Brachytherapy for GI malignancies

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BRACHYTHERAPY IN GASTROINTESTINAL MALIGNANCIES

HEPATOBILIARY

- Klatskin tumor
- HCC Liver
- Malignant strictures

LOWER GIT

- Anal canal
- Rectum
Brachytherapy for biliary tract
Anatomical considerations

Biliary System

- Right Hepatic Duct
- Liver
- Gallbladder
- Cystic Duct
- Common Bile Duct
- Duodenum
- Left Hepatic Duct
- Pancreas
- Stomach
- Common Hepatic Duct
- Pancreatic Duct

Bismuth Classification

- Type I
- Type II
- Type III a or b
- Type IV
Brachytherapy for biliary tract

• To relieve obstruction

• Brachytherapy catheter is placed in the bile duct via transcutaneous route.

• Radiation is delivered using high dose rate brachytherapy using 192Iridium source
Presenting symptom .... Jaundice

- **Intrahepatic**
  - Cholangiocarcinoma

- **Extrahepatic**
  - Cancer Gall bladder
  - Cancer head of Pancreas
  - Periampullary Cancers
  - Lymph nodes

- ~90% unresectable at presentation

- >50% present with obstructive jaundice
Work up

- For obstructive jaundice
  - Liver function tests, X ray chest etc.
  - Ultrasound / CECT scan / MRI
  - Cholangiography – Percutaneous transhepatic cholangiography / ERCP / MR cholangiogram
  - FNAC during Ultrasound / CECT/ ERCP
  - Brush / Exfoliative cytology during cholangiogram
  - Staging and Classification

- Establish biliary drainage
  - Transhepatic route
  - Endoscopically through transduodenal route
# Bile duct brachytherapy

## Indications
- Patient usually unresectable
- Lesion preferably less than 3 cm
- Fit enough to undergo the procedure
- Malignant strictures of the duct which can be cannulated through either
  - Trans-duodenal endoscopic technique
  - Trans-hepatic technique

## Target volume
- Identified through cholangiograms/ CECT/ MRCP
- Based on orthogonal films / CECT based
- 1 or 2 cm margins taken both proximally and distally
Cardiac sheath

Brachy catheter

Placement of endobiliary catheters
5-6Fr
-Bilateral or Unilateral
Cardiac sheath
PTC Cholangiogram

Complete block at Hilum
X-ray based planning
CT based planning

Topogram with dummies
Catheter in left hepatic duct

Catheter in right hepatic duct
Dose – RT
Various schedules

14Gy/ 4# HDR
10Gy/ 1# HDR
LDR – 25-30Gy
COMBINED MODALITY TREATMENT IN UNRESECTABLE EXTRAHEPATIC BILIARY CARCINOMA

Alessio G. Morganti, M.D.,* Lucio Trodella, M.D.,* Vincenzo Valentini, M.D.,*

- Evaluate the effect of CTRT plus intraluminal brachytherapy in unresectable or residual extrahepatic biliary ca
- 20 patients unresectable 16 or residual 4
- Mean age 61 years
- Median follow-up 71 months
- Nonmetastatic extrahepatic tumors (CBD8; GB1; Klatskin 11)
- External beam radiation (39.6–50.4 Gy); in 19 patients, 5-fluorouracil (96-h continuous infusion, days 1–4
- 12 patients received a boost by intraluminal brachytherapy using 192Ir wires of 30–50 Gy
- MOS- 21.2 mths, TTP 33.1 mths
Interventional radiology and radiotherapy for inoperable cholangiocarcinoma of the extrahepatic bile ducts.


Division of Radiology C, Istituto Nazionale per lo Studio e la Cura dei Tumori, Milan, Italy.

<table>
<thead>
<tr>
<th>Group</th>
<th>Patients</th>
<th>MOS (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 - palliative PTBD</td>
<td>n = 89</td>
<td>108</td>
</tr>
<tr>
<td>Group 2 - ERT</td>
<td>n = 10</td>
<td>345</td>
</tr>
<tr>
<td>ERT plus EBRT</td>
<td>n = 12</td>
<td>428</td>
</tr>
</tbody>
</table>

111 patients
HEPATIC BRACHYTHERAPY

LIMITATIONS: CURRENT THERAPEUTIC APPROACHES

• **SURGICAL**
  - Liver Transplant: Long delay, Complications
  - Partial Resection: Only for small lesions, 15-25% eligible

• **MINIMALLY INVASIVE**
  - TAE: Effective only for <3cm lesions
  - TACE: Significant liver dysfunction
  - RFTA: ~ 50% ablation if size <3cm; 13% complications

• **NON-INVASIVE**
  - External Beam Radiation Therapy: Poor Tolerance

DEMAND FOR ALTERNATIVE APPROACHES
Liver brachy

- RADIATION TOLERANCE OF WHOLE LIVER *
- DOSE (cGy) | INCIDENCE OF HEPATITIS
- | 11%
- 3000 – 3500 | 22.2%
- 3500 – 4000 | 38.8%
- 4000 | 75%

↓

- REDUCE VOLUME FOR BETTER TOLERANCE
Results

- **Ricke J et.al (Germany)**
  - 20 Pts (19 mets – unfavorable for thermal ablation
  - CT Guided Interstitial HDR- BRT
  - Mean Tumor diameter: **7.7cm (Grp A), 3.6cm (Grp-B)**
  - Treated with Ir-192 , Median dose: 17 Gy
  - Toxicity: 2/20 (10%) Obstr. jaundice from Tx edema
  - Liver enzyme elevation: 70%
  - Bilirubin elevation: 50%

- Tumor Control: LC 6m (74%), 12m (40%) **Grp. A (100%), 12m (71%) Grp. B**

- **Golfieri R2 ( J. Chemo., 2004)**
  - 11 Pts, Bilateral percutaneous drainage + BRT+ ERT
  - Mean Survival: 10.5mssss
IBT Liver: Pre-brachytherapy CT and PET-CT

Courtesy Dr D N Sharma
Results - Ir 192

Thomas D, Dritschilo A (USA) Phase I-II

- 33 Pts (19 mets – unfavorable for thermal ablation
  - Intraoperative catheters → HDR- BRT
  - Mean Tumor diameter 5 cm: Average Vol: 174 cc
  - Treated with Ir-192, Median dose: 15-30 Gy
  - Well tolerated
  - 7/20 Alive, Stable disease at 4,5,5,6, 36m
ANAL CANAL CANCERS

• At TMH: 50-60 new cases every year
• Standard of Care: Concomitant chemoradiation
• Radiation:
  - Radical : External alone / Brachytherapy alone
  - Boost : 1. Posterior Oblique
            2. Brachytherapy: LDR or HDR

TMH Cancer Registry 1999
Patient Selection Criteria

Indications

• Brachytherapy alone:
  – Effective in controlling very small lesions
  – Painful reactions in 50%, late necrosis in 10-15%
  – Usually not used as sole treatment modality

• Boost following concomitant Chemoradiotherapy, usually after 40-45 Gy of Ext. RT

• Located within 8 cm of anal verge

• Tumor size preferably not more than 6 cm

• Thickness preferably less than 3 cm

• Less than half of the lumen infiltration
Contraindications

- Insufficient tumor response to prior chemoradiotherapy at 40-45 Gy

More than 1/2 involvement of circumference

- Sphincter involvement

- Medically Inoperable (relative)
  - Proximal ends of tumor cannot be palpated, extends far beyond into rectum
  - Extensive T4 (except those with limited penetration to anovaginal septum)
Anal canal Brachytherapy

---Template

Orientation of Central Rings
- Select of needle size (length)
- Insert needles according to your calculation
- Fixing of needles in template
- Then fix the template to skin at 4 corners
- Put a flatus tube for drainage fecal matter if any afterwards
Other Templates
Interstitial brachytherapy
Martinez Universal Perineal Implant Template (MUPIT)
Anal canal Brachytherapy
----Planning Details

- Orthogonal X-rays or Axial Planning CT scans (3-5 mm )
- Catheter tracking
- Appropriate Loading lengths
- Doses:
  - Prescription Isodose: 90 -100%
  - Optimization as needed (graphical)
  - Dose
    1. Radical – 50-55 Gy equivalent @ 3.4 -4 Gy/#,2#/d
    2. Boost -15 -20 Gy equivalent @3.4 - 4 Gy/#,2#/d
### CARCINOMA ANAL CANAL

#### RESULTS

$n = 83$ (1985 - 1997)

<table>
<thead>
<tr>
<th>Implant dose (Gy)</th>
<th>Recc (%) Total (n=83)</th>
<th>Ano- Rectal Complications (%)</th>
<th>Bladder Complications (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-20</td>
<td>12/49 (25)</td>
<td>13 (25)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>21-30</td>
<td>11/32 (34)</td>
<td>6 (15)</td>
<td>1 (5)</td>
</tr>
<tr>
<td>&gt; 40 (Radical)</td>
<td>2/2 (100)</td>
<td>1 (50)</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>25/83 (30)</td>
<td>20/83 (24)</td>
<td>2 (2)</td>
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Rectal cancer

- Second most GI malignancy in India
- 14.9% of all GI malignancies seen in T.M.H
  
  *TMH Cancer Registry 1999*

- APR & Anterior Resections are the standard of care
- Radiotherapy remains the standard of care after the surgery tumors more than $T_2-N_0$
- Brachytherapy is the newer modality of care
Radiotherapy for rectal cancer

• XRT
  - Conventional
  - Conformal

• Brachytherapy
  - Endocavitary
  - Interstitial
    - Endoluminal approach
    - Transperineal approach

Palliative Brachytherapy for Bleeding, Discharge per rectum
Rectal Brachytherapy

---Planning Details

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Flexible multi-channel rectal probe

Preoperative high dose rate endorectal brachytherapy as an alternative preoperative modality for patients with resectable rectal cancer

_Courtesy of T. Vuong, McGill, Montreal_
Flexible multi-channel rectal probe

Central Catheter

Optional: Kink protection

Re-usable parts

Disposable part

Courtesy of T. Vuong, McGill, Montreal
Endoscopic clips

Endo-clip
Delineation on CT scan with applicator in situ

Courtesy of T. Vuong, McGill, Montreal
Conformity with brachytherapy

- Asymmetrical catheter loading

Courtesy of T. Vuong, McGill, Montreal
Conformity with brachytherapy

- Asymmetrical catheter loading
- Stand-off balloon
- Inverse optimization, graphical optimization

Courtesy of T. Vuong, McGill, Montreal
Conformity with brachytherapy

Courtesy of T. Vuong, McGill, Montreal
Results after 6 weeks

Brachy + 6 wks

N=285  T2-6%, T3 91%, T4-3%, N0-52%, N+ 38%
No anaesthetics needed

Courtesy of T. Vuong, McGill, Montreal