BRACHYTHERAPY IN SKIN CANCER

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“I have no conflicts of interest to disclose.”
Learning Objectives

• Become familiar with different techniques in brachytherapy for treatment of skin cancers
SKIN CANCERS
EPIDEMIOLOGY

- NON MELANOMA SKIN CANCER
  - BASAL CELL CARCINOMA (80%) (BCC)
  - SQUAMOUS CELL CARCINOMA (20%) (SCC)

- PREMALIGNANT SKIN LESIONS
  - ACTINIC KERATOSES (malignant transformation 1 %)
  - BOWEN’S DISEASE (progression to invasive ≈ 20%)
  - KERATOACANTHOMA

90% SUN EXPOSURE
SKIN CANCERS
TREATMENTS

- SURGERY
- EXTERNAL BEAM RADIOTHERAPY (Electrons or superficial orthovoltage x-ray)
- BRACHYTHERAPY (LDR/HDR)
- TOPIC AGENTS
- LASER
SKIN CANCERS

RISK OF RECURRENCES AFTER SURGERY

- Fixation to underlaying structures (Bone, cartilage)
- Perienueral involvement/vascular invasion
- Infiltrative patterns/Poorly defined borders
- Immunosupression
- Depth (Clark level): IV, V or ≥ 4 mm
- Prior radiotherapy

- Aggressive histology
  - BCC (Morpheaform, sclerosing, infiltrative, micronodular)
  - SCC (G2-G3 adenoid (acantholityc, adenosquamous, desmoplastic)
SKIN CANCERS
TREATMENTS

➤ RADIOTHERAPY DEPARTMENTS
  ➤ PATIENTS WITH SURGICAL CONTRAINDICATIONS

  ➤ RECURRENCES AFTER MULTIPLE SURGERIES

  ➤ POSITIVE MARGINS AFTER SURGERY
RADIOTHERAPY IN SKIN CANCERS

MACROSCOPIC LESIONS
RADIOTHERAPY IN SKIN CANCERS
MICROSCOPIC - I-
(AFFECTED MARGINS)
RADIOTHERAPY IN SKIN CANCERS

MICROSCOPIC ~ II~
(AFFECTED MARGINS)
1998

LOOKING FOR:
- LOCAL CONTROL
- COSMESIS
- COMFORTABILITY (Treatment and time)
  - PATIENT
  - RADIOThERAPY DEPARTMENT
- DECREASE WAITING LIST

HIGH DOSE RATE BRACHYTHERAPY (HDR)
HDR BT IN SKIN Cancers

LITERATURE

1998


2009

- ≈ 12 REFERENCES
HDR BT IN SKIN CANCERS
BRACHYTHERAPY TECHNIQUES

1998

- SUPERFICIAL MOULDS

- INTERSTITIAL CATHETERS

DEPTH

TREATMENT VOLUME

10 mm MARGIN
SUPERFICIAL MOULDS

TYPES -I-

THERMOPLASTIC = IRREGULAR SURFACES
SUPERFICIAL MOULDS

TYPES -III-

FREIBURG FLAP ⇒ REGULAR SURFACES
HDR BT IN SKIN CANCERS

INTERSTITIAL BT ~ I ~

- LOCAL ANESTHESIA
- SEDATION if it is required

- SINGLE PLANE
- MULTIPLES PLANES
HDR BT IN SKIN CANCERS

INTERSTITIAL BT ~II~

INTERSTITIAL NEEDLES AND OBTURATORS
HDR BT IN SKIN CANCERS
INTERSTITIAL BT ~III~
HDR BT IN SKIN CANCERS

INTERSTITIAL BT ~IV~

INTRAVENOUS CATHETER
HDR BT IN SKIN CANCERS

INTERSTITIAL BT ~V~

» INTRAVENOUS CATETHER
HDR BT IN SKIN CANCERS
FLAP/ DOSIMETRY

- DOSE PRESCRIBED 10 mm FROM THE CENTER OF THE CATHETER
- CATHETERS SEPARATED 1 CM

BOLUS
HDR BT IN SKIN CANCERS

DOSIMETRY ~II~

THERMOPLASTIC MOULDS

➢ IMAGE GUIDED BRACHYTHERAPY WITH CT SCAN

BOLUS
TREATMENT CHARACTERISTICS I

PROTOCOL (1998)

- INTERSTITIAL CATHETHERS
  Macroscopic disease

- SUPERFICIAL MOULDS
  Small macroscopic disease (≤ 1 cm) / Microscopic disease ⇒ Affected margins
**INITIAL PROTOCOL**

**CHARACTERISTICS/ DOSE**

- **TWO DAILY FRACCIONS (6 HOURS BETWEEN THEM)**
- **MONDAY TO FRYDAY**
- **OUT PATIENTS**

**MICROSCOPIC DISEASE**
- **10 X 400 cGy**

**MACROSCOPIC DISEASE**
- **10 X 450 cGy**
- **10 X 500 cGy**
- **5 X 600 cGy (1 fr per day)**

**Size of the lesion**
INITIAL PROTOCOL

ACUTE TOXICITY

RTOG grade 2 – 3 (75%)
LOCAL RECURRENCES: 2
(May 1998-September 1999)

CASE 1. Nose/ Margin affected.
11 months
RESCUE: Láser

CASE 2. Scalp/Macroscopic tumor
10 months
RESCUE: New brachytherapy
Interstitial treatment
CHANGES -I-

ULTRASOUND ⇒ DEPTH (Lesion/ surgical bed)
CHANGES -II-

PROTOCOL MODIFICATION/
Technique Brachytherapy
(October 1999)

- INTERSTITIAL CATHETERS
  Macroscopic disease or
  Area in ultrasound > 5 mm

- SUPERFICIAL MOULDS
  Microscopic/macroscopic disease with
  Area in the ultrasound ≤ 5 mm
CHANGES -III-

PROTOCOL MODIFICATION/
Dose

» MICROSCOPIC DISEASE
   » 10 X 300 cGy

» MACROSCOPIC DISEASE
   » 10 X 400 cGy
   » 10 X 450 cGy

Size of the lesion
RESULTS ~I~

ACUTE TOXICITY

RTOG grade 1
RESULTS -II-

CHRONIC TOXICITY
RESULTS ~III~
EXCELLENT COSMETIC RESULTS
PATIENT CHARACTERISTICS

- 74 LESIONS
  - SQUAMOUS CARCINOMA
  - BASAL CELL CARCINOMA
  - OTHERS
    - BOWEN’S DISEASE
    - MERCKEL CELL CARCINOMA
TUMOR CHARACTERISTICS  

LOCALIZATION

- HEAD AND NECK 70 (94.5%)
- LOWER LIMB 3 (4%)
- OTHERS (Vulva) 1 (1.5%)
TUMOR CHARACTERISTICS II

STATUS

- MACROSCOPIC LESIONS  47 (63%)

- AFFECTED MARGINS  27 (37%)
TREATMENT CHARACTERISTICS

- **INTERSTITIAL CATHETERS**
  - 46 lesions (62%)

- **SUPERFICIAL MOULDS**
  - 28 lesions (38%)
TREATMENT CHARACTERISTICS (II)

- **NUMBER OF FRACTIONS**
  - Median: 10
  - Range: 5 – 10

- **DOSE PER FRACTION**
  - Median: 350 cGy
  - Range: 300 – 600 cGy

- **TOTAL DOSE**
  - Median: 3000 cGy
  - Range: 1800 – 4500 cGy
FOLLOW-UP

- CLINICAL EXAM
- ULTRASOUND
- 3 months FIRST YEAR
- 4 months SECOND YEAR
- 6 months THIRD AND FOURTH YEARS
- ONCE A YEAR
RESULTS –I–

- LOCAL CONTROL ⇒ 96% 10 years

- FOLLOW-UP: 38 months (2 – 137)

2 RECURRENCES INITIAL PROTOCOL
RESULTS – II

- MARGINAL FAILURE ⇒ 3.5% 10 years

COMMON CHARACTERISTICS
- SQUAMOUS CELL CARCINOMA
- BT. WAS MADE AFTER SEVERAL RECURRENCES TREATED WITH MULTIPLE SURGERIES WITH DEEP MARGIN AFFECTED (BONE OR CARTILAGE)
CASE 1

BRACHYTHERAPY TREATMENT

RECURRENCE 10 MONTHS after BT

EXTERNAL RADIOTHERAPY
CASE 2

BRACHYTHERAPY TREATMENT
CASE 2

3 MONTHS after BT
CASE 2

FIRST BT.

SECOND BT.
VALENCIA APPLICATORS

DEPARTMENT OF ATOMIC, MOLECULAR AND NUCLEAR PHYSICS
D, UNIVERSITY OF VALENCE
Dr. Granero, Dr. J. Pérez-Calatayud, Dr. Jimeno. F. Ballester, E.
Casal, V. Crispin, R. Van der Laarse
HDR BT IN SKIN CANCERS

NEW APPLICATORS

- 2007
- VALENCIA APPLICATORS (2 and 3 cm)

Perez-Calatayud 2005
Ballester 2006
Granero 2007
VALENCIA APPLICATORS
INDICATIONS

- ≤ 20 MM OF MAXIMUM DIAMETER (MARGINS 5-7 MM)
- ULTRASOUND ⇒ ≤ 4 MM DEPTH OF THE LESION
- REGULAR SURFACE
VALENCIA APPLICATORS
PROTOCOL

- LYNN CANCER INSTITUTE. BOCA RATON COMMUNITY HOSPITAL (FLORIDA. USA)
- HOSPITAL LA FE (VALENCIA)
- HOSPITAL CLÍNICA BENIDORM (BENIDORM. ALICANTE)
VALENCIA APPLICATORS

PROTOCOL -I-

- PRIMARY TUMOURS NON MELANOMA
- NO LIMIT OF AGE
- NO RECURRENTS
- ANY LOCALIZATIONS EXCEPT EYELID
VALENCIA APPLICATORS

PROTOCOL - II -

- EQUIVALENT DOSE (BED): 70 Gy IN 3 WEEKS
  - 6 x 700 cGy (2 TIMES IN THE WEEK)

- DOSE PRESCRIBED 3 MM
VALENCIA APPLICATORS

Inmobilization system
PATIENT CHARACTERISTICS

Hospital La Fe/ITIC

Dr. A. Tormo/Dr. Pérez Calatayud/Dr. S. Rodriguez

- 30 PATIENTS (May 2007 – June 2009)
- 43 LESIONS
- BASAL CELL CARCINOMA
RESULTS

VALENCIA APPLICATORS

- LOCAL CONTROL ⇒ 96.3%
- Median Follow-up: 12 months (3 – 28)
- ONE LOCAL RECURRENCE

SURGERY
BASAL CELL CARCINOMA
\[ \text{BED} = n d \left(1 + \frac{d}{\alpha/\beta}\right) \]

\[ \text{BED} = \text{EQD}_2 \left(1 + \frac{2}{\alpha/\beta}\right) \]

\[ \alpha/\beta \begin{cases} 10 & \text{GTV-CTV} \\ 3 & \text{OR} \end{cases} \]
<table>
<thead>
<tr>
<th>Treatment</th>
<th>EQD2 (Gy)</th>
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<tbody>
<tr>
<td>10 x 300 cGy</td>
<td>36 Gy</td>
</tr>
<tr>
<td>10 x 400 cGy</td>
<td>56 Gy</td>
</tr>
<tr>
<td>10 x 450 cGy</td>
<td>67.5 Gy</td>
</tr>
<tr>
<td>6 x 700 cGy (4 week. 1 fr per day)</td>
<td>59.5 Gy</td>
</tr>
<tr>
<td>5 x 600 cGy (1 week. 1 fr per day)</td>
<td>40 Gy</td>
</tr>
<tr>
<td>10 x 500 cGy</td>
<td>80 Gy</td>
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**MICROSCOPIC DISEASE**

**MACROSCOPIC DISEASE**
HUR HDR Brachytherapy with previous ultrasound study, for optimising planning dosimetry, it is a useful and patient comfortable technique for primary skin cancers treatment, with a low toxicity and excellent cosmetic outcomes.

Local control rates are similar to other approaches such as surgery or electron beam radiotherapy.
CONCLUSIONS II

Diferents strategies, both technical and fractionations, result in similar control rates, because the influence of the radiobiological effect of 2 daily fractions or the higher size of each fraction.

The approach in five days, or classical hypofraccionations, twice a week, represent an attractive alternative to more conventional radiotherapy: Shorter total treatment time, reduction of the waiting time in radiotherapy departments, increasing the efficiency of them.
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RADIOThERapy DEPARTMENT

PATIENTS