Topic: COVID-19 and Pregnancy

Date & Time:

Presented by:

Sara Haseli, MD
Assistant Professor of Radiology
Shahid Beheshti University of Medical Sciences
Masih Daneshvari Hospital

Pregnant women may be at increased risk for severe illness from COVID-19 compared with non-pregnant women.
COVID-19 and Pregnancy

Aims and Objectives:

➢ To investigate the computed tomography (CT) characteristics and diagnostic value of novel coronavirus pneumonia (COVID-19) in pregnancy.

➢ Discuss the risk of fetal radiation during pregnancy

➢ Iranian Society of Radiology guidelines, imaging techniques along with optimal protection and safety for pregnant women
Introduction

➢ The risk of severe coronavirus disease 2019 (COVID-19) during pregnancy may be higher than in the general population.

➢ Vertical transmission is plausible, but mechanisms are uncertain. Severe neonatal disease appears to be rare.

➢ Clinicians should have a low threshold for thromboprophylaxis in mothers with COVID-19, and for investigation of possible thromboembolic events.

➢ Clinicians should be mindful of the wider implications of the pandemic and ensure that screening takes place for mental health distress and intimate partner violence whenever possible.
Introduction

Radiation

Radiography

CT scan

MRI

CDC

Cases review

Conclusion

Radiation during pregnancy

➢ Radiation Exposure and Pregnancy: When Should We Be Concerned?

➢ The potential biological effects of in utero radiation exposure of a developing fetus include prenatal death, intrauterine growth restriction, small head size, mental retardation, organ malformation, and childhood cancer.

➢ The risk of each effect depends on the gestational age at the time of exposure, fetal cellular repair mechanisms, and the absorbed radiation dose level.

➢ A comparison between the dose levels associated with each of these risks and the estimated fetal doses from typical radiologic examinations lends support to the conclusion that fetal risks are minimal and, therefore, that radiologic and nuclear medicine examinations that may provide significant diagnostic information should not be withheld from pregnant women.
Introduction

Radiation

Radiography

CT scan

MRI

CDC

Cases review

Conclusion

Radiation during pregnancy

➢ The imaging of pregnant women presents a **unique challenge** to radiologists because of the concern about the radiation risk to the conceptus (ie, embryo or fetus)

➢ Data regarding the potential biological effects on the conceptus after in utero radiation exposure are based on the results of animal studies and human exposures

➢ The primary sources of human data are studies of the **1945 atomic bomb survivors** from Hiroshima and Nagasaki

➢ The potential effects of radiation on a conceptus include **prenatal death**, **intrauterine growth restriction**, **small head size**, **severe mental retardation**, **reduced intelligence quotient**, **organ malformation**, and **childhood cancer**
## Radiation during pregnancy

<table>
<thead>
<tr>
<th>Examination</th>
<th>Typical Conceptus Dose (mGy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical spine (AP, lat)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Extremities</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Chest (PA, lat)</td>
<td>0.002</td>
</tr>
<tr>
<td>Thoracic spine (AP, lat)</td>
<td>0.003</td>
</tr>
<tr>
<td>Abdomen (AP)</td>
<td></td>
</tr>
<tr>
<td>21-cm patient thickness</td>
<td>1</td>
</tr>
<tr>
<td>33-cm patient thickness</td>
<td>3</td>
</tr>
<tr>
<td>Lumbar spine (AP, lat)</td>
<td>1</td>
</tr>
<tr>
<td>Limited IVP*</td>
<td>6</td>
</tr>
<tr>
<td>Small-bowel study†</td>
<td>7</td>
</tr>
<tr>
<td>Double-contrast barium enema study‡</td>
<td>7</td>
</tr>
</tbody>
</table>
Radiation during pregnancy

<table>
<thead>
<tr>
<th>Examination</th>
<th>Dose Level</th>
<th>Typical Conceptus Dose (mGy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra-abdominal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head CT</td>
<td>Standard</td>
<td>0</td>
</tr>
<tr>
<td>Chest CT</td>
<td>Standard</td>
<td>0.2</td>
</tr>
<tr>
<td>Routine</td>
<td>Standard</td>
<td>0.2</td>
</tr>
<tr>
<td>Pulmonary embolus</td>
<td>Standard</td>
<td>0.2</td>
</tr>
<tr>
<td>CT angiography of coronary arteries</td>
<td>Standard</td>
<td>0.1</td>
</tr>
<tr>
<td>Abdominal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdomen, routine</td>
<td>Standard</td>
<td>4</td>
</tr>
<tr>
<td>Abdomen/pelvis, routine</td>
<td>Standard</td>
<td>25</td>
</tr>
<tr>
<td>CT angiography of aorta (chest through pelvis)</td>
<td>Standard</td>
<td>34</td>
</tr>
<tr>
<td>Abdomen/pelvis, stone protocol*</td>
<td>Reduced</td>
<td>10</td>
</tr>
</tbody>
</table>
## Table 3. Fetal Radiation Doses Associated With Common Radiologic Examinations

<table>
<thead>
<tr>
<th>Type of Examination</th>
<th>Fetal Dose* (mGy)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Very low-dose examinations (&lt;0.1 mGy)</strong></td>
<td></td>
</tr>
<tr>
<td>Cervical spine radiography (anteroposterior and lateral views)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Head or neck CT</td>
<td>0.001–0.01</td>
</tr>
<tr>
<td>Radiography of any extremity</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mammography (two views)</td>
<td>0.001–0.01</td>
</tr>
<tr>
<td>Chest radiography (two views)</td>
<td>0.0005–0.01</td>
</tr>
<tr>
<td><strong>Low- to moderate-dose examinations (0.1–10 mGy)</strong></td>
<td></td>
</tr>
<tr>
<td>Radiography</td>
<td></td>
</tr>
<tr>
<td>Abdominal radiography</td>
<td>0.1–3.0</td>
</tr>
<tr>
<td>Lumbar spine radiography</td>
<td>1.0–10</td>
</tr>
<tr>
<td>Intravenous pyelography</td>
<td>5–10</td>
</tr>
<tr>
<td>Double-contrast barium enema</td>
<td>1.0–20</td>
</tr>
<tr>
<td>CT</td>
<td></td>
</tr>
<tr>
<td>Chest CT or CT pulmonary angiography</td>
<td>0.01–0.66</td>
</tr>
<tr>
<td>Limited CT pelvimetry (single axial section through the femoral heads)</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Nuclear medicine</td>
<td></td>
</tr>
<tr>
<td>Low-dose perfusion scintigraphy</td>
<td>0.1–0.5</td>
</tr>
<tr>
<td>Technetium-99m bone scintigraphy</td>
<td>4–5</td>
</tr>
<tr>
<td>Pulmonary digital subtraction angiography</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Higher-dose examinations (10–50 mGy)</strong></td>
<td></td>
</tr>
<tr>
<td>Abdominal CT</td>
<td>1.3–35</td>
</tr>
<tr>
<td>Pelvic CT</td>
<td>10–50</td>
</tr>
<tr>
<td>$^{18}$F PET/CT whole-body scintigraphy</td>
<td>10–50</td>
</tr>
</tbody>
</table>
### Radiation during pregnancy

<table>
<thead>
<tr>
<th>Measure</th>
<th>Definition</th>
<th>Legacy Unit</th>
<th>SI* Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure</td>
<td>Number of ions produced by X-ray or gamma radiation per kilogram of air</td>
<td>Roentgen (R)</td>
<td>$2.58 \times 10^{-4} \text{ C/kg}$</td>
</tr>
<tr>
<td>Dose</td>
<td>Amount of energy deposited per kilogram of tissue</td>
<td>Rad (rad)$^1$</td>
<td>Gray (Gy)$^1$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$1,000 \text{ mGy} = 1 \text{ Gy}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$1 \text{ Gy} = 100 \text{ rad}$</td>
</tr>
<tr>
<td>Relative effective dose</td>
<td>Amount of energy deposited per kilogram of tissue normalized for biological effectiveness</td>
<td>Roentgen equivalent man (rem)</td>
<td>sievert (Sv)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$1,000 \text{ mSv} = 1 \text{ Sv}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$1 \text{ Sv} = 100 \text{ rem}$</td>
</tr>
</tbody>
</table>

$^*$International System of Units (SI) – these are preferred.

$^1$For diagnostic X-rays, 1 rad = 1 rem, 1 Gy = 1 Sv.
## Radiation during pregnancy

<table>
<thead>
<tr>
<th>Radiation Dose Unit</th>
<th>Conversion Unit</th>
<th>Conversion Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.001 rem</td>
<td>1 mrem</td>
<td>0.01 mSv</td>
</tr>
<tr>
<td>0.01 rem</td>
<td>10 mrem</td>
<td>0.1 mSv</td>
</tr>
<tr>
<td>0.1 rem</td>
<td>100 mrem</td>
<td>1 mSv</td>
</tr>
<tr>
<td>1 rem</td>
<td>1,000 mrem</td>
<td>10 mSv</td>
</tr>
<tr>
<td>10 rem</td>
<td></td>
<td>0.1 Sv</td>
</tr>
<tr>
<td>100 rem</td>
<td></td>
<td>1,000 mSv</td>
</tr>
<tr>
<td>1,000 rem</td>
<td></td>
<td>10 Sv</td>
</tr>
<tr>
<td>0.001 rad</td>
<td>1 mrad</td>
<td>0.01 mGy</td>
</tr>
<tr>
<td>0.01 rad</td>
<td>10 mrad</td>
<td>0.1 mGy</td>
</tr>
<tr>
<td>0.1 rad</td>
<td>100 mrad</td>
<td>1 mGy</td>
</tr>
<tr>
<td>1 rad</td>
<td>1,000 mrad</td>
<td>10 mGy</td>
</tr>
<tr>
<td>10 rad</td>
<td></td>
<td>0.1 Gy</td>
</tr>
<tr>
<td>100 rad</td>
<td></td>
<td>1,000 mGy</td>
</tr>
<tr>
<td>1,000 rad</td>
<td></td>
<td>10 Gy</td>
</tr>
</tbody>
</table>
Radiation during pregnancy

- If the uterus is positioned outside the field of view, the conceptus is exposed to scattered radiation only and the conceptus dose is minimal.
- Higher conceptus dose values occur when the uterus is positioned within the field of view.
- In this case, the radiation dose to a conceptus from a radiographic or fluoroscopic examination depends on the thickness of the patient (i.e., the amount of tissue the x-ray beam must penetrate), the direction of the projection (anteroposterior, posteroanterior, or lateral), the depth of the conceptus from the skin surface, and x-ray technique factors.
- These values can be compared with the dose to the conceptus from naturally occurring background radiation of approximately 0.5–1 mSv for the entire period of gestation.
Radiation during pregnancy

- Depending on the position of the conceptus within the mother, it may be possible to use a lead shield to protect the uterus from external scattered radiation (scatter emanating from the exposed tissue or imaging equipment) if the area of interest is outside the uterus.

- Because the dose from external scattered radiation is minimal, the use of lead shielding is left to the discretion of the practitioner.

- Lead shielding may be an unnecessary precaution, it may offer the patient a sense of protection and reassurance.
## Radiation during pregnancy

<table>
<thead>
<tr>
<th>Gestational age</th>
<th>Radiation dose</th>
<th>Adverse biological effects</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2 weeks post conception†</td>
<td>&lt;50 mGy</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>&gt;50-100 mGy</td>
<td></td>
<td>Possible spontaneous abortion</td>
<td>None</td>
</tr>
<tr>
<td>2-15 weeks post conception†</td>
<td>&lt;50 mGy</td>
<td>Minimal risk</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Childhood cancer (childhood cancer death 0.06% per 10 mGy)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Absolute cancer risk (0.4 % per 10 mGy)</td>
<td></td>
</tr>
<tr>
<td>50-150 mGy</td>
<td></td>
<td>Small head size (0.5-1% per 10 mGy)</td>
<td>Generally, therapeutic abortion is not recommended. However, it may be considered with exposures &gt; 100 mGy in the setting of other risk factors, such as acute viral infection or exposure to teratogenic drugs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mental retardation (0.4% per 10 mGy)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Childhood cancer (childhood cancer death 0.06% per 10 mGy)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Absolute cancer risk (0.4 % per 10 mGy)</td>
<td></td>
</tr>
<tr>
<td>&gt; 150 mGy</td>
<td></td>
<td>Small head size (15% risk)</td>
<td>Counsel mother about possible therapeutic abortion.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mental retardation (6% risk)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Childhood cancer (childhood cancer death 0.06% per 10 mGy)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Absolute cancer risk (0.4 % per 10 mGy)</td>
<td></td>
</tr>
<tr>
<td>&gt; 15 weeks post conception</td>
<td>Any</td>
<td>Childhood cancer (childhood cancer death 0.06% per 10 mGy)</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Absolute cancer risk (0.4 % per 10 mGy)</td>
<td></td>
</tr>
</tbody>
</table>
Computed Tomography

➢ Computed tomography (CT) is associated with higher levels of radiation exposure than is radiography.

➢ At CT, the dose to the individual conceptus varies with the proximity of the uterus to the anatomic location of the scan plane, the thickness of the patient, the depth of the conceptus, and x-ray technique factors.

➢ CT projection radiography delivers a minimal radiation dose to the conceptus, and the benefits of its use (e.g., accurate localization of the CT scan) outweigh the small radiation risk.

➢ At CT, lead shielding of the abdomen and pelvis may be used if it will not interfere with the scan field, although the dose from external scattered radiation is minimal.
COVID-19 and Pregnancy

Introduction

Radiation

Radiography

CT scan

MRI

CDC

Cases review

Conclusion

Guide lines

➢ Several well-recognized published documents provide guidance regarding the radiologic imaging of pregnant women

➢ In 1977, the National Council on Radiation Protection and Measurements (6) issued the following statement: “The risk [of abnormality] is considered to be negligible at 50 mGy or less when compared to other risks of pregnancy, and the risk of malformations is significantly increased above control levels only at doses above 150 mGy. Therefore, exposure of the fetus to radiation arising from diagnostic procedures would very rarely be cause, by itself, for terminating a pregnancy.”
COVID-19 and Pregnancy

Introduction

Radiation

Radiography

CT scan

MRI

CDC

Cases review

Conclusion

Guide lines

➢ Fetal doses below 100 mGy should not be considered a reason for terminating a pregnancy

➢ Women should be counseled that x-ray exposure from a single diagnostic procedure does not result in harmful fetal effects. Specifically, exposure to less than 5 rad [50 mGy] has not been associated with an increase in fetal anomalies or pregnancy loss

➢ The American College of Radiology established the following as its policy concerning the use of therapeutic abortion: “The interruption of pregnancy is rarely justified because of radiation risk to the embryo or fetus from a radiologic examination.”

CDC

The American College of Radiology established the following as its policy concerning the use of therapeutic abortion: “The interruption of pregnancy is rarely justified because of radiation risk to the embryo or fetus from a radiologic examination.”
Ultrasonography

➢ The safest imaging test in pregnancy is ultrasound. (US) is recommended as the initial diagnostic imaging evaluation in pregnant women.

➢ If no abnormality is found at this initial US examination, then a repeat US examination should be performed 24 hours later.

➢ According to our calculations, the fetal radiation dose from CT (approximately 10 mGy) is lower than that from limited IVP for a patient with an anteroposterior thickness of 25 cm or greater.
CT angiography

➢ Winer-Muram and colleagues calculated the conceptus dose from chest CT for pulmonary embolus and found that it was less than that from nuclear medicine ventilation-perfusion scanning for all three trimesters.

➢ These data are consistent with our own and with CT pulmonary angiography other published data in which the fetal absorbed doses at were reported to be less than or similar to those incurred at ventilation-perfusion scanning.

➢ CT pulmonary angiography has a sensitivity of approximately 86%, a specificity of 94%, and a greater discriminatory power than ventilation-perfusion scanning at normal or near normal probability thresholds.
Introduction

Radiation
Radiography
CT scan
MRI
CDC

Cases review

Conclusion

CT angiography for emboli

➢ Its use for pulmonary embolus evaluation also has been documented in pregnant women, and 31% of investigators in the Prospective Investigation of Pulmonary Embolism Diagnosis study (PIOPED II) recommended it in that clinical situation.

➢ Therefore, chest CT is an appropriate secondary imaging modality for achieving a definitive diagnosis of pulmonary embolism when lower-extremity US is insufficient.

➢ Intravenous iodinated contrast is a Food and Drug Administration (FDA) class B agent. Very little iodinated contrast crosses the placenta and enters the fetal circulation. Thyroid dysfunction in the newborn has not been observed when iodinated contrast has been administered to the pregnant mother intravenously.

➢ As with all drugs in pregnancy, intravenous iodinated contrast should be administered only if necessary and after informed consent has been obtained.
In conclusion, in pregnant women with a normal chest radiograph, a perfusion scan may be the preferred imaging test to diagnose acute PE. In pregnant women with an abnormal chest radiograph, a CTPA may be the preferred imaging test to diagnose acute PE.

For CTPA in pregnancy, the radiologist should utilize bismuth shields (if appropriate for your particular scanner) and automated exposure controls to minimize the absorbed radiation dose to the breasts and breathing strategies to limit the number of inadequate studies.
The conceptus dose from common radiographic, fluoroscopic, CT, and nuclear medicine examinations is considerably lower than the established risk threshold of 50–100 mGy.

Notably, imaging examinations of the head, neck, chest, and peripheral extremities are associated with negligible risks to the conceptus.

In imaging of the abdomen or pelvis, US is preferred as the initial examination because it presents no risk from ionizing radiation to the conceptus.
MR imaging is emerging as an alternative for further evaluation of patients with indeterminate findings at US of the abdomen or pelvis, but access to MR imaging is limited in many practices.

The conceptus dose from a single acquisition CT examination of the abdomen and pelvis poses a minimal risk to fetal health, CT of the abdomen, the pelvis, or both is appropriate when imaging examinations based on the use of nonionizing radiation fail to yield the necessary clinical information, or in the setting of maternal trauma.

Magnetic resonance imaging (MRI) at 1.5 Tesla or less is safe in all trimesters of pregnancy. The safety of MRI at 3.0 T has not been proved and pregnant patients should be imaged at 1.5 T or less.

Intravenous gadolinium for MRI is an FDA class C agent and should not be given in pregnancy. It crosses the placenta into the fetal circulation and circulates indefinitely. Although no adverse effects have been observed in humans, animal studies have shown congenital anomalies in animal offspring exposed in utero.
Radiographic, fluoroscopic, and CT examinations in areas of the body other than the abdomen and pelvis deliver minimal radiation doses to the fetus. Moreover, fetal radiation doses from radiographic, fluoroscopic, and CT examinations of the abdomen and pelvis and from nuclear medicine studies rarely exceed 25 mGy. After comparing the doses from radiologic and nuclear medicine examinations with risk data from human in utero exposures, we have concluded that the absolute risks of fetal effects, including childhood cancer induction, are small at conceptus doses of 100 mGy and negligible at doses of less than 50
American College of Obstetricians and Gynecologist’s consensus:

Ultrasonography and magnetic resonance imaging (MRI) are not associated with risk and are the imaging techniques of choice for the pregnant patient, but they should be used prudently and only when use is expected to answer a relevant clinical question or otherwise provide medical benefit to the patient.

With few exceptions, radiation exposure through radiography, computed tomography (CT) scan, or nuclear medicine imaging techniques is at a dose much lower than the exposure associated with fetal harm. If these techniques are necessary in addition to ultrasonography or MRI or are more readily available for the diagnosis in question, they should not be withheld from a pregnant patient.

The use of gadolinium contrast with MRI should be limited; it may be used as a contrast agent in a pregnant woman only if it significantly improves diagnostic performance and is expected to improve fetal or maternal outcome.

Breastfeeding should not be interrupted after gadolinium administration.
Introduction

Radiation
Radiography
CT scan
MRI
CDC

Cases review

Conclusion

COVID-19 and Pregnancy

Proposed Imaging Guidelines for Pregnant Women Suspected of Having COVID-19

➢ The maximum permitted dose of radiation exposure is below 50 mGy in pregnant women. The absorbed dose of radiation for a fetus whose mother undergoes chest x-ray and chest CT scan are 0.002 mGy and 0.2 mGy respectively, which are not associated with known adverse effects on fetal health and thus are safe.

➢ Chest x-ray or CT scan requests must be based on thorough examination, in case of investigating differential diagnoses of respiratory problems during the COVID-19 pandemic, along with other conditions like pulmonary edema etc. or appraisement of COVID-19 pulmonary infection in case of clinical indications.

➢ The patient must be well informed of the necessity, benefits and possible risks of the imaging procedures (chest radiography or CT scan), by the attending physician.

➢ The patient must be well informed of the necessity, benefits and possible risks of the imaging procedures (chest radiography or CT scan), by the attending physician.
**Proposed Imaging Guidelines for Pregnant Women Suspected of Having COVID-19**

- To minimize the dose of exposure, the *minimum possible dose* for radiography must be utilized and CT scans must be carried out in accordance with the *low dose CT protocol*.

- When chest CTs and chest x-rays are indicated, *local protection for the fetus* (abdominal lead shields) must be utilized.

- **Standard personal protection equipment** for the corona virus like masks, gloves, gowns, goggles, and disinfectants must be available for the patients, the accompanying people and all other personnel who are involved in the procedure, in accordance with the relevant protection protocols.

- During the *first trimester of pregnancy*, the decision to proceed with chest x-ray or CT scan must be made with meticulous consideration of the risks involved. It is advisable to *initially perform chest x-ray with abdominal shield* and then proceed to CT only if the chest X-ray turns out to be inconclusive. During the *2nd and 3rd trimesters*, *low dose CT* may be requested in the first stage.
Introduction

During pregnancy, the mother’s body undergoes a variety of changes, which include changes in anatomy, bodily functions, and immune status; thus resulting in an immunosuppressive state.

Cases review

It is known that 2019-nCoV can infect pregnant women; such women are more susceptible to COVID-19, and the disease can cause potential maternal and fetal complications.

Conclusion

COVID-19 in pregnancy is often found to be associated with pleural effusion.
COVID-19 and Pregnancy

Introduction

Radiation
Radiography
CT scan
MRI
CDC

Cases review
Conclusion

CT characteristics and diagnostic value of COVID-19 in pregnancy

➢ 60% of patients had small bilateral pleural effusion, which indicated that pleural effusion is rare in COVID-19

➢ Pleural effusion may be associated with either COVID-19 or pregnancy status

➢ Decrease in plasma colloid osmotic pressure due to slight hypoproteinemia

➢ It plays an important role in early detection, early reporting, monitoring dynamic changes, and detection of complications.
Atypical clinical findings of pregnant women with COVID-19 could increase the difficulty in initial identification.

Consolidation was more common in the pregnant groups.

The clinically-diagnosed cases were vulnerable to more pulmonary involvement.

CT was the modality of choice for early detection, severity assessment, and timely therapeutic effects evaluation for the cases with epidemic and clinical features of COVID-19 with or without laboratory confirmation.
COVID-19 and Pregnancy

CT characteristics and diagnostic value of COVID-19 in pregnancy

Introduction

Radiation
Radiography
CT scan
MRI
CDC

Cases review

Conclusion

➢ The common characteristics in the pregnant group included pure GGO, GGO with consolidation or reticulation, and complete consolidation with predominantly peripheral distribution and bilateral lung involvement.

➢ The laboratory-negative cases with typical imaging findings were supposed to receive the same treatment protocol as the positive one.

➢ Pleural effusion was identified in (38%) and (24%) patients in the laboratory-confirmed and clinically-diagnosed pregnant groups.
CT characteristics and diagnostic value of COVID-19 in pregnancy

Fig 1. A 27-year-old female with menopause for 36-37 weeks presented with fever and cough for 2 days. Her husband was diagnosed with COVID-19 three days ago. She was diagnosed with COVID-19. The left upper lobe and the dorsal segment of the right lower lobe showed patchy shadow. Faint density shadows were seen throughout the lungs, displaying a halo sign.
COVID-19 and Pregnancy

Introduction

Radiation
Radiography
CT scan
MRI
CDC

Cases review

Conclusion

CT characteristics and diagnostic value of COVID-19 in pregnancy

Fig 4. A 33-year old female with menopause for 37+2 weeks, was diagnosed with COVID-19. (a) Chest CT at admission. Patchy increased density was seen in the right lower lung, with bronchiectasis, increased small vascular network, and ground glass opacity (GGO) throughout. (b) Same area as 4a after 3 days of treatment. A re-examination showed obvious absorption and thinning density of the lesion, which was replaced by light GGO.
COVID-19 and Pregnancy

Introduction

CT characteristics and diagnostic value of COVID-19 in pregnancy

Radiation

Radiography

CT scan

MRI

CDC

Cases review

Conclusion

Fig 6. A 33-year-old female with menopause for 37+2 weeks presented with abdominal distension and diarrhea for 2 days. She was diagnosed with COVID-19. (a) chest CT at admission showed small flashed-glass shadow in the posterior segment of the upper lobe of the right lung and the lobe of the left tongue. 7 days later. (b) re-examination showed a significant increase in lesions in both the lungs with increased density. It was observed as strip shadow, surrounding ground glass opacity, with interlobular septal thickening.
COVID-19 and Pregnancy

CT characteristics and diagnostic value of COVID-19 in pregnancy

Introduction

Radiation
Radiography
CT scan
MRI
CDC

Cases review

Conclusion
COVID-19 and Pregnancy

Introduction

Radiation
Radiography
CT scan
MRI
CDC

Cases review

Conclusion

CT characteristics and diagnostic value of COVID-19 in pregnancy

 rahnamai shasho va diran peyari kovide-19 dar bar dar

rahnamai shasho va diran peyari kovide-19 dar bar dar
COVID-19 and Pregnancy

Introduction

Radiation

Radiography

CT scan

MRI

CDC

Cases review

Conclusion

Cases review

CDC

Conclusion

Introduction

Radiation

Radiography

CT scan

MRI

CDC
COVID-19 and Pregnancy

Introduction

Radiation

Radiography

CT scan

MRI

CDC

Cases review

Conclusion

بيبجيري مادر بارداري كه از كويدي-19 بهبود یافته است:

در موارد ابتلاي قطعي سونوگرافي جهت بررسی رشد جنين و حجم ماماي امبيع امبيوتیک از نظر احتمال IUGR مقابلي راهنمایي كشوری ارائه خدمات مامايى و زایمان که 14 روز پس از بهبود علائم شروع می شود.

در موارد عفونت سه ماهه اول يا اوايلى سه ماهه دوم، سونوگرافي سلامت جنين يا جزئيات در 28-32 هفته توصیه می شود. انجام NST يا بیوفیزیکال پروفایل بر اساس دستور عمل سلامت مادران انجام شود.
**Low Dose CT Protocol**

### Introduction

- **Radiation**
- **Radiography**
- **CT scan**
- **MRI**
- **CDC**

### Cases review

### Conclusion

**Selected Cannon Scanners**

**Scanogram:** PA and LAT dual Scanogram: scan from top of shoulder through mid-liver.

<table>
<thead>
<tr>
<th>CANON</th>
<th>Aq RXL</th>
<th>Aq Lightning (16 Rows)</th>
<th>Aq Lightning (80 Rows)</th>
<th>Aq Prime (40 Rows)</th>
<th>Aq Prime (80 Rows)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scan Type</strong></td>
<td>Helical</td>
<td>Helical</td>
<td>Helical</td>
<td>Helical</td>
<td>Helical</td>
</tr>
<tr>
<td><strong>Rotation Time (s)</strong></td>
<td>0.5</td>
<td>0.75</td>
<td>0.75</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td><strong>Detector Configuration</strong></td>
<td>16 x 0.5 mm</td>
<td>16 x 1.0 mm</td>
<td>80 x 0.5 (mm)</td>
<td>40 x 0.5 mm</td>
<td>80 x 0.5 mm</td>
</tr>
<tr>
<td><strong>Pitch</strong></td>
<td>Fast (1.434)</td>
<td>Fast (1.439)</td>
<td>Standard (0.913)</td>
<td>Standard (0.825)</td>
<td>Standard (0.813)</td>
</tr>
<tr>
<td><strong>kV</strong></td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td><strong>Minimum &amp; Maximum mA</strong></td>
<td>Min mA = 20 / Max mA = 110</td>
<td>Min mA = 10 / Max mA = 300</td>
<td>Min mA = 10 / Max mA = 300</td>
<td>Min mA = 20 / Max mA = 120</td>
<td>Min mA = 20 / Max mA = 120</td>
</tr>
<tr>
<td><strong>SureExp Setting</strong></td>
<td>Body Std Axial (5 mm Target Slice)</td>
<td>Body Std Axial (5 mm Target Slice)</td>
<td>Body Std Axial (5 mm Target Slice)</td>
<td>Body Std Axial (5 mm Target Slice)</td>
<td>Body Std Axial (5 mm Target Slice)</td>
</tr>
<tr>
<td><strong>SureExposure</strong></td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td><strong>8D</strong></td>
<td>25°</td>
<td>20°</td>
<td>20°</td>
<td>25°</td>
<td>25°</td>
</tr>
<tr>
<td><strong>CTDvol</strong></td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
</tr>
</tbody>
</table>

* Create a new SureExp setting using Body Std Axial SureExp with 5 mm Target Slice and the given 8D, min and max mA values.
* ** For standard sized patient, defined as 5'7", 155 pounds. Do not adjust the 8D as patient size varies. SureExposure modulates mA automatically based on patient size.
## Low Dose CT Protocol

### Cases review

**Scanogram:** PA and LAT dual Scanogram; scan from top of shoulder through mid-liver.

<table>
<thead>
<tr>
<th>CANON</th>
<th>Aq ONE/Premium</th>
<th>Aq ONE Vision</th>
<th>Aq ONE Genesys (160 row)</th>
<th>Aq ONE Genesys (320 row)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scan Type</strong></td>
<td>Helical</td>
<td>Helical</td>
<td>Helical</td>
<td>Helical</td>
</tr>
<tr>
<td><strong>Rotation Time (s)</strong></td>
<td>0.35</td>
<td>0.275</td>
<td>0.35</td>
<td>0.275</td>
</tr>
<tr>
<td><strong>Detector Configuration</strong></td>
<td>80 x 0.5 mm</td>
<td>80 x 0.5 mm</td>
<td>80 x 0.5 mm</td>
<td>80 x 0.5 mm</td>
</tr>
<tr>
<td><strong>Pitch</strong></td>
<td>Standard (0.813)</td>
<td>Standard (0.813)</td>
<td>Standard (0.813)</td>
<td>Standard (0.813)</td>
</tr>
<tr>
<td><strong>kV</strong></td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td><strong>Minimum &amp; Maximum mA</strong></td>
<td>Min mA = 20 / Max mA = 120</td>
<td>Min mA = 20 / Max mA = 150</td>
<td>Min mA = 20 / Max mA = 600</td>
<td>Min mA = 20 / Max mA = 700</td>
</tr>
<tr>
<td><strong>SureIQ Setting</strong></td>
<td>Body Std Axial (5 mm Target Slice)</td>
<td>Body Std Axial (5 mm Target Slice)</td>
<td>Body Std Axial (5 mm Target Slice)</td>
<td>Body Std Axial (5 mm Target Slice)</td>
</tr>
<tr>
<td><strong>Sure Expo Setting</strong></td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>*<strong>SD</strong></td>
<td>25&quot;</td>
<td>25&quot;</td>
<td>20&quot;</td>
<td>20&quot;</td>
</tr>
<tr>
<td><strong>CTD/ctm</strong></td>
<td>1.7</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Create a new SureExp setting using Body Std Axial Sure IQ with 5 mm Target Slice and the given SD, min and max mA values.
* For standard sized patient, defined as 57", 155 pounds. Do not adjust the SD as patient size varies. SureExposure modulates mA automatically based on patient size.
COVID-19 and Pregnancy

Introduction

Radiation

Radiography

CT scan

MRI

CDC

Cases review

Conclusion

* کدام گزینه صحیح نیست؟
الف) پلورال افیوژن در درگیری ریه کوید در بیماران باردار دیده نمی‌شود.
ب) خانم‌های باردار مبتلا به کوید نسبت به جمعیت عادی شانس ابتلا به بیشتری دارند.
ج) میزان پلورال افیوژن در بیماران باردار مبتلا به کوید اندک است.
د) درگیری ریه ناشی از کوید در هر سه تریمستر محتمل است.

* کدام گزینه می‌تواند علت پلورال افیوژن در بیماران باردار مبتلا به کوید با درگیری ریه شود؟
الف) کاهش فشار اسموزی پلاسما
ب) هیپوپروتینمی
ج) تغییرات التهابی در پلورا
د) همه موارد

* کدام گزینه صحیح است؟
الف) نباید از سیتی اسکن ریه در بیماران باردار برای تشخیص کوید استفاده کرد.
ب) سی‌تی‌اسکن به در جریری و بیماران باردار مبتلا به کوید فقط در تریمستر سوم قابل انجام است.
ج) سی‌تی‌اسکن با شرایط خاص فقط در تریمستر دوم قابل انجام است.
د) استفاده از شیلد شکم در هر سه تریمستر برای انجام سی‌تی‌اسکن توصیه می‌گردد.
کدام گزینه صحیح است؟
الف) پترن درگیری ریه در بیماران باردار مبتلا به کوید اختصاصی است
ب) حساسیت سیتی اسکن در تشخیص درگیری ریوی بیماران باردار مبتلا به کوید کم است
ج) میزان کانسالیدیشن در بیماران باردار مبتلا به کوید نسبت به جمعیت عادی بیشتر است
د) کوید ۱۹ می تواند در بارداری تراتوژن باشد

* کدام گزینه صحیح است؟
COVID-19 and Pregnancy

Introduction

Radiation
Radiography
CT scan
MRI
CDC
Cases review
Conclusion

THANK YOU