

# Respiration-Gated Radiotherapy in a large prospective Lung Cancer study : Dosimetric and Clinical Benefits

## FRANCE

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### Objective

Lung radiotherapy needs improvements to take into consideration tumour motion, some tumour exhibiting movements >1cm incompatible with the current expected precision. Respiration-gated radiotherapy (RGR) is implemented with different methods. The therapeutic benefit is evaluated, in our study, comparing RGR and Conventional Radiotherapy (CRT) in lung cancer patients.

### Materials/Methods

- \* 20 French Radiotherapy departments
- \* Budget: 3 160 000 euros
- \* Patient inclusion criteria:  
NSCLC, with or without lung resection, requiring curative irradiation, WHO score ≤ 2, concomitant chemotherapy authorized, age ≥ 18 years, FEV1 > 1 liter
- \* 401 Evaluable patients (218 RGRT – 183 CRT)
- \* Median age 65 years (range: 57-87)
- \* T2-T3 (63%) and N2 (44%)
- \* 65 to 70 Gy to PTV
- \* 2 years inclusion–2 years follow up

### Acknowledgement

The French health ministry supported this project entitled "STIC 2003" to promote this multicenter, non-randomized study approved by the ethical research board.

Remonnay R, Morelle M, Giraud P, Carrere MO. The cost of respiration-gated radiotherapy in the framework of a clinical research programme "STIC". Cancer Radiother 2009;13:281-90.

### Results

No significant difference of efficacy was observed between the 2 groups in terms of overall survival, specific survival or disease free interval.

- **Dosimetric Data RGRT versus CRT:**
- Heart:** V40: 8,1 vs 11,5 %, Dmax: 51,5 vs 55,3 Gy, Dmean: 10,9 vs 13,1 Gy
- Esophagus:** V50: 22,6 vs 25,5 %, EL50: 6,6 vs 7,1 %, Dmean: 22,5 vs 24,4 Gy, Dmax: 58,4 vs 59,1 Gy
- Acute Toxicity:**  
Esophagitis, cutaneous toxicity: no significant difference was observed.  
Pulmonary toxicity: 36% vs 48%, p=0.02

### Late Toxicity:

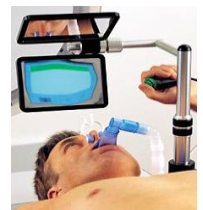
- Esophagitis:** Grade ≤ 2: 91% RGRT vs 28% CRT (p = 0.04) Grade ≥ 3: 9% RGRT vs 72% CRT (p = 0.01)
- Pulmonary toxicity: after 6 month:**  
Grade ≤ 2 : 79.7% RGRT vs 71.7% CRT (p = 0.01)  
Grade ≥ 3 : 20.4% RGRT vs 28.4% CRT (p = 0.01)
- PFT Analysis after 24 month:**  
DLCO -17% RGRT vs -66% CRT  
FEV -3,6% RGRT vs -13% CRT  
CV -4,4% RGRT vs -16,8% CRT

### Comparison of the dosimetric parameters of 3 respiratory gating systems after combining the 2 DIBH devices

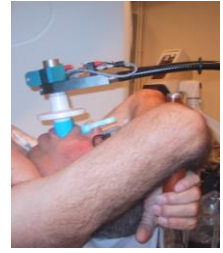
|                   |             | ABC + SDX | RPM       |            |
|-------------------|-------------|-----------|-----------|------------|
| <b>Lung:</b>      | Mean Volume | 5525±1245 | 3106±602  | p<0.000001 |
|                   | V20 (%)     | 22.4±9.2  | 27.9±10.9 | p<0.0001   |
|                   | V25 (%)     | 18.4±2.8  | 23.9±9.7  | p<0.001    |
| <b>Heart:</b>     | Dmean (Gy)  | 12.7±5    | 14.2±4.3  | p<0.01     |
|                   | V40 (%)     | 7.9±11.3  | 11.6±10.8 | p<0.001    |
|                   | Dmax (Gy)   | 51.1±23.7 | 57.5±15.8 | p<0.0001   |
| <b>Esophagus:</b> | Dmean (Gy)  | 8.1±9.4   | 14.2±9.2  | p<0.001    |
|                   | EL50 (cm)   | 6.5±4.6   | 7.5±4.8   | NS         |
|                   | V50 (%)     | 21.6±18.2 | 28.8±17.3 | p<0.001    |
|                   | Dmax (Gy)   | 57.6±18.3 | 64.3±3.6  | p<0.001    |
|                   | Dmean (Gy)  | 22.0±11.2 | 27.1±10.3 | NS         |

### Conclusions:

- RGRT reduce pulmonary, cardiac and esophageal toxicity.
- DIBH respiratory gating techniques appear to be more efficient than synchronized systems to reduce these various toxicities.
- RGRT increases the costs from 57% to 106% which must be taken into account in the fee structure in order to encourage the development and routine use of these techniques.



ABC / Elekta  
Breath Hold



SDX / Dyn'R  
Breath Hold



RPM / Varian  
FB  
synchronisation