Laboratory Abnormalities in Pregnant Women with Novel Coronavirus Disease 2019

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Novel coronavirus disease 2019 (COVID-19), sustained by the causative agent called severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), is highly contagious.1,2 At present, above 2 million confirmed cases and over 170,000 deaths of COVID-19 have occurred in the world according to the World Health Organization.3 Pregnant women, because of their special physiological conditions, are susceptible to the virus and put themselves at greater risk.4 Timely control and treatment of pregnant women with COVID-19 infection are a major concern.5 Moreover, laboratory medicine plays a vital role in this process.6 Therefore, the purpose of this article is to identify the most common laboratory abnormalities in pregnant women with COVID-19.

PubMed, Chinese National Knowledge Infrastructure (CNKI), and Wanfang databases were reviewed by two independent authors, using the keywords “coronavirus” OR “Wuhan coronavirus” OR “SARS-CoV-2” OR “2019 novel coronavirus” OR “2019-ncov” OR “COVID-19” AND “pregnancy” OR “pregnant woman” OR “pregnant women” OR “vertical transmission” (up to April 20, 2020). There were no country, race, or language restrictions. We included articles reporting laboratory data in pregnant women with confirmed COVID-19 by reading titles, abstracts, and full texts. Besides, the lists of references for all articles were also screened to identify potentially additional articles. A descriptive statistical analysis was applied to summarize their findings. A random-effects model meta-analysis was then carried out to calculate the pooled prevalence and 95% confidence interval (95% CI) to assess the prevalence of laboratory abnormalities in pregnant women with COVID-19. Double arcsine method was implemented to make original data conform to normal distribution, and then we analyzed them in software Stata version 11.2 to obtain initial results. Final results were restored by the formula (\(P = \sin^2(\frac{t}{2})\)).7 Begg’s test and Egger’s test were utilized to evaluate publication bias.

A total of 244 articles were reviewed, among which 223 were removed due to a lack of laboratory data about pregnant women. Although eight articles reported laboratory data in pregnant women with COVID-19, they were eliminated because of duplicated data. In addition, two articles that did not clearly report laboratory abnormalities were also excluded. Overall, a total of 11 articles with 173 pregnant patients were included,8–18 among which 11 women had severe disease, and 2 women had critical disease. Most of the patients came from China, and one each came from Korea, the United States, Sweden, Iran, Peru, and Canada. The stages of pregnancy ranged from the first trimester to the third trimester. The characteristics of these patients are indicated in Table 1.

Four articles were included in the meta-analysis.9,10,15,16 Our results indicated that among all laboratory parameters of pregnant women with COVID-19, the incidence of elevated D-dimer was 82% (95% CI: 75–89%), elevated neutrophil count was 81% (95% CI: 69–91%), elevated C-reactive protein was 69% (95% CI: 58–79%), and decreased lymphocyte count was 59% (95% CI: 41–75%). Begg’s test and Egger’s test showed that no publication bias existed (Table 2). No other laboratory parameters showed apparently consistent changes due to the limitation of available data.

Considering the relatively high-sequence identity of SARS-CoV-2 and SARS-CoV and the effects of SARS-CoV on pregnant women, we must pay great attention to the group of pregnant women infected with COVID-19.19,20 Our review suggests that the most frequent abnormalities are elevated D-dimer (82%), elevated neutrophil count (81%), elevated C-reactive protein (69%), and decreased lymphocyte count (59%). However, a meta-analysis of adult COVID-19 infection reported that...
### Table 1 Characteristics of the included studies

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Wang et al(^7)</th>
<th>Li et al(^{14})</th>
<th>Lee et al(^{13})</th>
<th>Iqbal et al(^{12})</th>
<th>Gidlöf et al(^{11})</th>
<th>Zamanian et al(^{18})</th>
<th>Alzamora et al(^8)</th>
<th>Vlachodimitropoulou Koumoutsea et al(^{16})</th>
<th>Chen et al(^{10})</th>
<th>Liu et al(^{15})</th>
<th>Chen et al(^9)</th>
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<tbody>
<tr>
<td><strong>Location</strong></td>
<td>China</td>
<td>China</td>
<td>Korea</td>
<td>USA</td>
<td>Sweden</td>
<td>Iran</td>
<td>Peru</td>
<td>Canada</td>
<td>China</td>
<td>China</td>
<td>China</td>
</tr>
<tr>
<td><strong>Number of cases</strong></td>
<td>1 (severe)</td>
<td>1</td>
<td>1</td>
<td>1 (critical)</td>
<td>1 (severe)</td>
<td>2</td>
<td>5</td>
<td>41</td>
<td>118 (9 severe and 1 critical)</td>
<td>29 (median)</td>
<td>30 (median)</td>
</tr>
<tr>
<td><strong>Age (y)</strong></td>
<td>28</td>
<td>30</td>
<td>28</td>
<td>34</td>
<td>34</td>
<td>22</td>
<td>41</td>
<td>40/23</td>
<td>29 (median)</td>
<td>30 (median)</td>
<td>31 (median)</td>
</tr>
<tr>
<td><strong>Gestational age (wk)</strong></td>
<td>30</td>
<td>35</td>
<td>37</td>
<td>39</td>
<td>36</td>
<td>32</td>
<td>33</td>
<td>35/35</td>
<td>38–41</td>
<td>22–40</td>
<td>N/R</td>
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<tr>
<td><strong>Laboratory data</strong></td>
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<tr>
<td><strong>Leukocytes</strong></td>
<td>↓ 100%</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>↓ 100%</td>
<td>N/R</td>
<td>↓ 100%</td>
<td>N/R</td>
<td>↓ 100%</td>
<td>N/R</td>
<td>N/R</td>
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<tr>
<td><strong>Neutrophils</strong></td>
<td>↑ 100%</td>
<td>↑ 100%</td>
<td>N/R</td>
<td>N/R</td>
<td>↑ 100%</td>
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<td>↑ 100%</td>
<td>N/R</td>
<td>↑ 100%</td>
<td>N/R</td>
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<tr>
<td><strong>Lymphocytes</strong></td>
<td>↓ 100%</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>↓ 100%</td>
<td>N/R</td>
<td>↓ 100%</td>
<td>N/R</td>
<td>↓ 100%</td>
<td>N/R</td>
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<tr>
<td><strong>CRP</strong></td>
<td>↑ 100%</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>↓ 100%</td>
<td>N/R</td>
<td>↑ 100%</td>
<td>N/R</td>
<td>↑ 100%</td>
<td>N/R</td>
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<tr>
<td><strong>Platelets</strong></td>
<td>N/R</td>
<td>↓ 100%</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
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<tr>
<td><strong>Hemoglobin</strong></td>
<td>N/R</td>
<td>↓ 100%</td>
<td>N/R</td>
<td>N/R</td>
<td>↓ 100%</td>
<td>N/R</td>
<td>↓ 100%</td>
<td>N/R</td>
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<tr>
<td><strong>Procalcitonin</strong></td>
<td>↓ 100%</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
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<tr>
<td><strong>ESR</strong></td>
<td>N/R</td>
<td>N/R</td>
<td>↑ 100%</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
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<tr>
<td><strong>Albumin</strong></td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
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<tr>
<td><strong>ALT</strong></td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
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<tr>
<td><strong>AST</strong></td>
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<td><strong>ALP</strong></td>
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<tr>
<td><strong>Bilirubin</strong></td>
<td>N/R</td>
<td>N/R</td>
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<tr>
<td><strong>Creatinine</strong></td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
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<tr>
<td><strong>Creatine kinase</strong></td>
<td>N/R</td>
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<td>N/R</td>
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<tr>
<td><strong>LDH</strong></td>
<td>↑ 100%</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
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<td>N/R</td>
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</tr>
<tr>
<td><strong>D-dimer</strong></td>
<td>↑ 100%</td>
<td>↑ 100%</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>↑ 100%</td>
<td>N/R</td>
<td>N/R</td>
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<tr>
<td><strong>PT</strong></td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
<td>N/R</td>
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<td>N/R</td>
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</tr>
</tbody>
</table>

**Abbreviations:** ALP, alkaline phosphatase; ALT, alanine transaminase; AST, aspartate transaminase; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; LDH, lactate dehydrogenase; N/R, not (clearly) reported; PT, prothrombin time.

\(^a\) Data missing for patients; \(\sim\) Data within the normal reference range.

Note: Laboratory data are presented as percent of patients with abnormalities defined by local reference ranges.
decreased albumin (75.8%), high C-reactive protein (58.3%),
high lactate dehydrogenase (LDH; 57.0%), lymphopenia (43.1%),
and high erythrocyte sedimentation rate (ESR; 41.8%) were the most prevalent laboratory abnormalities.21
Our study found that the incidence of increased LDH in
pregnant women with COVID-19 was only 29%. A total of
seven cases reported by Wang et al.,17 Iqbal et al.,12
and Chen et al10 showed decreased albumin levels. Similarly, only Lee
et al13 described that ESR increased in the pregnant woman
with COVID-19. Due to the limitation of the data, we did not
further conduct a meta-analysis on these laboratory param-
eters. Thus, more studies with large sample size are needed
to discuss this in the future. In addition, Zhang et al.,22 reported
that among five pregnant women with SARS-CoV infection,
two cases had decreased lymphocytes. Recent studies also
reported elevated D-dimer levels, elevated neutrophil count,
elevated C-reactive protein levels, and decreased lymphocyte
count as indicators of poor outcomes in nonpregnant individ-
uals with COVID-19.23 We should pay careful attention to these
laboratory indicators of pregnant women with COVID-19.
However, D-dimer was typically elevated during pregnancy,24
and a comparative cross-sectional study revealed that preg-
nant women had significantly higher white blood cell count,
neutrophil count, and lymphocyte count compared with non-
pregnant women.25 Therefore, pregnancy factors should also
be considered when dynamically monitoring changes of labo-
ratory indicators in pregnant women with COVID-19.

Of course, our review has some limitations. We included
only 11 articles, including case reports and case series, and
most of them were from China. Again, reference ranges for
laboratory values differed between reports and several data
elements were not clearly reported. In addition, most of the
pregnant women with COVID-19 included in our review
were mild and moderate, with only 11 cases being severe
and 2 cases being critical. We were unable to compare
laboratory abnormalities between pregnant women with
mild and severe. So, more data from other regions are
needed to better define laboratory abnormalities in preg-
nant women with COVID-19 infection. In our meta-analysis,