CANCERPARTNERSUK

How much lung is in the field?

A comparison of lung depth measured in the DRRs of breast tangential fields with the corresponding volume of lung receiving high doses in the DVHs of CT planned Ca Breast patients.

K. Walsh[1], J. Pettingell[1], H. Kerr[1], A. Eve[1], B. Mzenda[2], P. Peters[2], N. McAndrew[3], M. Robb[3], S. Razaq[4], A. Penny[4]

[1]CancerPartnersUK, Elstree, London [2]CancerPartnersUK, Chalybeate Close, Southampton [3]CancerPartnersUK, South Downs, Portsmouth [4]CancerPartnersUK, Little Aston, Birmingham

Purpose

In breast radiotherapy it is often necessary to reduce field borders (compromising coverage) to reduce the volume of lung receiving high doses. Traditionally this decision has been based on the "centimetres of lung in the field", with centres imposing a limit of between 2cm[1] and 3cm[2] of "Central Lung Depth" (CLD). With the development of 3D planning systems it is now possible to determine full volumetric dose information for the lung, and as several authors have commented[2,3,4] it is reasonable to expect that this would be a better indicator of potential radiation induced side affects. The difficulty in clinical practice is that the majority of experience is based on CLD and so this study seeks to determine whether a correlation between CLD and volumes of lung receiving high doses can be found.

Materials & Method

At CancerPartnersUK breast tangent treatments are CT planned using Pinnacle TPS and treated using a forward planned IMRT technique or a wedged plan if the hotspot is below 105%. In this study data from 51 patients drawn from four CancerPartnersUK sites were sampled. For these patients the CLD and the corresponding percentage volumes of ipsilateral and composite lung receiving 50% of the prescribed dose (PD) were recorded. A value of 50% was chosen as this corresponds to the beam edge from which CLD is determined.

Figure 1

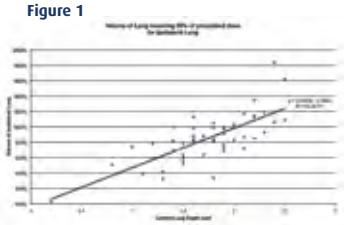


Figure 2

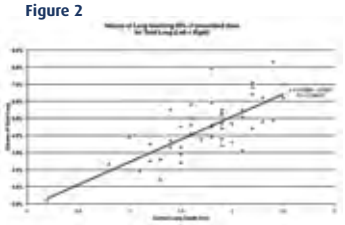


Figure 3

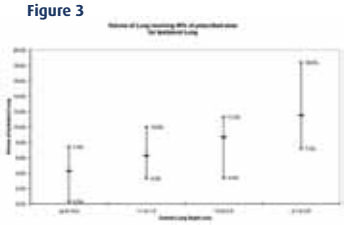
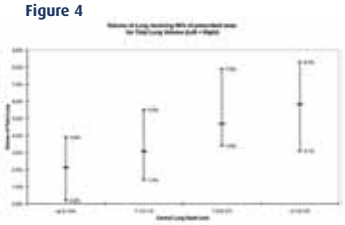


Figure 4



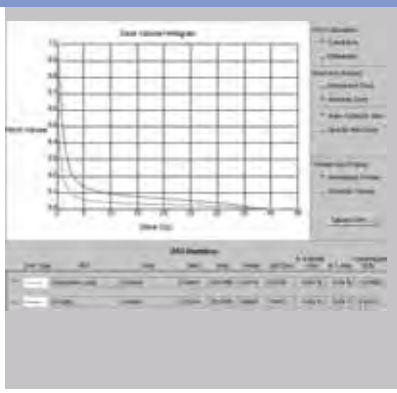
Conclusions & Further Work

The results from this study suggest that CLD is a poor indicator of the volume of lung (ipsilateral and total) receiving high doses from tangential breast irradiation. It seems reasonable to assume that radiation induced side-effects are proportional to the volume of lung receiving high doses, and if this is the case it is unfortunate that breast tissue coverage is compromised based on the requirement to reduce the CLD.

As previous authors have commented there is an obvious need for clinical data which directly investigates the relationship between radiation induced side-effects and volumetric data. In the meantime it may be sensible to use volumetric limits that are related to CLD, such as those in Table 2, instead of or in conjunction with CLD.

An alternative to CLD must be found as new technologies such as treatment with deep inspiration breath-hold will enable considerable reduction in the volume of lung receiving high doses but will increase the CLD. As CancerPartnersUK are currently in the process of implementing a deep inspiration breath-hold solution a comparison of lung volumetric data will be an integral part of this process.

Results & Discussion



As expected, plots of CLD against lung volume, figures 1 and 2, show that larger CLDs correlate to greater volumes receiving higher doses. However the R2 (square of the correlation coefficient) values (~0.55) indicates the correlation is poor.

Figures 3 and 4 show the ranges of lung volumes corresponding to CLDs and are further evidence that CLD is a poor surrogate for determining the volume of lung receiving high doses. Indeed figure 4 suggests there is little difference in total lung volume irradiated between the CLD ranges 1.6 to 2.0 and 2.1 to 2.5, calling into question the practice of imposing a 2cm limit.

Table 1 shows extreme cases where a centre imposing a 2cm limit would reject patients 1 and 3 but accept patients 2 and 4 even though they have a greater volume of ipsilateral lung receiving high doses.

Table 1, extreme cases

Patient	Ipsilateral Lung Volume receiving 50% PD	CLD (cm)	2cm limit imposed
1	7.2%	2.1	Rejected
2	7.4%	1.0	Accepted
3	10.9%	2.5	Rejected
4	11.3%	1.6	Accepted

Table 2, calculation using formulae from figures 1 and 2

CLD (cm)	Lung Volume receiving 50% PD	
	Ipsilateral	Total
1.5	7%	4%
2.0	10%	5%
2.5	12%	6%
3.0	15%	8%

Little Aston Centre, Birmingham

References

[1]Barret A, Dobbs J, Morris S, Roques T. (2009) Practical Radiotherapy Planning 4th ed. London: Hodder Arnold. 272

[2]Yuen Meei Tei A, Park EJ, Shen L., Chung HT. Three-Dimensional volumetric analysis of irradiated lung with adjuvant breast irradiation, Int. J. Radiation Oncology Biol. Phys. 2009; 75. 1309-1315

[3]Das IJ, Cheng EC, Freedman G, et al. Lung and Heart dose volume analyses with CT simulator in radiation treatment of breast cancer. Int J. Radiation Oncology Viol. Phys. 1998;42:11-19

[4]Enami B, Lyman J, Brown A, et al. Tolerance of normal tissue to therapeutic irradiation. Int J. Radiation Oncology Viol. Phys. 1991;21:109-122