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**Science Internship Program:**  
**Radiology**

# **Adjuvant Radiotherapy in a Pregnant Patient with Squamous Cell Carcinoma (SCC) of the Tongue: Importance of Fetal Dose Minimization**

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# Abstract

- An analysis report describes a squamous cell carcinoma (SCC) pregnant patient at a high recurrence risk. Adjuvant radiotherapy would optimize overall survival rate. She was treated during the 2<sup>nd</sup> trimester of pregnancy. Treatment modifications and shielding were used to safely deliver treatment and minimize fetal dose.

# Background

- Cancer-pregnancy coexistence is relatively uncommon.
  - 1 out of 1000 pregnant women is diagnosed with a form of cancer.
- Increasing prevalence is shown by:
  - Cohorts from 1973-1997 that demonstrate a 60% increase in tongue cancer patients < age 40
  - A delay in child-bearing to an older age

# Background (cont.)

- Every cancer patient presents a unique situation.
- This case involves:
  - A pregnant female in her early 30s with multifocal tongue tumor
  - Underwent prior tongue resection
  - Postoperative pathology exposed squamous cell carcinoma of the tongue
  - High-risk for disease recurrence at 17-week gestational age

# Background (cont.)

- Developmental effects depend on dose, dose rate, and stage of gestation.
- 2<sup>nd</sup> trimester developmental effects may include
  - microcephaly / growth restriction
  - cancer later in life
  - neurocognitive, neuroendocrine, and neuropsychological disorders
- Dose is recommended to be  $< 10$  cGy.

# Problem/Purpose

- There are concerns as to whether radiation therapy can be administered safely.
  - Fetal radiation exposure may result in congenital disorders.
  - The challenge is to attain the optimal risk-benefit balance.
- Purpose: identify and demonstrate techniques to reduce fetal dose to as low as reasonably achievable.



# Hypothesis

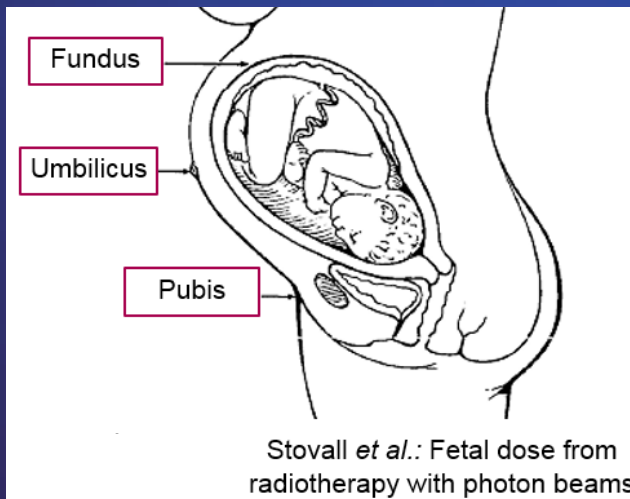
- For a pregnant patient requiring adjuvant radiotherapy to the head and neck, planning and shielding techniques could reduce fetal dose to acceptable levels.

# Methodology

- Demonstrated fetal dose reduction techniques.
- Consulted patient and agreed upon risk.
- Planned 60 Gy in 30 fractions to tongue and neck.
- Radiation to the fetus occurred from radiation machine and radiation deflected within the patient's body.
  - Direct scatter and indirect scatter, respectively.
- Cerrobend shielding reduced the direct scatter.

# Methodology (cont.)

- Patient set-up using phantom
  - 1.5 cm of cerrobend as half-value layer for 6 MV.
  - Doses measured with a thermoluminescent dosimeter.



# Methodology (cont.)

- Planning techniques:
  - Rotated the collimator to maximally block head leakage.
  - Applied constraints to minimize monitoring units required.
  - Used partial arcs to avoid 40° posterior to the patient.
- Maximum fetal dose < 10 cGy

# Data

<u>Phantom Measurements</u>			
<u>Shielding</u>	<u>Location</u>	<u>30 FX Dose (cGy)</u>	<u>Shielding %</u>
UNSHIELDED	8 CM	12.7	
UNSHIELDED	UMBILICUS	6.8	
SHIELDED	8 CM	10.9	14%
SHIELDED	UMBILICUS	3.4	50%

<u>Patient Measurements</u>		
<u>Shielding</u>	<u>Location</u>	<u>30 FX Dose (cGy)</u>
SHIELDED	8 CM Superior of Umbilicus	6.52
SHIELDED	Umbilicus	3.33
SHIELDED	Pubis	1.48

# Results

- Phantom measurements
  - From 8 cm superior: estimated dose  $>10$  cGy and 14% reduction
  - From umbilicus: estimated 50% reduction
- Patient measurements
  - From 8 cm superior: dose  $<10$  cGy and reduced  $\sim 49\%$
  - From umbilicus: reduced  $\sim 51\%$

# Conclusions

- Fetal protection is vital during radiotherapy.
- Radiation exposure to fetus can be reduced by these techniques:
  - Blocking/shielding
  - Avoiding radiation beams where shielding is limited
  - Optimizing the collimator angle and minimizing monitor units
- Clinicians need to recognize all factors and use humanistic approaches.

# Recommendations

- Radiotherapy during pregnancy should not be carried out as a standard treatment.
- Consider:
  - Changing field sizes/angles
  - Estimating doses with and without shielding and documenting fetal doses during procedures
  - Constructing custom shield
  - Staying within safety limits



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# Special Thanks

- Timothy Meier, RT (R), Ellen Stevens, RT (R)
- Salim Balik, PhD, Zi Ouyang, PhD
- Eric Murray, CMD, Shireen Parsai, MD
- Martin Tom, MD, Neil Woody, MD
- Office of Government and Community Relations' Civic Education Department
- Nedra Starling, MA, MPH, DrPH/ABD

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