Low Dose-Rate Brachytherapy vs. Standard External Beam Radiotherapy vs. Stereotactic Body Radiotherapy for Low Risk Prostate Cancer: A Cost-Utility Analysis


*Sunnybrook Odette Cancer Centre, Institute of Health Policy Management and Evaluation, University of Toronto, Toronto, ON, Canada*
Disclosures

- Nothing to disclose
Background/Purpose

- In Canada, 24000 new prostate cancers diagnosed in 2015
  - 70% favorable-risk

- Plethora of Treatments and no randomized trials:
  - Active surveillance, Radical prostatectomy and Radiotherapy
  - 40% of low-risk patients are treated with radiotherapy

- Technological advances ➔ Escalated Costs ➔ Value of cost-effectiveness analyses:
  - None of the studies has compared Stereotactic Body Radiotherapy (SBRT) to Low-dose rate Brachytherapy (LDR-BT)

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3 Ploquin N., *Radiother Oncol.* 2008
Background/Purpose

Differing toxicity profile and costs

- Treatment decisions: physician’s expertise and patient preference
- Comparative cost utility analysis → true value of SBRT and LDR-BT compared to EBRT
Base case and decision

**Markov Cohort Model**
TreeAge Pro 2015 software (TreeAge, Williamstown, MA)

- Cohort of men with low risk prostate cancer treated at our institution (192 LDR-BT, 66 EBRT, 84 SBRT; )
- Sunnybrook Research Ethics Board (066-2011)

- **Cycle length**: 1 year
- **Time horizon**: life-time
- **Perspective**: Ontario healthcare payer
Model Schematic
9 Health states

PCa RF no SE

PCa RF long-term GI SE

PCa RF long-term GU SE

PCa RF long-term GI&GU SE

Death from other causes

PCa Biochemical Recurrence

PCa Metastatic Disease

PCa RF resolved toxicity

PCa Death

PCa RF
no SE

PCa RF
long-term
GI SE

PCa RF
long-term
GU SE

PCa RF
long-term
GI&GU SE

Death

from
other
causes

PCa Metastatic Disease

PCa Death

PCa RF
resolved
toxicity

NOYClA
Novartis Oncology Young Canadian Investigator Awards
2016
Model Inputs

- **Institutional cohort analysis**
  - Transition Probability: Recurrence Free → Biochemical Recurrence
  - Probability of short and Long-term side effects

- **Literature**
  - Health states utilities\(^5\) and costs\(^6\)

- **Micro costing Odette Cancer Centre, Ontario fee schedule, Ontario Drug Benefit and Cancer Care Ontario**
  - Costs associated with treatment – Activity-Based Costing
    - LDR-BT(I-125): $5,834
    - EBRT (38 fractions): $8,961
    - SBRT(5 fractions): $3,435
  - Costs associated with toxicity

\(^5\)Stewart S. et al. Med Care 2005
\(^6\)Krahn MD et al. Med Decis Making 2013
Results

6 year biochemical disease free survival >90%
Results of Base Case Analysis

- Quality Adjusted Life-Years gained
- Life-Years gained
- Cost Ratio

NOYCIA 2016
Two-Way Sensitivity Analysis on biochemical recurrence probability for SBRT and LDR-BT comparing the two strategies (Base-case probability is a multiplier of 1)
### Scenario Analysis:

**Scenario assuming same biochemical recurrence probability for LDR-BT vs SBRT**

Discounted at 5%

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Effectiveness</th>
<th>Cost</th>
<th>NMB*</th>
<th>ICER#</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDR-BT</td>
<td>11.166</td>
<td>9.897</td>
<td>$74,993</td>
<td>$419,855</td>
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<tr>
<td>SBRT</td>
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<td>$72,644</td>
<td>$421,774</td>
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<td>0.009</td>
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<td>-1,919</td>
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</tbody>
</table>

*NMB=Net Monetary Benefit assuming a willingness-to-pay threshold of $50,000 then converting health benefits (QALYs) into the CAD$.  
NMB = (E * WTP) − C  
E = effectiveness; WTP = willingness-to-pay threshold; C = cost.  
#ICER=Incremental Cost- Effectiveness Ratio
Limitations

- Quality of the evidence:
  - **Probability of biochemical recurrence**:  
    - Single-institution retrospective cohort study  
    - Median follow-up of 70 months  
    - this is the only available comparison of these techniques
  - **Physician reported toxicity**  
    - Patient Reported outcomes, more sensitive in uncovering morbidity over time than toxicity graded by an observer\(^7,8\)

- Different aspects of GI and GU toxicity were not modeled

\(^7\)Calvert M et al. JAMA 2013
\(^8\)Sonn G et al. J Urol 2009
Conclusions

- In the setting of low-risk prostate cancer, LDR-BT and SBRT are cheaper and more effective when compared to standard fractionated EBRT.
- SBRT has the advantage of being non-invasive.
- It is likely to be considered economically attractive in Ontario and comparable jurisdictions.
- Given the increasing prevalence of the disease, further research should be performed to provide longer-term follow-up and high quality evidence.
Acknowledgements

- Andrew Loblaw, MD, MSc
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- Sofia Torres, MD
- Odette Cancer Centre GU group
- Patients and families
THANK YOU!

And in the end, it’s not the years in your life that count. It’s the life in your years.

Abraham Lincoln