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

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	
Lung:	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
	Dmean (Gy)	12.7±5	14.2±4.3	p<0.01
Heart:	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
	Dmean (Gy)	8.1±9.4	14.2±9.2	p<0.001
Esophagus:	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

ABC / Elekta

Breath Hold

SDX / Dyn'R

Breath Hold

RPM / Varian

FB synchronisation

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.

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.