Existence of SARS-Cov-2 in the Peritoneal Fluid

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Abstract

Objective  To determine the existence of SARS-CoV-2 in the peritoneal fluid to assess the risk of exposure through surgical smoke and aerosolization threatening healthcare workers during abdominal surgery.

Background  SARS-CoV-2 is a respiratory virus and possible ways of viral transmission are respiratory droplets, close contact, and fecal-oral route. Surgeries pose risk for healthcare workers due to the close contact with patients. Aerosolized particles may be inhaled via the leaked CO₂ during laparoscopic procedures and surgical smoke produced by electrocautery.

Methods  All the data of 8 patients, who were tested positive for COVID–19, were collected between August 31, 2020 and April 30, 2021. Recorded clinicopathologic data included age, symptoms, radiological and laboratory findings, antiviral treatment before surgery, type of surgery and existence of the virus in the peritoneal fluid. Nasopharyngeal swab RT-PCR was used for the diagnosis. COVID–19 existence in the peritoneal fluid was determined by RT-PCR test as well.

Results  All 8 COVID–19 positive patients were pregnant, and surgeries were cesarean sections. 1 of the 8 patients was febrile during surgery. Also only 1 patient had pulmonary radiological findings specifically indicating COVID-19 infection. Laboratory findings were as follows: 4 of 8 had lymphopenia and all had elevated D-dimer levels. Peritoneal and amniotic fluid samples of all patients were negative for SARS-CoV-2.

Conclusion  SARS-CoV-2 exposure due to aerosolization or surgical fumes does not seem to be likely, provided the necessary precautions are taken.
Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) outbreak was declared as a pandemic by the World Health Organization (WHO) on January 30, 2020. The disease initially appeared in China and spread to many other countries rapidly. Human to human transmission was demonstrated shortly after the outbreak and the virus infected millions of people around the world in the following months. Early reports showed the mortality rate as 2.3% in China while as 1.6 in other countries.

SARS-CoV-2 is a respiratory virus and possible ways of viral transmission are respiratory droplets, close contact, and fecal-oral route. Operating rooms (OR) are among risky places in situations like viral outbreaks because patients and healthcare workers are often in close contact. National and international surgical guidelines still evolve to protect healthcare workers from the risks posed by their colleagues and patients.

Inhalation of aerosolized particles is considered as a risk factor for transmission of SARS-CoV-2. Surgical smoke due to electrocautery or the leaked CO2 that is used during laparoscopy may be inhaled in the OR. Mintz et al. claimed that laparoscopy should be used if the procedure is more suitable for the patient. They also stated that more evidence-based research is needed to determine the safety of laparoscopy. Viral load of the peritoneal fluid seems to be the main factor that increases the risk of transmission through inhalation of leaked laparoscopic gases and smoke due to electrocautery.

This study was designed to evaluate patients, who were tested positive for COVID-19 and underwent obstetrical surgery, regarding the presence of viral genome in the peritoneal cavity.

Methods

All women, who underwent surgery and had positive COVID-19 test results, at Dokuz Eylul University Hospital Department of Obstetrics and Gynecology between August 31, 2020 and April 30, 2021 were included in the study. The diagnosis was determined with nasopharyngeal RT-PCR. The existence of COVID-19 in the peritoneal fluid was determined by the test of RT-PCR.

Results

Todas as 8 pacientes positivas para COVID-19 estavam grávidas, e as cirurgias eram cesarianas. 1 das 8 pacientes estava com febre durante a cirurgia. Também apenas 1 paciente tinha achados radiológicos pulmonares especificamente indicando infecção por COVID-19. Os achados laboratoriais foram os seguintes: 4 de 8 tinham linfopenia e todas apresentavam níveis elevados de D-dímero. Amostras de fluido peritoneal e líquido amniótico de todas as pacientes foram negativas para SARS-CoV-2.

Conclusion

A exposição ao SARS-CoV-2 devido à aerossolização ou fumaças cirúrgicas não parece ser provável, desde que sejam tomadas as precauções necessárias.

Palavras-chave

► SARS-CoV-2
► fluido peritoneal
► fumaça cirúrgica
► líquido amniótico
► COVID-19

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Nasopharyngeal swab specimens were tested for SARS-CoV-2 at the microbiology laboratory of the same institution. The test was conducted by using virus mini kit (EZ1 Virus Mini Kit v2.0, Germany), followed by RT-PCR according to WHO guidelines.

Birth weight and gestational age at the delivery were recorded. Amniotic fluid samples were collected in addition to peritoneal irrigation fluid for the pregnant patients during the cesarean section (C/S). Peritoneal cavity was irrigated with 10 mL of saline solution and then the irrigation fluid was aspirated for testing. Peritoneal washing aspirate was also used by other researchers. The peritoneal fluid sample was obtained before hysterotomy to prevent contamination. Testing for COVID-19 was performed 24/7 in the institution and therefore specimens were transferred to the laboratory momentarily in sterile vials provided by the laboratory. All biological samples were tested for SARS-CoV-2 with the same kit that was used for the nasopharyngeal specimens followed by RT-PCR according to WHO guidelines.

All analyses were performed by using IBM SPSS Statistics Version 25. Only descriptive statistics were calculated and given. Mean ± standard deviation was used to present the data. This study was performed in consensus with our university’s ethics guidelines. The ethics committee approval was obtained for this study (No:2021/04–41).

### Results

The mean age of patients was 28 ± 2 years. All patients, who underwent surgery when they were tested positive for COVID-19, were pregnant and all surgeries were cesarean sections. 3 of 8 (37.5%) patient were in their first pregnancy. All patients were at term during birth and only one of them was symptomatic while the other 7 were clinically asymptomatic. The symptomatic patient’s body temperature was 39°C during admission. This patient was operated 4 days after the onset of fever. Due to pregnancy, ionizing radiation was avoided and no patient had radiological imaging except obstetrical ultrasonography preoperatively. However, computerized tomography (CT) scanning was performed on one patient after birth (case 6). Ground – glass opacities and patchy lung consolidations were detected in the CT scan. None of the patients received antiviral medication preoperatively (Tables 1 and 2).

Blood samples from all patients were tested within 24 hours before surgery. Complete blood count, serum c – reactive protein (CRP), alanine aminotransferase, aspartate aminotransferase, blood urea nitrogen, creatinine concentrations and plasma d – dimer concentrations were recorded. Lymphopenia was detected in 4 of 8 patients and plasma d – dimer concentration was high in all 8 patients as laboratory findings related with COVID – 19 infection (Table 3).

### Table 1 Characteristics of the patients

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Nasal swab for Covid-19</th>
<th>Age (year)</th>
<th>Parity</th>
<th>Gestational age (week)</th>
<th>Birth Weight (g)</th>
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<td>26</td>
<td>0</td>
<td>39</td>
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<td>+</td>
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<td>0</td>
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<td>+</td>
<td>30</td>
<td>1</td>
<td>37</td>
<td>3400</td>
</tr>
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<td>+</td>
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<td>2</td>
<td>38</td>
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<td>1</td>
<td>39</td>
<td>3217</td>
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<td>27</td>
<td>0</td>
<td>39</td>
<td>3300</td>
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<td>+</td>
<td>27</td>
<td>1</td>
<td>40</td>
<td>2960</td>
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<tr>
<td>Mean ± SD</td>
<td></td>
<td>28 ± 2</td>
<td></td>
<td></td>
<td>3282 ± 191</td>
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</table>

### Table 2 Clinicopathologic data of the patients

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<th>Case No.</th>
<th>Fever</th>
<th>Cough</th>
<th>Dyspnea</th>
<th>Radiological finding</th>
<th>Time between symptoms and delivery (day)</th>
<th>Antiviral treatment before delivery</th>
<th>Covid-19 test in amniotic fluid</th>
<th>Covid-19 test in peritoneal fluid</th>
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</thead>
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<td>1</td>
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</table>
Table 3 Laboratory findings of the patients

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Leukocyte (x10⁹ cells/L)</th>
<th>Lymphocyte (x10⁹ cells/L)</th>
<th>Neutrophile (x10⁹ cells/L)</th>
<th>Platelet (x10⁹ cells/L)</th>
<th>C-reactive protein (mg/L)</th>
<th>Aspartate transaminase (IU/L)</th>
<th>Alanine transaminase (IU/L)</th>
<th>Urea (mmol/L)</th>
<th>Creatinine (µmol/L)</th>
<th>D-dimer (µg/ml)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>9.1</td>
<td>1.1*</td>
<td>7.3*</td>
<td>272</td>
<td>70.4*</td>
<td>45*</td>
<td>44</td>
<td>7</td>
<td>0.6</td>
<td>3.2*</td>
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<tr>
<td>2</td>
<td>15.7*</td>
<td>1.7</td>
<td>12.8*</td>
<td>329</td>
<td>4.7</td>
<td>22</td>
<td>10</td>
<td>6.8</td>
<td>0.52</td>
<td>1.8</td>
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<tr>
<td>3</td>
<td>4.2</td>
<td>1.1*</td>
<td>2.8</td>
<td>144</td>
<td>11.6*</td>
<td>29</td>
<td>12</td>
<td>3.3</td>
<td>0.53</td>
<td>5.9*</td>
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<tr>
<td>4</td>
<td>10.8*</td>
<td>1.8</td>
<td>8.5*</td>
<td>280</td>
<td>18.8*</td>
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<td>10</td>
<td>6.7</td>
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<tr>
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<td>9</td>
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<td>18.4*</td>
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<td>0.36</td>
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<td>8</td>
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<td>5.7</td>
<td>326</td>
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<td>27</td>
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<td>2.4</td>
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<td>63*</td>
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<td>6</td>
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<td>0.36</td>
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<tr>
<td>8</td>
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<td>10.9*</td>
<td>162</td>
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<td>26</td>
<td>9</td>
<td>0.39</td>
<td>0.8*</td>
<td>0.8*</td>
</tr>
<tr>
<td>Median</td>
<td>9 (5.1-13.3)</td>
<td>1.4 (1-1.7)</td>
<td>7.5 (3.5-10.3)</td>
<td>276 (185-321)</td>
<td>18.6 (12.8-59.8)</td>
<td>24 (16.5-28.5)</td>
<td>10 (9-20.2)</td>
<td>6.6 (4.4-6.9)</td>
<td>0.3 (0.3-0.5)</td>
<td>2.8 (1.5-5.4)</td>
</tr>
</tbody>
</table>

Discussion

There is limited data regarding intraoperative aerosolization of SARS-CoV-2 during cesarean section. The average birth weight was 3282 ± 198 g. Cesarean sections were performed in an isolated operating room. There were eleven cases of cesarean section with a maximum diameter of 20-40 nm. Airborne transmission has been acknowledged as a possible way for viral transmission, but further research is needed to understand its role in this context. It is currently unknown whether SARS-CoV-2 can be aerosolized through surgical smoke or laparoscopic gas. The peritoneal cavity of a non-perforated appendicitis patient may be negative for SARS-CoV-2. Further research is needed to understand the aerosolization potential of SARS-CoV-2 in the peritoneal fluid.
electrocautery while operating on COVID-19 positive patients. Surgery of COVID-19 patients should be performed by staff with required PPE and the operating rooms should be managed according to current COVID-19 guidelines. Further studies are needed to investigate the viral presence in the peritoneal fluid to establish more reliable protocols.

Most of the patients were asymptomatic and this may be considered as a limitation, since severe cases concomitantly might have higher viral load and a higher probability of viral presence in the peritoneal fluid. Nevertheless, in the light of our findings, laparoscopic surgery or electrocautery usage should not be avoided due to COVID-19 when indicated and performed under required safety precautions. Our data will contribute to the literature and eventually also help to improve the surgical guidelines for COVID-19 patients.

**Conclusion**

SARS-CoV-2 was not detected in the peritoneal fluids or amniotic fluids of all 8 patients with positive nasopharyngeal test results. Apparently, C/S is not a laparoscopic technique and does not provide an ideal example to assess the risks of laparoscopic surgeries. However, the key point is the virus presence in the peritoneal fluid. Although our study is helpful to understand the risk of aerosolization of SARS-CoV-2 during laparoscopy and electrocautery usage, further studies are needed in the field of surgical safety during the COVID-19 pandemic.

**Contributions**

OI: conception and design, analysis and interpretation of data, statistical analysis MEQ: acquisition of data, drafting of manuscript OA: acquisition of data, technical support BE: analysis and interpretation of data HTT: drafting of the manuscript for important intellectual CP: supervision

**Conflicts to Interest**

The authors have no conflict of interest to declare.

**References**