (58.3%)	5 (20.8%)
Serum LDH		
<400	8 (33.3%)	18 (75.0%)
>400	16 (66.7%)	6 (25.0%)
Serum Ferritin		
<300	10 (41.7%)	18 (75.0%)
>300	14 (58.3%)	6 (25.0%)

Table 6: Comparison of Maternal and Newborn Outcomes among cases and controls

	Tocilizumab Number (Percentage)	Control Number (Percentage)	p value
PREGNANCY STATUS			0.755
Continued	6 (25.0%)	4 (17%)	
Vaginal delivery	2 (8.3%)	1 (4%)	
Caesarean delivery (mother sake)	15 (62.5%)	17 (71%)	
Hysterotomy	1 (4.2%)	2 (8%)	
MATERNAL DEATH			0.4899
Broncho pneumonia, ARDS	4 (16.7%)	6 (25%)	
Septic shock, AKI, ARDS	1 (4.2%)	0 (0%)	
Survived	19 (79.2%)	18 (75%)	

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Table 6: Continue

NEWBORN OUTCOME			0.2184
Lost follow up	6 (25.0%)	4 (16%)	
Live term	0 (0.0%)	3 (13%)	
Live preterm	15 (62.5%)	16 (67%)	
Stillbirth	3 (12.5%)	1 (4%)	
COVID STATUS OF NEWBORN			0.632
Testing not done	9 (37.5%)	7 (29%)	
COVID-19 Negative	13 (54.2%)	13 (54%)	
COVID-19 positive	2 (8.3%)	4 (17%)	

Discussion

COVID-19 is an airborne illness that mostly affects the respiratory system. It causes a significant inflammatory response, which releases several inflammatory mediators such IL-1, IL-6 and Tumor Necrosis Factor-alpha (TNF-α), creating a cytokine storm. Immunomodulatory therapies must be used to control the cytokine storm as soon as possible in order to improve treatment outcomes and lower mortality rates in COVID-19 patients. Tocilizumab, by inhibiting IL-6 signaling, potentially dampens excessive inflammation and cytokinin release, minimizes organ damage and dysfunction and enhances clinical outcomes and potential recovery (Xu et al., 2020).

Pregnancy-induced physiological changes make antenatal women highly vulnerable to SARS-CoV-2, which significantly increases their risk of severe maternal complications like pneumonia and ICU hospitalization. (Rasmussen et al., 2020). Currently, the data regarding the use and safety of tocilizumab in pregnancy is limited. However, some studies have reported that tocilizumab does not cross the placenta or, even if it does, the amount is minimal. Also, no congenital anomalies are reported with tocilizumab. The CDC, ACOG and NICE guidelines initially did not recommend Tocilizumab in pregnancy due to lack of human pregnancy data and insufficient information on placental transfer. However, literature review done by Akinosoglou, recommends use of tocilizumab in treating severe COVID infection. (Akinosoglou et al., 2023). According to the RECOVERY REMAP-CAP Trail, Tocilizumab may be used in pregnancy in patients who have severe COVID-19 infection and the decision has to be made on a case by case basis by a multidisciplinary team (Abani et al., 2021; The REMAP-CAP Investigators, 2021).

In an analysis of a large cohort of pregnant women with SARS-CoV-2 infection done by Galang et al. (2021) the presence of any underlying medical condition, being 25 years of age or older were linked to an increased risk of moderate-to-severe or critical illness (Galang et al., 2021). Our study also points to similar findings. The mean age of case and control groups were 29.5+/-6.6 years & 28.13+/-6.08 years, respectively. Diabetes mellitus was a preexisting condition in 50% of the patients with severe disease and 70.8% of those treated with Tocilizumab. Around 30% of study population had hypertension, lung disease & autoimmune disease and the variables were comparable in both groups. 92% of the study population were not vaccinated against COVID.

The study observed that Tocilizumab exposure had improved maternal outcomes, resulted in shorter oxygen support duration (2.58 days vs 4.08 days, $p = 0.03$), a lower cumulative steroid dose (1876.8mg vs 2975 mg, $p = 0.03$) and improved SpO2 levels (91.3 vs 86.2%, $p<0.01$). Patients receiving Tocilizumab also had a shorter hospital stay of 12.5 days, a shorter ICU stay of 8.9 days, less noninvasive ventilatory support lasting 2.3 days, shorter oxygen therapy via nasal prongs/ facial mask lasting 2.6 days, suggesting beneficial effects of treating with tocilizumab. These findings align with major clinical trials; for instance, the CORIMUNO-19-TOCI-1 trial indicated that tocilizumab improves 14-day ventilation-free survival (Hermine et al., 2021) Similarly, the EMPACTA trial reported a reduced risk of progression to mechanical ventilation or death by day 28, though it noted no statistically significant reduction in overall mortality alone (Salama et al., 2021).

However, trial like RCT-TCZ-COVID-19 found no statistically significant difference in death rates or the combined outcomes of death, mechanical ventilation, or ICU admission between patients who received tocilizumab than those who received a placebo or standard care (Salvarani et al., 2021).

Biochemical markers showed significant improvement within 48hrs post Tocilizumab administration, with serum Ferritin and LDH normalizing in 75% of patients and CRP normalizing in 79.2% of patients.

Tocilizumab treated patients exhibited improved pregnancy outcomes compared to controls, with a higher rate of pregnancy continuation (25% vs 19.2%). Vaginal delivery rates were slightly higher in Tocilizumab group (8.3%) than controls (3.8%). In our cohort, 72.9% of patients delivered via emergency lower segment cesarean section (LSCS), aligning closely with the 68.9% cesarean rate reported in a systematic review by Debrabandere et al. (2021). These high intervention rates are consistent with data from Isaac et al., who observed a 78% emergency LSCS rate, 50% of which were driven by COVID-19 complications (Isaac et al., 2023).

During a median follow up period of 30 days, 66.7% (16 patients) showed no clinical evidence of disease.

Among the tocilizumab recipients, 5 patients (20.8%) with multiple comorbidities died over a median follow up period of 30 days due to ARDS. While in the control group, 6 patients (23.07%) succumbed to death due to ARDS.

Conclusion

This study indicates that Tocilizumab may be beneficial in managing severe COVID-19 in pregnant women. Tocilizumab was associated with reduced oxygen support duration, decreased steroid use and shorter ICU and ventilator stay, alongside improvements in SpO2 levels and normalization of biochemical markers (Ferritin, LDH, CRP). Furthermore, Tocilizumab treatment correlated with better pregnancy outcomes, including higher rates of pregnancy continuation. At the 30-day follow-up, 66.7% A of patients showed no clinical evidence of disease. However larger studies are required.

Limitations

Some of the patients in both the case and control groups were administered Remdesivir and steroids which could also have acted as confounding factors while assessing progression of severe disease. Also, because of the short follow up period, we were not able to assess long term safety and adverse effects. Sample size of the study was small, which precludes definitive conclusions to be reached.

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Author's Contributions

Jaimie T Jacob: Served as the primary author of the manuscript. Contributed to clinical data collection, manuscript preparation and edited.

S Lakshmi Vinodh: Contributed to clinical data collection.

Aravind R: Served as Consultant specialist and offered expert clinical contributions.

Sreekumari R: Provided expert clinical insight, assisted with patient management.

Shilpa S Shibu: Assisted with manuscript preparation.

Betsy John: Assisted with manuscript preparation and editing.

Ethics

Study was initiated after obtaining permission from Institutional Research Committee and Human Ethics Committee [HEC NO :10/10/2021 MCT]. Information disclosing the identity of the patient was not included in the data collection format.

Conflict of Interest

All authors report no conflict of interest.

Abbreviations

ACOG- American College Of Obstetrics & Gynecology
AKI-Acute Kidney Injury
ARDS.- Acute Respiratory Distress Syndrome
CDC-Centre For Disease Control & Prevention
CRP- C Reactive Protein
CRS -Cytokine-Release Syndrome
Fio2-Fraction Of Inspired Oxygen
HFNC- High Flow Nasal Cannula
IL-6- Interleukin-6
LDH- Lactate Dehydrogenase
NICE-National Institute For Health And Care Excellence
NIV- Non Invasive Ventilation
PaO2-Partial pressure of oxygen in Arterial blood
SARS-CoV-2 -Severe Acute Respiratory Syndrome Coronavirus-2
TNF-α -Tumor Necrosis Factor-Alpha

References

Abani, O., The Lancet, A., Abbas, F., Abbas, M., Abbasi, S., & Abbass, H. (2021). Tocilizumab in patients admitted to hospital with COVID-19 (RECOVERY): a randomised, controlled, open-label, platform trial. *The Lancet*, *397*(10285), 1637–1645.

Akinosoglou, K., Schinas, G., Rigopoulos, E.-A., Polyzou, E., Tzouvelekis, A., Adonakis, G., & Gogos, C. (2023). COVID-19 Pharmacotherapy in Pregnancy: A Literature Review of Current Therapeutic Choices. *Viruses*, *15*(3), 787. https://doi.org/10.3390/v15030787

COVID-19. (2021). *Guidelines to Optimize COVID Treatment Outcomes in Kerala*.

Debrabandere, M. L., Farabaugh, D. C., & Giordano, C. (2021). A Review on Mode of Delivery during COVID-19 between December 2019 and April 2020. *American Journal of Perinatology*, *38*(04), 332–341. https://doi.org/10.1055/s-0040-1721658

Galang, R. R., Newton, S. M., Woodworth, K. R., Griffin, I., Oduyebo, T., Sancken, C. L., Olsen, E. O., Aveni, K., Wingate, H., Shephard, H., Fussman, C., Alaali, Z. S., Silcox, K., Siebman, S., Halai, U.-A., Lopez, C. D., Lush, M., Sokale, A., Barton, J., … Gilboa, S. M. (2021). Risk factors for illness severity among pregnant women with confirmed SARS-CoV-2 infection – Surveillance for Emerging Threats to Mothers and Babies Network, 22 state, local, and territorial health departments, March 29, 2020 -March 5, 2021. *Clinical Infectious Diseases*, *73*(Supplement 1), S17–S23. https://doi.org/10.1093/cid/ciab432

Hermine, O., Mariette, X., Tharaux, P.-L., Resche-Rigon, M., Steg, P. G., Porcher, R., & Ravaud, P. (2021). Effect of Tocilizumab vs Usual Care in Adults Hospitalized With COVID-19 and Moderate or Severe Pneumonia. *JAMA Internal Medicine*, *181*(9), 1241.

Isaac, B., Hazari, K., Harb, D. K., Mallick, A. K., Abdelkareem, W., Ammar, A., Gergawi, T., Zahmi, E. S. A., & Khamis, A. H. (2023). Maternal and Fetal Outcome in Pregnant Women With Critical COVID-19 Treated With Tocilizumab in a Tertiary Care Hospital in Dubai. *Cureus*, *15*(1), e34395. https://doi.org/10.7759/cureus.34395

Jorgensen, S. C. J., & Lapinsky, S. E. (2022). Tocilizumab for coronavirus disease 2019 in pregnancy and lactation: a narrative review. *Clinical Microbiology and Infection*, *28*(1), 51–57. https://doi.org/10.1016/j.cmi.2021.08.016

Mehta, P., McAuley, D. F., Brown, M., Sanchez, E., Tattersall, R. S., & Manson, J. J. (2020). COVID-19: consider cytokine storm syndromes and immunosuppression. *The Lancet*, *395*(10229), 1033–1034. https://doi.org/10.1016/s0140-6736(20)30628-0

Rasmussen, S. A., Smulian, J. C., Lednicky, J. A., Wen, T. S., & Jamieson, D. J. (2020). Coronavirus Disease 2019 (COVID-19) and Pregnancy: What Obstetricians Need to Know. *Obstetric Anesthesia Digest*, *40*(4), 173–173. https://doi.org/10.1097/01.aoa.0000719440.84472.52

Salama, C., Han, J., Yau, L., Reiss, W. G., Kramer, B., Neidhart, J. D., Criner, G. J., Kaplan-Lewis, E., Baden, R., Pandit, L., Cameron, M. L., Garcia-Diaz, J., Chávez, V., Mekebeb-Reuter, M., Lima de Menezes, F., Shah, R., González-Lara, M. F., Assman, B., Freedman, J., & Mohan, S. V. (2021). Tocilizumab in Patients Hospitalized with Covid-19 Pneumonia. *New England Journal of Medicine*, *384*(1), 20–30. https://doi.org/10.1056/nejmoa2030340

Salvarani, C., Dolci, G., Massari, M., Merlo, D. F., Cavuto, S., Savoldi, L., Bruzzi, P., Boni, F., Braglia, L., Turrà, C., Ballerini, P. F., Sciascia, R., Zammarchi, L., Para, O., Scotton, P. G., Inojosa, W. O., Ravagnani, V., Salerno, N. D., Sainaghi, P. P., … Costantini, M. (2021). Effect of Tocilizumab vs Standard Care on Clinical Worsening in Patients Hospitalized With COVID-19 Pneumonia. *JAMA Internal Medicine*, *181*(1), 24. https://doi.org/10.1001/jamainternmed.2020.6615

The REMAP-CAP Investigators. (2021). Interleukin-6 Receptor Antagonists in Critically Ill Patients with Covid-19. *New England Journal of Medicine*, *384*(16), 1491–1502. https://doi.org/10.1056/nejmoa2100433

Xu, X., Han, M., Li, T., Sun, W., Wang, D., Fu, B., Zhou, Y., Zheng, X., Yang, Y., Li, X., Zhang, X., Pan, A., & Wei, H. (2020). Effective treatment of severe COVID-19 patients with tocilizumab. *Proceedings of the National Academy of Sciences*, *117*(20), 10970–10975. https://doi.org/10.1073/pnas.2005615117