

STEREOTACTIC BODY RADIOTHERAPY (SBRT) IN CARCINOMA LUNG: WHERE DO WE STAND?

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What is Stereotactic Body Radiation Therapy (SBRT)?

Stereotactic Body Radiation Therapy (SBRT) is a treatment procedure similar to central nervous system (CNS) stereotactic radiosurgery, except that it deals with tumors outside of the CNS. A stereotactic radiation treatment for the body means that a specially designed coordinate-system is used for the exact localization of the tumors in the body in order to treat it with limited but highly precise treatment fields. SBRT involves the delivery of a single high dose radiation treatment or a few fractionated radiation treatments (usually up to 5 treatments). A high potent biological dose of radiation is delivered to the tumor, improving the cure rates for the tumor, in a manner previously not achievable by standard conventional radiation therapy.

Similarly, because this specialized form of radiation involves the use of multiple radiation beam angles, expert Radiation Oncologists specialized in this technique are able to safely deliver high doses of radiation, with very sharp dose gradient outside the tumor and into the surrounding normal tissue.

Why is it challenging?

Traditionally, stereotactic radiotherapy was being used in treating small brain tumors since a long time ago. The main advantage of treating brain tumor with stereotaxy was that brain is a closed compartment without any intra and inter- fraction tumor motion. Hence it can be treated easily without giving any consideration to tumor motion management. Also, brain tumors are more or less circular or oval in shape making it easier for dose conformity. But the challenge lies in treating lung tumors when due consideration has to be given for intra-fraction tumor motion management. Otherwise there is a very high chance of geographical miss of lung tumor. Apart from that, stereotactic body radiotherapy in carcinoma lung involves a gamut of processes starting initially from very accurate positioning and immobilization with the help of stereotactic body frames or vacuum cushions. The high dose conformity can be achieved with today's modern radiotherapy planning techniques with the use of multiple beams or arc therapy and also the use of non co-planar fields. But the toughest part is managing the low-dose region surrounding the tumor which basically differentiates a good plan from an inferior plan. The low-dose radiotherapy region is responsible for the side effects associated with the procedure. Hence managing the steep dose gradient is the biggest challenge faced by a radiation oncologist while planning SBRT for lung tumors and it assesses the physician's capability to create a good SBRT plan.

Respiratory Motion Management:

It is recommended that tumor motion should be measured (when possible) for each patient for whom respiratory motion is a concern. If target motion is greater than 5 mm, a method of respiratory motion management is available; and if the patient can tolerate the procedure, respiratory motion management technology is appropriate. Respiratory motion management is also appropriate when the procedure will increase normal tissue sparing.

The methods that have been developed to reduce the impact of respiratory motion in radiotherapy can be broadly separated into five major categories: motion-encompassing methods, respiratory-gating techniques, breath-hold techniques, forced shallow-breathing techniques, and respiration-synchronized techniques¹. Of these, most of the centers use motion encompassing methods in the form of 4-dimensional CT scan or breath-hold techniques e.g. Active breathing control (ABC).

Treatment of Early Stage Non-small cell lung cancer: Is surgery the panacea of all evils?

Surgery is accepted as standard of care for Stage I (T1 or T2, N0, M0) non-small cell lung cancer (NSCLC). Overall survival rates of all patients with T1 N0 disease have been reported to be 82% at 5 years and 74% at 10 years while those for patients with T2 N0 disease are 68% and 60% at 5 and 10 years respectively². In the past, surgical lobectomy plus mediastinal lymph node dissection was established as the standard treatment in operable patients. Patients with higher surgical risk due to comorbidity may undergo sublobar resection, although its outcome is inferior based on a randomized study³. About 80% of stage I disease patients undergo surgical resection⁴. However in treatment of elderly patients with increasing numbers of comorbidities, the value of surgery will decrease⁵. In the USA the percentage of patients with age >85 years as well as having >3 comorbidities doubled between 1998 and 2007. The number of patients treated with no local therapy at all increased from 14.6% in 1998 to 18.3% in 2007. Looking at these data the decline in use of surgical resection from 75.2% to 67.3%, despite the increasing use of less invasive video-assisted thoracoscopic surgery (VATS), isn't surprising^{6,7}.

Hence, in the past, inoperable early stage non-small cell lung cancer patients were referred for radiotherapy. But, due to unavailability of more sophisticated techniques and poor knowledge about the effect of high dose per

fraction radiotherapy in lung, patients were treated with conventional fractionation radiotherapy. Obviously, the results were dismal. Two literature reviews can be cited about the effect of conventional fraction radiotherapy in lung cancer. In one study by Kaskowitz et al, 53 patients of stage I NSCLC were treated with conventional fractionation radiotherapy. The median total dose was 63.2 Gy. The actuarial disease free survival (DFS) at 3 years was 33% and actuarial overall survival (OS) at 3 years was 19% and at 5 years was 6%⁸. In another study by Coy et al, 141 patients of early stage NSCLC were treated with conventional fraction radiotherapy between 1963 to 1974. The crude overall 3 year and 5 year survival were 18% and 10% respectively. On subgroup analysis, if the tumor size was ≤ 3 cm, the 3 year OS was 28% compared to only 14%, when the tumor size was > 3 cm⁹. So, undoubtedly, surgery had an edge over radiation therapy in the management early stage NSCLC till 1990. The situation began to change after that.

The first reported SBRT:

The Danish group was the pioneer in SBRT in carcinoma lung and they reported the first literature on SBRT in lung cancer. They used stereotactic body frame with fixation device and mean total dose was 8-66 Gy/ 1-4 fractions in 31 patients of stage I medically inoperable lung cancer. This group also used inhomogeneity in dose prescription which is very essential in planning SBRT to achieve a very high dose in the centre of the tumor and a steep dose fall off. The duration of follow up varied from 1.5-38 months. They achieved a local control of as high as 80%¹⁰. This ushered a new era in the treatment of early stage NSCLC who were medically inoperable. Now the need of the hour was to improve the local control with acceptable toxicities and dose escalation studies.

Dose escalation studies in SBRT in carcinoma lung:

The Japanese group of Uematsu et al treated 50 patients of stage I NSCLC between 1994 to 1999. They used a FOCAL unit which was a combination of linear accelerator, CT scan, X-ray simulator and carbon table. The dose was 50-60 Gy/5- 10 fractions and the dose was prescribed to 80% isodose line. After a median follow up period of 36 months, the local control was 94%, which was very impressive and OS was 66%. Only 2 patients suffered minor rib fractures and 6 had temporary pleural pain¹¹.

Onishi et al published their result of 87 patients of stage I NSCLC treated between 1995 and 2004. Total dose was 45-72.5 Gy/ 3-10 fractions at isocenter with a median biological effective dose (BED) of 116 Gy and median follow up period was 55 months. Local progression-free rate at 5 years was 92% for stage IA & 73% for stage IB ($p= 0.01$) Overall survival at 5 years was 72% for stage IA & 62% for stage IB ($p= 0.14$). These results were comparable to the published surgical series¹².

In another study published by Takeda et al, 128 patients of stage I NSCLC were treated with SBRT between 2001 and 2007. Dose prescribed was 50 Gy/5 fractions at periphery of PTV at 80% isodose line. They used long CT scan time (6- 8 sec/slice) to counter the respiratory motion. They achieved a local control of 96% and 93% for stage IA and stage IB respectively and overall survival (OS) of 90% and 63% for stage IA and stage IB NSCLC¹³.

So it was seen that with dose escalation in SBRT in carcinoma lung, the local control tends to improve with no increase in toxicities.

RTOG 0236- The Landmark Trial:

The whole paradigm of treatment in early stage NSCLC changed after the publication of the results of RTOG 0236 trial by Timmermann et al. It was the first multicenter North American Cooperative group study. They excluded the tumors within the proximal bronchial tree. 4D CT scans were used to counter the respiratory motion and generate the internal target volume (ITV). A dose of 60Gy/3 fractions was prescribed with PTV covered by 95% isodose. For the first time, this group recommended the tolerance dose for the adjacent normal structures and acts as guideline today. The most important point of this study was a very high local control rate (97.6% at 3 years) and 3 year loco-regional control rate was 87.2%. Regional failure occurred only in 2 patients and there was no SBRT related deaths¹⁴. This trial acts as a benchmark till today for the treatment of early stage NSCLC patients with SBRT.

Reirradiation with SBRT:

Apart from distant metastases, the rate of locoregional recurrence in early stage NSCLC is also very high. In this scenario, surgery is mostly avoided by the surgeons and second and third line chemotherapeutic drugs have disappointing results. The concept of reirradiation is studied mostly in cancers of head and neck, though there are some published data of Reirradiation with SBRT in locally recurred NSCLC previously treated with radiation. In a study published by Kelly et al, 37 patients of recurrent or second primary early stage NSCLC between 2004 and 2008 were treated with SBRT. Primarily, all the patients received external beam radiotherapy by conventional fractionation. Dose was 50Gy/ 4 fractions prescribed to PTV and median follow up duration was 2 years. In- field local control was 92% and actuarial survival was 59%. 50% of patients developed some form of pneumonitis but no grade 3 pneumonitis was observed. 30% patients developed chest wall pain¹⁵.

SBRT in poor lung function and old age group:

Chronic obstructive pulmonary disease (COPD) is an independent predictor for lung cancer and many lung cancer patients have underlying COPD. Apart from that, COPD is often associated with cardiovascular disease which deters

the surgeons from surgery. Radical radiotherapy by conventional fractionation is the next best but inferior treatment modality. The advent of SBRT has brought in a huge change in treatment of this type of patients. In a study published by Palma et al, 176 patients of early stage NSCLC with underlying COPD were treated with SBRT to a dose of 3×20 Gy (T1 surrounded by parenchyma) or 5×12 Gy (T2, T1 close to chest wall) or 8×7.5 Gy (central tumors). Actuarial 3 year local control was 89% and 1 and 3 year overall survival was 79% and 47% respectively¹⁶. These data was comparable to surgery.

As the life expectancy of population is increasing, lung cancer is often seen in people with very old age. Often it is associated with multiple comorbidities and surgery is not possible. In a retrospective review by Palma et al, patients with age more than 75 years from North Holland were analyzed dividing them into three periods (Period A- 1999-2001; Period B- 2002-2—4 and Period C- 2005-2007). The use of radiotherapy (SBRT) for the treatment of early stage NSCLC gradually increased from Period A to Period C (26% vs 42%; p=0.01). Median survival for all patients increased from 16 months in period A to 21 months in period C. The improvement in OS was confined to RT patients (HR 0.70; 95% CI- 0.49 to 0.99), whereas no significant survival improvements were seen in the other groups¹⁷. Hence, SBRT as a treatment modality for early stage NSCLC is well suited for frail, elderly patients with improvement in local control.

SBRT in Lung metastases:

Metastases to lung from other sites are relatively common. The strongest predictor of survival in solitary metastases is removal of metastases. Complete resection of solitary lung metastases can achieve 5 year overall survival of 36% and partial resection can achieve 13%¹⁸. Many patients of lung metastases are not ideal candidates of surgical resection. SBRT seems to be the best alternative for those patients if normal lung can be spared. 38 patients with 63 lung metastases were treated using SBRT from 2004-2007. Most common sites of primary were colorectal carcinoma, soft tissue sarcoma and renal cell carcinoma. Dose prescribed was 48-60 Gy/3 fractions at 80% isodose line. Active breathing control (ABC) or abdominal compression was used to counteract respiratory motion. 6 patients died before 6 month follow up and 2 patients died soon after due to progressive systemic disease. Actuarial local control at 1 and 2 years were 100% and 96% respectively. Median overall survival (OS) was 19 months. Grade III pneumonitis was seen only in 8% of patients¹⁹. Hence, high dose SBRT was safe and effective in patients with 1-3 lung metastases.

SBRT in centrally located lung tumors:

The conventional 3 fraction regimen of 60Gy for T1 and 66Gy for T2 lung tumors was very effective for peripheral tumors achieving local control of 95% at 2 years according to RTOG 0236 trial. But at the same time, the clinicians warned about the toxicity associated while using the same dose for centrally located tumors. In a subgroup analysis in the RTOG 0236 trial, the 2 year freedom from severe toxicity was 83% for peripherally located tumors and only 54% for central tumors. Hence a word of caution was issued while treating central lung tumors with SBRT.

To optimize the dose for central lung tumors, 27 patients with central/superior early stage NSCLC were treated with SBRT. First seven patients were treated with 40Gy/4 fractions and the remainders were treated with 50Gy/5 fractions prescribed to 75-90% isodose line. Median follow up duration was 17 months. 3/7 patients treated with 40 Gy had regional recurrence during the follow up period. Local control was 100% for patients treated with 50 Gy/4 fractions. Only 4 patients had grade 2 pneumonitis and 3 patients had chest wall pain. So, the optimal dose for treating central lung tumors with SBRT was 50Gy/4 fractions²⁰.

SBRT- Toxicity:

The majority of patients treated with SBRT suffer from severe pulmonary or cardiovascular comorbidities and their poor pulmonary status, which does not allow surgical resection. Consequently pulmonary toxicity is an important point of concern in lung SBRT. Radiation induced pneumonitis (RP) is usually seen after a median of 5 months which is longer compared to conventional radiotherapy. Risk of RP is reported to be dependent on planned target volume (PTV), mean lung dose and low-dose spread for conventional radiotherapy²¹. Development of high grade RP after stereotactic treatment is rarely reported. The two largest retrospective papers show an incidence of RP toxicity Grade e"2 of below 8%^{22,23}. Patients with pre-existent pulmonary fibrosis might be at increased risk for RP. Additionally, pulmonary function is stable after SBRT with a loss of <10% (FEV1, DLCO) within 24 months after treatment²⁴. Pulmonary toxicity was not increased even in patients with very poor pre-SBRT pulmonary function and with severe COPD GOLD III-IV.

Chest wall toxicity (myositis, neuralgia, rib fracture, subcutaneous fibrosis, and skin ulceration) has been reported when tumors are located close to the respective normal tissue structures. Doses >30 Gy (delivered in 3 fractions) to the chest wall have been correlated with these toxicities and the volume of the chest wall exposed to these doses should be minimized by conformal treatment planning. Based on their data, Mutter *et al.* suggest a 30 Gy constraint to a max of 70 cm³ of the chest wall (2 cm expansion of the lung) to prevent chest wall pain²⁵.

Severe toxicity to the brachial plexus (neuropathic pain, motor weakness, or sensory alteration), large bronchi (stenosis with pulmonary atelectasis) and esophagus (ulceration, perforation, fistula) has been reported but these toxicities are rare. Limiting the total dose to the plexus to <26 Gy in 3-4 fractions can minimize the risk of toxicity²⁶.

Some reports even mention treatment- related deaths, especially in centrally located tumors²⁷. Studies consistently reported that SBRT has no detrimental or negative on quality-of-life (QoL). Overall QoL as well as subdomains of

dyspnea and cough were stable after SBRT in all studies and one study described significantly improved emotional functioning²⁸.

Conclusion:

SBRT is a relatively effective, convenient and tolerable retreatment option for inoperable early stage non-small cell lung cancer. Overall toxicities, while prevalent, are mostly tolerated by patients. Future studies incorporating systemic biologic agents will need to be conducted to evaluate efficacy and toxicity of combined modality treatment. At the present time, SBRT is also a reasonable option for re-irradiation in previously treated lung tumors, treatment of lung metastases, patients with underlying lung disease and elderly, frail patients. Care must be taken in the cumulative dose to nearby critical structures and patient comorbidities, present disease burden and overall prognosis should be assessed prior to proceeding with SBRT.

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HYPOFRACTIONATED EXTERNAL BEAM RADIOTHERAPY: NEW HOPE FOR TWENTY FIRST CENTURY.

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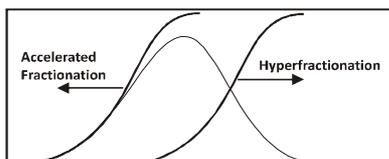
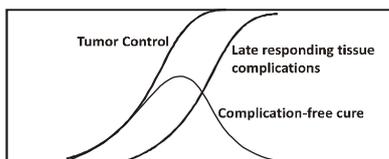
Introduction:

Soon after discovery of X-rays, practice of radiotherapy started with hypofractionated protocols for convenience, and with limited experience and understanding of radiotherapy. In 1905 Claudius Regaud started experiments of effect of radiation on testes. He observed rapidly proliferating cells which are undergoing mitosis are more sensitive to radiotherapy on other hand mature cells are less sensitive radiation. His observation ("Law of Bergonie and Tribondeau") formed the biological basis of fractionation. Philosophy of hypofractionation for most of the sites in curative aspects were mostly abandoned after the results of Coutard's experiences between 1928 and 1930. So for next almost 100 years empirically selected 2 Gy / fraction therapy has been considered standard. After almost 20 years the hypofractionated therapy came back again in the form of stereotactic radiosurgery. Famous neurosurgeon Lars Leksell, in association with a radiation physicist Borge Larsson first developed the system called Gamma Knife (Elekta AB, Stockholm, Sweden). Leksell broke from the perceived wisdom of conventionally fractionated radiotherapy by using large dose in single fraction. It was proved extremely effective method of radiotherapy by virtue inherent radiobiological advantage and its unique accuracy.

Radiobiology:

Understanding of radiobiological effects has become simpler though not very accurate with the use of linear quadratic model. LQ model dominates the field of radiobiology. This model incorporates the effect of dose per fraction and can, by making additional assumptions, also incorporate the effect of repopulation during course of fractionated radiotherapy. In linear quadratic model believes there are two components of cell kill by radiotherapy i) linear component which directly proportional with the dose and ii) curvier part is proportional to the square of radiation dose. The alpha/beta ratio is the dose of radiation in gray at which amount of cell killing that is directly proportional to the dose is equal to the amount of cell killing proportional to the dose squared. Curvier the curve lower the alpha/beta ratio and greater the sparing effect of fractionation on tissue damage. Alfa component represents the intrinsic radiosensitivity of the target cells and the beta component represents the extent to which damage can be repaired. Lately reacting tissues have low alpha/ beta ratio and acutely reacting tissues have high alpha/beta ratio. So tumours like prostate, breast, nervous system have low a/b ratio and other like head and neck, Gastro-intestinal, lung has high a/b ratio. Over 90% of radiation oncologists use the LQ model as it is simple and has a microdosimetric underpinning. a/b is large (> 6 Gy) when survival curve is almost exponential and small (1-4 Gy) when shoulder is wide. The a/b value quantifies the sensitivity of a tissue/tumor to fractionated radiation. But both a and b vary with the cell cycle. At high doses, S phase and hypoxic cells become more important. The a/b ratio varies depending upon whether a cell is quiescent or proliferative. The LQ model best describes data in the range of 1 - 6Gy and should not be used outside this

range. Balance between tumour control probability and normal tissue complication probability is utmost important for deciding of hypofractionation. It is important to separate two curves efficient to achieve better tumour control with limited toxicity. It has become clear that the therapeutic ratio, the balance between tumor cell kill and normal tissue damage is affected not only by fraction size but also the total dose of radiation and in instances overall treatment time and the volume of tissue irradiated.



Dose –Effect Curve

Extreme hypofractionated radiotherapy has potential to benefit in low a/b tumours by increasing equivalent dose, vascular changes and

change in tumour microenvironment.

Technology:

From the beginning of hypofractionated radiotherapy technology has evolved a lot. Intension for ever was to do more good than more harm. Technological renaissance started with advent of Gammaknife in 1950s. It is important to reduce normal tissue dose as much as possible even with conventional fractionated radiotherapy. IMRT, IGRT, respiratory gating has made it more elegant in sparing of normal tissues. But if we look at various moderate hypofractionated protocols like prostate and breast equivalent dose to normal tissues are actually less than that of conventional fractionated radiotherapy. So with simple Co60 machine it is possible to hypofractionate breast radiotherapy or with simple 3DCRT it is possible to hypofractionate prostate radiotherapy. These are radiobiologically safer than conventional radiotherapy.

Brain:

Stereotactic radiotherapy in brain was breakthrough for hypofractionation. Major advances in technology of radiation delivery and image guidance facilitated much wider application of stereotaxy to other sites as well.

Application of stereotaxy in brain started with benign lesions, now it has important role for malignant tumours and metastatic disease.

Trigeminal Neuralgia Series	N	Follow up	Dose	Pain relief	Recurrence	Numbness
Seattle1998	110	19	70-80	95	34	2.7
Pittsburgh2001	220	24	60-90	82	13	10.2
Maryland 2003	112	30	70-80	77	29	7.3
Virginia 2005	151	19	50-90	90	27	9
Ga 2007	106	34	70-85	85-92	23	16

Acoustic Neuroma	N	Prior Surgery	Median Dose	Volume	Follow up	5yr PFS	Cranial Nv injury	Hearing preservation
Munich	111	33%	13	1.6 ml	84	95%	V8% VII3%	NS
Taipei	187	37%	13	4.1 ml	30	93%	V1% VIII1%	60%
Pittsburgh	313	NS	13	1.1 ml	24	93%	V4% VII0%	78%
Florida	149	28%	14	4.8 ml	34	87%	V11% VII 9%	NS

Meningioma	Patient	Follow up	Vol	Margin Dose	PFS	Complication
JCRT	127	31 m	4.1 ml	15 Gy	3yrs	4.7%
Pittsburgh	934	48 m	7.4 ml	14 Gy	10 yrs	5.7%
Mayo	330	43 m	7.3 ml	16 Gy	94	8

One to fourcBrain Metastasis		Protocol		End point	Remarks
Aoyama et al Asian Trial 2006		SRS (21.9Gy) Vs SRS(16.6Gy)+ WBRT(30Gy)		16.7 Vs 10.6m in GPA score 2-5	SRS alone is beneficial in good GPA score
RTOG 9508	333	WBRT and Stereotactic Radiotherapy Vs WBRT alone		6.5 Vs 4.9m in favour of WBRT+ STx	For single metastasis addition of STx with WBRT beneficial.
Alliance Trial N0574	213	SRS+WBRT Vs SRS	85% Vs 58% 12 m local control	7.5m Vs 10.7m median OS	Decline in cognitive function in WBRT
Lim SH	105	SRS+Chemo-Vs-observation+Chemo in NSCLC		Median OS 14.6 Vs 15.3	No benefit in asymptomatic oligo metastasis

Breast Cancer:

Reason behind early use of hypofractionation in whole breast RT was pure logistic. It is estimated that upto 30% of women in North America do not receive such treatment after BCT. This has been attributed to age related morbidity, travel distance, inconvenience and the cost of therapy. Radiotherapy on cell cultures suggested of low a/b ratio in breast cancer which also supports hypofractionated treatment.

Study	Patients	Fractionation	Follow up	Locoregional rec (%)	Cosmesis (excellent or good)
Whelan 2002	1234 node -	50Gy/25#/5wk Vs 42.5 Gy/16#/3wk	5.5 yr	3.0, 2.8	77/ 77
Yarnold et al 2006	14 10 node – and +	50 Gy/25#/5wk Vs 42.9 Gy/13#/5wks Vs 39 Gy/13#/5wks	10,10,10	12.1, 9.1, 14.8	47, 42, 44
START A	2236 node – and +	50 Gy/25#/5wks Vs 41.6Gy/13#/5wks Vs 39 Gy/13#/5wks	5,5,5	3.6, 3.5, 5.2	59, 59, 70
START B	22 15 node – and +	50 Gy/25#/5wks Vs 40Gy/15#/5wks	5,5	3.3, 2.2	57, 64

Partial Breast radiotherapy:

Most of the local failures in BCT occur at primary tumour site in the breast . Numerous hypofractionated radiotherapy techniques have been developed for partial breast radiotherapy like interstitial brachytherapy,

ballon catheter brachytherapy, inraop electron and electron and photon therapy, conformal radiotherapy. It is more convenient for patients as overall treatment is usually get completed within a week. Most of phase 2 studies had promising results in terms of cosmetic outcome with comparable outcome results. But recently published ELIOT and TARGIT study results have failed to show equivalence in terms of local failure with whole breast radiotherapy.

PBI RCT	Patient	Protocols	Follow up	Locoregional rec	Cosmesis
UK Fast 2004-2007	915	50Gy/25#/5wks Vs 28.5Gy/5#/5wks Vs 30Gy/5#/5wks	37.3, 37.3, 37.3m		At 3 yr 28.5Gy/5# is comparable to 50Gy/25# and milder than 30Gy in 5#
IMPORT Low 2006- 2010		WBRT 40Gy/15#, PBI 40Gy/15# with normal breast 36Gy/15#, PBI 40Gy/15#			Ongoing, Primary end point Local control
ELIOT	1305	WBRT 50Gy/25#/5wks Vs 21Gy IORT	68m	0.4, 4.4%	Better cosmetic oucome in hypofractionated protocol.
TARGIT 2000-2012	3451	WBRT Vs 20Gy tumour bed surface dose.	29m	1.3, 3.3%	Less grade 3 and 4 toxicity in TARGIT arm compared to WBRT

There are enough long term data to support hypofractionated radiotherapy in breast conservation therapy or post mastectomy with equivalent results.

Prostate:

Now there are convincing evidences that biochemical control is improved with higher cumulative dose to the prostate. Conformal radiotherapy has made it feasible to escalate dose without increase in toxicity. Various recent data have indicated a/b ratio for prostate cancer on the order of 1 to 3 Gy. This is lower than surrounding organ at risk. For this reason prostate has unique therapeutic ratio advantage in favour of hypofractionation.

Study	Protocol	Follow up	End points	Remarks
Yeoh EE 2011 N=217	64Gy/32# Vs 55Gy/20#	90m	Bladder and Bowel Toxicity	No difference in toxicity
Arcangeli G 2011 N=168	80Gy/40# Vs 62Gy/20#	35,32m	Toxicity: Bowel (14% Vs 17%) Bladder (11% Vs 16%)	Significant biochemical relapse free survival in favour of hypofractionated RT
Dearnaley D (CHHiP) 2012 N=457	74Gy/37# Vs 60Gy/20# Vs 57Gy/19#	50.5m	Toxicity Bowel(4.3% Vs 3.6% Vs 1.4%) Bladder (2.2% Vs 2.2% Vs 0%)	No significant difference in toxicity
RTOG 0415 (2015) N=1115	73.8Gy/41# Vs 70Gy/28#	69m	DFS 75.6 Vs 81.8%	Hypofraction is non inferior

With advent of conformal radiotherapy techniques and various image guidance facilities now medical science is moving forward towards extreme hypofractionation in prostate. Phase 2 results are encouraging.

Extreme Hypofractionation in the form of SBRT or SABR:

Knowledge of hypofractionated RT, experience in cranial stereotaxy and technological advancement has made it feasible to explore extreme hypofractionation in extra cranial structures. Here I have limited scope for discussion of SBRT. It has widespread application in various sites like lung, liver, prostate, bones, pancreas etc. It needs trained physician and staffs who are comfortable with modern technologies.

Conclusion:

Hypofractionation is gradually gaining confidence in various aspects. Apart from mentioned situation it is widely used for reirradiation at various part including head and neck region. In palliative care hypofractionation has important role in early pain control and reducing overall treatment time. Before going for hypofractionation for a particular disease we need to be careful about case and technology selection. In India radiotherapy centres are still inadequate in number and many are not equipped well to deal with extreme hypofractionation. Moderate hypofractionation is feasible with limited resources. It has great impact in reducing waiting time in busy centres, reduce financial burden and reduced stay for the people who are coming from distance. When healthcare resources are limited, hypofractionation makes even more sense for the world. In twenty first century hypofractionation will lead the role in radiotherapy in most of the sites.

ABSTRACT

**A PROSPECTIVE STUDY TO ASSESS ACUTE AND LATE TOXICITY,
AVERAGE TREATMENT TIME AND MONITOR UNIT DELIVERY IN HEAD
AND NECK SQUAMOUS CELL CARCINOMA
BY USING RAPID ARC TECHNIQUE**

Dr Vijay Kumar Kontham, Apollo Gleneagles Hospitals, Kolkata

BACKGROUND:

Head and neck squamous cell carcinoma displays a clear radiation dose-response relationship. Radiotherapy is the main non-surgical modality of treatment for squamous-cell carcinoma of the head and neck. However, treatment planning for head and neck cancers is challenging because of the complex anatomy, with soft tissues and air cavities. Rapid arc enables IMRT-like dose distributions to be delivered using a single rotation or multiple rotations of the gantry. Rapid arc improve Organs at Risk and healthy tissue sparing compared to other IMRT solutions and maintain or improve the same degree of target coverage.

AIMS:

To evaluate the acute and late toxicity profiles of patients according to RTOG toxicity criteria, to assess the average treatment time per fraction of radiation and to assess average monitor unit (MU) delivery.

MATERIALS AND METHODS:

This is a single arm prospective, single institutional study, conducted from January 2014 to July 2015, at Apollo Gleneagles Hospital, Kolkata. Study population were Patients who are d" 75years of age, PS ECOG grade 0-2, Biopsy proven squamous cell carcinoma of the larynx, oropharynx, oral cavity(except buccal mucosa), hypopharynx and larynx (except T2 glottis) who are TNM stage II-IV who are receiving radical or adjuvant radiation with or without concurrent chemotherapy.

RESULTS:

46 patients were registered in the study, of which 22 (47.8%) patients belongs to ECOG performance status score 0 and 24 (52.2%) belongs o ECOG score 1. 37 male and 7 female patients. mean age of the total patient population was 52.35 ± 11.12 . 39.1% of the study population had stage IVA disease, 34.8% stage II and 26.1% with stage III disease. 22 patients received radical radiotherapy and 24 patients received post-operative radiotherapy. Our RA plans achieved good OAR sparing, as is proven by the significantly lower dose to the spinal cord (Max- 37.58 ± 5.7 Gy), parotids (Mean- 31.44 ± 12.94 Gy) and the remaining organs at risk. Our plans achieved a conformity index of 0.97 ± 0.11 and Homogeneity index of 1.12 ± 0.052 for the largest PTV. Average treatment time per fraction was 193.26 ± 27.11 sec. Average MU delivery per fraction was 485.50 ± 52.80 . 26.1% of the patients had grade 3 skin reactions , grade 3 for mucositis in 15.2%, grade 3 for dysphagia in 8.7% and grade 2 xerostomia in 45.7%. Late toxicity results showed no grade 3 toxicity at 12months and only 4.3% patients had grade 3 salivary gland toxicity.

CONCLUSION:Rapid arc technique in head and neck cancers is feasible and effective, with acceptable toxicities and treatment delivery completed in around 3 minutes and the MU usage is very efficient.

ABSTRACT**PROSPECTIVE RANDOMIZED STUDY OF CONCOMITANT CHEMORADIATION
IN LOCALLY ADVANCED HEAD AND NECK CARCINOMA
COMPARING CONVENTIONAL FRACTIONATION VERSUS
HYPERFRACTIONATED ACCELERATED IRRADIATION.**

*Sourav Ghosh, Krishnangshu Bhanja Choudhury, Abhishek Basu, Koushik Ghosh,
Kazi Sazzad Manir, Chandan Dasgupta, Subir Gangopadhyay.*

Background:

Locally advanced squamous cell carcinoma of head and neck (LAHNSCC) constitutes a considerable burden of disease worldwide. Concomitant platinum based chemoradiotherapy remains the standard of care as a radical treatment modality for LAHNSCC. Despite this, locoregional failure remains a major cause of death. Altered fractionation with or without chemotherapy is another viable option in these patients. Hence we studied hyperfractionated accelerated radiotherapy with concurrent cisplatin in comparison to conventional chemoradiation in LAHNSCC.

Aims:

To compare the locoregional response, toxicities (acute and late) and progression free survival between concurrent chemoradiation using hyperfractionated accelerated radiotherapy versus conventionally fractionated radiotherapy.

Materials and methods:

Between November 2013 to August 2014, a total of 80 patients of locally advanced inoperable head and neck squamous cell carcinoma (stage III & IVA) were accrued for this study and randomized into two groups: Arm A receiving external beam radiotherapy 72 Gy in 60 fractions over 6 weeks (1.2 Gy per fraction b.i.d) and Arm B receiving 70 Gy in 35 fractions over 7 weeks. In both arms patients received concurrent cisplatin 30mg/m² weekly. Radiotherapy in both arms was delivered by Theratron 780 E cobalt-60 machine.

Results:

32 patients in Arm A and 31 patients in Arm B completed treatment and were available for response assessment by using RECIST v1.1 at 6 weeks post treatment. Toxicities were analyzed using CTCAE v4.0 and RTOG late radiation morbidity criteria. Median follow up period was 11.5 months (2.8 to 22.4 months). Median treatment duration in arm A was 51 days (42 to 74 days) and Arm B was 54 days (51 to 69 days). Complete response rate at the end of study was better in Arm A (n=17) in respect to Arm B (n=14), p value 0.87. Acute oral mucositis was higher in Arm A than in arm B, p value 0.027. Higher grades of xerostomia, dysphagia and cutaneous toxicities were in arm A but were not statistically significant. There was no significant difference in late radiation toxicity between the two arms. Progression free survival was comparable in both arms (p value 0.91, log rank test).

Conclusion:

Hyperfractionated accelerated radiation schedule with weekly concurrent cisplatin is comparable to conventional chemoradiation with weekly cisplatin in terms of locoregional control with more acute toxicity within acceptable limit. However, large prospective study with long term follow-up is needed to validate this issue.

ABSTRACT**POSTOPERATIVE STRONTIUM - 90 BETA IRRADIATION IN BULBAR CONJUNCTIVAL CARCINOMA : AN INSTITUTIONAL EXPERIENCE**

B. Dutta, R. Tudu, A. Halder, N. Biswas, D. Barman, A. R. Deb

Introduction:

Conjunctival squamous cell carcinoma, a rare, slow growing malignancy, is associated with an unacceptably high rate of local recurrence after simple excision, prompting the use of various adjuvant treatments, including localised beta irradiation.

Materials and Methods:

From April 06 to August 15, a total of 28 patients (corresponding to 29 eyes with disease) were referred to us after primary surgical removal of a suspicious growth of the bulbar conjunctiva, followed by histopathological diagnosis of invasive or in-situ squamous cell carcinoma. Beta irradiation was given to 19 among those eyes to a dose of 80 Gy in 8-10 fractions, 3 fractions per week. The machine used was a Strontium 90 β -ray applicator, which consists of a circular strontium source mounted on a long handle, with an intervening Perspex disc meant to protect the treating doctor from radiation. The radioactive Strontium 90 and its decay product, Yttrium 90 are pure β emitters of low penetrating power, ideal for treatment of surface lesions, including conjunctival carcinoma.

The patients were regularly followed up at our OPD for assessment of response, recurrence and adverse events.

Results:

After a median follow up period of 9 months (range: 2-38 months) none of the patients had a residual lesion or showed locoregional recurrence. Three patients were noted to have cataracts in our series, among which only one could be definitely labelled as treatment induced. Almost all of the patients reported mild eye irritation and foreign body sensation during treatment, which were easily controlled with steroid-antibiotic and lubricant eye drops. No other adverse events were seen.

Discussion:

A review of the published literature reveals that beta irradiation is less toxic and at least as effective as the competing modes of treatment, e.g. topical cytotoxics, immunotherapy and cryotherapy. Also, our results tally with previously published reports with regard to response and adverse effects.

The main shortcoming of our report is the short follow up periods for most patients. The apparently small sample size can be attributed to the rarity of the disease being studied.

Conclusion:

Adjuvant beta irradiation with a Strontium90 applicator remains one of the first choices for conjunctival intraepithelial or invasive carcinoma, in view of its simplicity, efficacy and minimal morbidity.

ABSTRACT**A PROSPECTIVE STUDY COMPARING INDUCTION CHEMOTHERAPY FOLLOWED BY CHEMORADIATION VERSUS CHEMORADIATION ALONE IN LOCALLY ADVANCED NON SMALL CELL LUNG CANCER**

*Dr. Rajib Bhattacharjee, Dr. Subir Kr Pal, Dr. Soumen Mukherjee, Prof. (Dr.) Siddhartha Basu,
Dept. of Radiotherapy, IPGME&R*

INTRODUCTION :

Locally advanced non small cell lung carcinoma (stage III) has usually been treated by surgery or radiotherapy. The new approaches are sequential chemoradiotherapy (induction chemotherapy followed by standard radiation therapy) and concurrent chemoradiotherapy. An alternate approach may be the use of induction chemotherapy. The study aims to compare the response rate and toxicity pattern in two arms between induction chemotherapy followed by chemoradiotherapy versus concurrent chemoradiotherapy in locally advanced non small cell lung cancer.

MATERIALS AND METHODS :

Eligible patients were cases of NSCLC stage III within the age group of 18-70 years, ECOG performance status of 0-2 and without any serious co-morbidity. Eligible patients (n=53) were randomized into two arms. In arm A, patients received weekly paclitaxel (50 mg/m²) and carboplatin (AUC 2) IV concurrently with XRT to 66 Gy at 2Gy/# for 7 weeks. In arm B (n=25), two cycles of induction chemotherapy with paclitaxel (200mg/m²) and carboplatin (AUC 6) IV every 21 days. Concurrent chemoradiotherapy began on day 43 and continued as outlined for patients on arm A. Mean period of follow up was 8 months.

RESULTS :

Overall response rate was higher in arm B (56% v 69.55% ; p=0.759). Acute hematogenous and acute skin toxicity was higher in arm A (60% v 47.82%; p=0.496 and 24% v 17.39%; p=0.598 respectively) and acute pulmonary and aero-digestive tract toxicity were higher in arm B (56% v 69.56; p=0.524 and 64 v 82.59; p=0.44 respectively), but none of these differences were statistically significant. There were hardly any difference in DFS and PFS in arm A & B (9.5 v 10 months and 10.4 v 11.8 months respectively; CI 95%).

CONCLUSION :

No significant difference in terms of efficacy and toxicity was found between induction chemotherapy followed by chemoradiotherapy and chemoradiotherapy alone.

ABSTRACT**ASSESSMENT AND COMPARISON OF QUALITY OF LIFE AND SEXUAL FUNCTIONS BEFORE AND AFTER RADICAL CONCOMITTANT CHEMORADIATION IN CANCER CERVIX**

Faridha Jane R M Momin*, Krishnangshu Bhanja Chowdhury*, Abhishek Basu*, Kakali Choudhury*, Partha Dasgupta*, Kousik Ghosh*, Subir Gangopadhyay*

*Department Of Radiotherapy, R.G.Kar Medical College & Hospital, Kolkata.

BACKGROUND:

Globally, cancer of cervix is the 3rd most common malignancy among females, but unfortunately the health care services offered to these patients are mostly aimed at treating the disease and not the patient as whole. Particularly in developing countries like ours, quality of life issues and psychosexual problems is not often addressed properly. This study might help to assess and compare the psychosexual functions and quality of life in these patients before, during and after treatment which might help to find out some treatment specific interventions directed towards information, education and counselling (IEC).

AIMS AND OBJECTIVES:

To assess the quality of life and psychosexual function of survivors of locally advanced carcinoma cervix treated with radical chemoradiation.

MATERIALS AND METHODS:

Patients of histopathologically proven locally advanced carcinoma cervix and sexually active were included in this study from sept 2013 to may 2014 .Patients were assessed using 2 structured questionnaire of health related quality of life (The European Organisation and Treatment of Cancer, EORTC QLQ C-30 & Cx-24). It is a cancer-specific 30 item questionnaire, these scores were transformed according to the EORTC QLQ C-30 scoring manual (Fayers et al,1999) And the sexual activity were measured by Female Sexual Function Index (FSFI), it includes 19 items compiled in six domains. They were calculated according to the recommended scoring system (Rosen et al). The baseline observation were recorded when patient first reported & 2nd, 3rd, 4th, 5th evaluation was done immediately after treatment, at the end of 3rd, 6th and 12th months respectively. The change in quality of life and sexual morbidity were assessed by comparing before and after treatment by measuring and comparing their mean scores.

RESULTS:

66 patients were enrolled in the study with average age around 48 years. The mean score of global health of cervical cancer patients at twelve months post treatment was 78.1, which was significantly higher than the pre-treatment score 66.18. Patients experienced substantial decrease in sexual activity during and post treatment period and gradually improved with time.

CONCLUSION:

From this study, it can be concluded that treatment with chemoradiation is significantly affected the quality of life and psychosexual function along with physical problems. Hence, further studies are needed for more information and intervention to improve the problems.

ABSTRACT
WHAT IS COST OF REDUCING CARDIAC MORBIDITIES
WHEN TREATING BREAST CANCERS
WITH RADIATION THERAPY?

Moses Arunsingh

Purpose/Objective:

There is no threshold limit for radiation induced cardiac toxicity, making it especially relevant for cardiac sparing radiation delivery in adjuvant breast radiotherapy. Deep inspiratory breath hold (DIBH) technique is one method for reducing the heart dose, however, it is resource intensive. This study analyses the cost of cardiac sparing using DIBH and its associated benefits.

Materials/methods:

DIBH technique using Varian RPM, was used to deliver radiotherapy for 50 consecutive patients of left sided breast cancer. The time required in minutes and the number of personnel involved during each step of the planning and the treatment (40Gy in 15 fractions) were recorded. Weighted person hours (WPH) for each step were calculated and all the steps were summed up to arrive at the WPH for each patient. Radiographers, medical physicists and radiation oncologists were given a weightage of 1, 2 and 3 respectively for calculating the WPH. The data was analysed to see if experience reduces the time required. We also calculated the average WPH required for reducing the heart dose by 1 Gy.

Results:

The mean age was 51 years. 14 patients were known hypertensive on medications while none of them were known ischemic heart disease patients. Three were suffering from COPD. Twenty nine patients had breast conservation surgery while the remaining 21 patients underwent mastectomy. The mean WPH was 21.49 for the entire cohort. The average mean heart dose (MHD) in the free breathing (FB) technique was 380.96cGy and 160.61cGy in the DIBH technique (p=0.002). Average WPH required for the DIBH planning process was 13.09 and 8.39 for delivery. Patients were divided into 2 cohorts, of 20 and 30 respectively, to assess if practice allowed reduction in DIBH WPH and this showed a decreasing trend of the WPH in the second cohort (22.2 vs 21.0, p=0.36). The average WPH required to reduce the MHD by 2.2 Gy was 22.54 WPH. The average person hours of the oncologist required to reduce the MHD by 2.2 Gy was 0.39 hours, while that of medical physicists and radiographers were 2.89 and 15.9 hours respectively.

Conclusion:

Although a resource intensive procedure, with practice the time required reduces with experience. On an average 10.25 WPH is required to reduce the MHD by 1 Gy, with 0.18 person hours of the oncologist versus 1.31 person hours of physicist and 7.23 person hours of radiographers time.

	Radiographer	Medical Physicist	Radiation Oncologist
Average Person Hours for a patient treated by DIBH technique	15.9 person hours	2.89 person hours	0.39 person hours

Formulae used :

$$\text{Weighted Person Hours} = (\text{Weightage} \times \text{Person involved} \times \text{Time in Minutes}) / 60$$

$$\text{Person Hours} = (\text{Person involved} \times \text{Time in Minutes}) / 60$$

ABSTRACT**PERCEPTION OF PATIENT'S RELATIVES ABOUT CANCER:
AN INSTITUTION BASED, QUESTIONNAIRE BASED SURVEY****AUTHORS:**

Dr. Sourav Sinha¹, Dr. Rudrajit Paul², Dr. Swapan Kumar Mallick³.

1. 2nd year PGT, Department of Radiotherapy, Medical College Kolkata
2. Assistant Professor, Department of Internal Medicine, Medical College, Kolkata
3. Assistant Professor, Department of Radiotherapy, Medical College, Kolkata

INTRODUCTION:

An important question that we have little information on at present is where do illness beliefs come from? The source of people's perception of illness is diverse and ranges from first hand experiences with a family member who may suffer from an illness, to information from the relatives and friends as well as the media. Our research is based on this belief and varied perception of the patient's relatives who attended Medical College Kolkata, Radiotherapy Department both outpatient and inpatient department with their patients for treatment.

MATERIALS AND METHODS:

A cross-sectional, hospital based observational study. Institutional ethical permission and informed consent of every study subjects was taken. We considered 38 healthy relatives of different cancer patients as our study subjects. Study duration was a period of 3 months from October 2015 till December 2015. The subjects were given questionnaire based on "The Illness Perception Questionnaire Format". It included five sections: Identity, Cause, Timeline, Consequences and Cure-control. With that we added an additional component of 'Prevention'. SPSS version 20.0 was used for statistical analysis.

RESULTS:

66.7% of males had no idea about the probable cause of cancer in compare to females (33.7%) and this is statistically significant ($p=0.05$). Majority of the relatives of cancer patients 63.2% found it difficult to live with the patients. 47.4% found cancer illness as a prolonged course of disease. 50% of males considered treatment is effective and is statistically significant ($p=0.003$) in compared to the females (77.8%). There was no hope among 26.3% of patients who considered that death is inevitable. 40% of males resorted to alternative medicine in compare to 22.2% females. 80% males came to know about the disease from doctors in compare to 33.3% females and the result is statistically significant ($p=0.001$).

DISCUSSIONS:

Similar type of study was carried out at King Abdulaziz University Hospital, Jeddah, Saudi Arabia which revealed similar results with males having lot misconceptions about cancer itself and its prognosis like the present study.

CONCLUSIONS:

From the above study it is quite evident that a majority of study subjects particularly males who have not received college education, don't even know the established causes of cancers like smoking or tobacco and had deficient perceptions and poor attitude about important issues concerning cancer such as different mode of treatment, alternative treatment, biological causes, and prognosis.

ABSTRACT**NEOADJUVANT CHEMORADIATION FOR RECTAL CANCER:
AN AUDIT OF ACUTE TOXICITY , RESPONSE
AND LOCAL CONTROL**

**Partha Sen, D Gowardhanan, Sudeep Banerjee, Manas Roy, Suagata Sen,
Paromita Roy, Sanjoy Chatterjee, Rimpa Basu Achari,
Raj Kumar Shrimali, Indranil Mallick**

AIM:

Audit the results of multimodality treatment of rectal cancer with neoadjuvant chemoradiation followed by surgery with/without adjuvant chemotherapy, specifically focussing on response rates and local control.

METHODS:

The records of the first 102 rectal cancer patients who received neoadjuvant chemoradiotherapy in Tata Medical Center, Kolkata between Nov'11 to June'14 were audited.

RESULTS:

Sixty one patients (59.8%) were male. Median age of presentation was 51yrs (range 24yrs to 80yrs). He majority had locally advanced disease [stage III- 99 (97%)patients, Stage I-II 3(2.9%) patients]. Tumor Location was almost equally distributed over lower (36 patients—35.3%), middle(42 patients—41.2%) and upper (24 patients—23.5%) rectum. Median pre-treatment length of tumor was 5 cm (range 1.2 cm to 10cm). All patient received radiotherapy using 3D conformal techniques with 3 fields in two phases: Phase I: 45Gy/25#@180cGy/# to Tumor + pelvic nodes followed by a boost with 5.4Gy/3# along with concurrent Capecitabine (825mg/m² BD 5 days a week). Acute toxicity was low [Gr 2+ toxicity was seen in 3 (2.9%)]. Seventy-six patients (74.5%) underwent low anterior resection and 23 patients (22.5%) underwent abdominoperineal resection. On surgical pathology 18 patients (17.6%) had complete pathological response (ypT0N0), and 2 more patients had complete primary tumor response (ypT0N+). A total of 19 patients(18.6%) had ypT1-2N0 disease. Adjuvant chemotherapy was administered to 84 patients(82.3%). Median follow up was 21.62 months. Disease was progressed in 27 patient, actuarial 2 year PFS was 73.5%. There has been one local failure, remaining being distant metastases. Median progression free survival has not been reached.

CONCLUSIONS:

Neoadjuvant chemoradiation can be delivered safely with low rates of acute toxicity. There were a relatively large number of complete responders and low rates of local failure. Long term control and survival data are being audited.

ABSTRACT**PROSPECTIVE NON RANDOMIZED OBSERVATIONAL COMPARATIVE STUDY OF CONCURRENT CHEMORADIATION IN CARCINOMA OF ORAL CAVITY AND OROPHARYNX (STAGE III & NON-METASTATIC STAGE IV) TREATED WITH 3D-TPS BASED RADIATION AND SIMULATION BASED CONVENTIONAL RADIATION IN RELATION TO TOXICITY AND RESPONSE.****Author: Dr.Sanchayan Mandal, DNB (Resident), SGCCRI, Dept of Radiotherapy****Purpose:**

3D-CRT is the corner stone of modern radiation treatment. Although it offers more conformal dose distribution than 2D conventional radiation therapy, 3D-TPS based planning is more costly and time taking procedure in comparison to X-ray based simulation planning treatment. It is of much common concern in the context with a centre with a huge bulk of patients belonging to low socioeconomic condition who cannot afford 3D-CRT. Our purpose is to compare the two radiation treatment modalities to see the comparative results in terms of clinical response and acute and late toxicity.

To compare clinical response and acute and late toxicities between 3D-TPS based and X-ray simulation based concurrent chemoradiation treatment of locally advanced oral cavity and oropharyngeal cancer, observed at completion of treatment ,3 months, 6 months, and 1 years after the completion of treatment.

Materials and Methods:

2 Patients with age 18 years to 70 years including both sexes, histologically proven stage III and non-metastatic stage IV, patients with ECOG<2 included in the study. Total numbers of subjects were 60 and divided into X-ray simulator based radiation (Group A) and 3d-TPS based planning (Group B) with 30 patients each arm. In both cases Cisplatin (40mg/m²) used as weekly concurrent chemotherapy. Patients were treated with conventional radiation by using 6 MV linac and 6MV 3D-CRT.

Target volume delineation based on ICRU 50 and contouring guideline followed according to RTOG and EORTC guideline.

Patients were treated with ipsilateral anterolateral wedge pair or two parallel opposed lateral field and a lower anterior neck field (AP).

Doses 66 Gy in 33 fractions (2 Gy per fraction). Spinal cord shielded after 45 Gy in 23 fraction and in lower neck 50Gy in 25 Fraction. Cisplatin (40mg/m²) used weekly for 6 cycles. Premedication with adequate hydration used along with it.

Subjects chosen from SGCCRI for 1year period (November 2013 to October 2014). Statistical analysis performed by t test, Z test, x².

CTCAE version 3.0 was used for assessing acute toxicities and RTOG/EORTC late radiation morbidity scoring criteria was used for late toxicities.

RECIST 1.1 criteria was used to assess response after 6 weeks, 3 months, 6 months and 1 year of treatment completion.

Results:

Final analysis was done on 25 patients selected in each group. 3 patients in each arm (total 6 patients lost to follow up) and 4 patients were treatment defaulter. 3 Patients and tumor characteristics studied on basis of age, gender, addiction, clinical stage, performance status, overall treatment compliance. Distribution of acute mucosa reaction during RT was Grade 1—2(8%), grade 2—8 (32 %), grade 3—15(60%) in group A and Grade 1—1 (4%), grade 2- 10 (40%), grade 3- 14(56%) in group B. Acute grade 2 mucosal toxicity noted on group B but not significant (p>0.05).

Salivary gland toxicity were like Grade 1—20(80%), grade 2—4(16%) in group A and was grade 1—21(84%), grade 2—(8%) in group B. Grade 2 acute salivary toxicity higher noted in group A (p>0.05), no patient in both groups develop grade 3 toxicity.

Pharynx and esophageal toxicity was like grade 1-3 (12%), Grade 2- 17(20%) in group A and was grade 1 -2(8%), Grade 2 – 20(80%), Grade 3 -3 (12%) in group B. Group B had acute grade 3 toxicity of pharynx and esophagus but not statistically significant (p>0.05)

Acute skin toxicities were Grade 1- 22(88%), Grade 2—3(12%) in group A and was Grade 1 -23 (92%), Grade 2 -2(8%). No grade 3 or higher skin reaction noted.

Late toxicities in mucosal reaction noted. These were noted at 3months, 6 months and 1 year. No grade 1 or 2 toxicities in both groups.

Late salivary gland toxicity (Xerostomia) at 1 grade 1 -8 (44.4%) in group A and grade 1- 5 (31.2%) in group B (p>0.05).

No Late pharynx and esophageal toxicity (Dysphagia) and late skin toxicities noted at 1 year follow up period.

At completion of the treatment complete response in Group A and Group B was 60% & 64% respectively (p= NS)

At 1 Year follow-up complete response (CR) 16(64%), partial response (PR) 2(8%), Progressive disease (PD) 28% in group A and CR 16 (64%) and PD 36% in group B. P value not significant. 4

Conclusion:

In conclusion there was trend of superiority of 3D-CRT over 2D-RT regarding acute and late toxicity of salivary glands though not clinically significant. As conformal radiation is more time consuming and costlier and not available in every radiation centre of India, we can consider simulator based conventional treatment for patients from low economic background and locally advanced stage. Although, longer follow up and well designed randomized controlled trial is required to conclude finally.

ABSTRACT**A RETROSPECTIVE AUDIT OF DEFINITIVE THORACIC RADIATION
WITH OR WITHOUT CHEMOTHERAPY FOR NON METASTATIC
LOCALLY ADVANCED (T3-4N0-2) NON SMALL CELL
LUNG CANCER PATIENTS (NSCLC).**

Upasana Mukherjee
Medical College, Kolkata

Background:

Although the standard treatment for unresectable stage IIIA and most IIIB NSCLC patients is concurrent CRT, there is still a propensity among oncologists to use sequential chemoradiation instead, for the fear of exaggerated toxicity. Moreover, though most robust evidence for concurrent chemoradiation comes from trials using cisplatin there is an increasing trend of using other active agents like paclitaxel and vinorelbine in the concurrent setting. With this background a retrospective audit was undertaken to evaluate results of use radiation alone or with various chemotherapeutic agents in practice setting.

Objective:

To determine the response rates, toxicity, failure patterns and survival outcomes of locally advanced non-small cell lung cancer (NSCLC) treated with definitive radiotherapy with or without chemotherapy.

Materials and methods:

Eligibility criteria includes histology/cytology proven primary NSCLC localised to one lung and non metastatic at diagnosis receiving definitive treatment between 01.01.2012 to 31.12.2014 along with at least one year of follow up or valid contact number.. The primary outcome was overall survival (OS). Secondary outcomes were response, failure patterns and toxicities

Results: Sixty five patients with stage IIIA and IIIB NSCLC who received definitive radiotherapy with or without chemotherapy were retrospectively reviewed. 29 cases were of squamous type (40%) and 27 cases were of adenocarcinoma . The mean age was 55.6 years. The standard radiotherapy scheme was 60 Gy in 30 fractions using Cobalt 60 gamma rays in two phases. The main concurrent chemotherapy regimen was cisplatin or weekly paclitaxel combined with AUC 2 carboplatin. Thirteen patients received concurrent chemoradiation, 11 patients received radiation alone and the rest received sequential chemoradiation. Acute toxicity was highest in the concurrent arm (33% grade III or more)

After a median follow up of 17 months, the overall survival for all patients was 65.8%. the median disease free survival was 16.8 months. The most failure pattern was distant metastases, most commonly brain metastases. The median survival was 19.4 months for the CCRT arm, 16.6 for the Sequential RT arm and 15.5 months for the only RT Arm (P=0.171)

Conclusion:

Though use of concurrent chemotherapy was associated with better outcome, it is used for a small subset of patients due to its increased acute toxicity, in the practice setting, in a tertiary care centre of Kolkata.

INTERDIGITATED BRACHYTHERAPY IN CERVICAL CANCER IN THE INDIAN PERSPECTIVE

Dr Md Asifullah, Medical College, Kolkata

Introduction:

Cervical cancer is one of the most common malignancy in rural India. Several studies have shown decrease in survival and pelvic control with prolongation of treatment duration. About 1% loss of tumor control is noticed with per day prolongation of treatment beyond 30 days. Commonest way to reduce treatment duration in cervical cancer is to interdigitate brachytherapy with external beam radiation.

Aims And Objectives

- Response, acute and late toxicity and disease free survival in patients of locally advanced cervical cancer scheduled to receive interdigitated brachytherapy.
- Addressing logistic and patient compliance issues associated with interdigitated brachytherapy in a tertiary centre.

Materials And Methods:

.Adult patients of age 35 to 70 years , having pathologically proven squamous cell cervical carcinoma and FIGO stage IIB and IIIB without any history of prior hysterectomy and ECOG performance status 0 and 1 were included in the study.

Patients received external beam radiation 36.4 Gy in 20 fractions, 5 fractions per week, along with weekly concurrent cisplatin 40 mg/m² for 4 weeks in Phase I, followed by external beam radiation 14.4 Gy in 8 fractions, 4 fractions in a week along with interdigitated brachytherapy of 7 Gy fraction size for 3 fractions. Target treatment completion was in 44 days.

Statistical analysis was done with IBM SPSS v 20

Results

Out of the 40 patients, 35 achieved complete response and 2 partial response. During the follow-up only one patient died due to metastatic disease to lungs, while there was one loco-regional failure and one distant failure.

Most common grade 3 acute toxicity was nausea and vomiting. Median follow up period was 18 months (3- 24 months). 5 patients were lost to follow up. Grade 3 late toxicity was most commonly proctitis (2), subcutaneous fibrosis (9), vaginal stenosis (16) and dyspareunia (19).

Logistic and patient compliance factors were not a bar in our study. 37 patients completed their treatment among which 31 completed within target time period. The most common cause of delay in treatment was nausea and vomiting

Discussion

A Japanese retrospective data of 1495 patients treated with 50 Gy EBRT along with interdigitated brachytherapy 4 Gy per fraction, biweekly, for 10 fractions, showed 1430 patients (95.65%) had a complete response, rate comparable with our interdigitated arm (92.1%). Though , in terms of complete response , our sequential arm did poor (71%). Five year local control rate in Japanese study was 92%, 79.4% and 64.2% for stage IB, II and III/ IVA respectively, data not available in our study due to short follow up limitation.

Commonest late toxicity of Grade III, IV and V(fatal) was rectal, small bowel and urinary , particularly proctitis (Grade III-1.5%) and haematuria (Grade III-1.1%) predominating. In our study also grade III late proctitis is one of the commonest late complication in (0.54 %) with little more expected with longer follow up. However , we have found another two common late grade 3 complication , vaginal stenosis (43.2%) and dyspareunia (40.54%)

Conclusion

Interdigitated brachytherapy is a viable option to reduce treatment duration in cervical cancer and this option is not limited by logistic or patient compliance factors even in a high volume Indian Centre . Expected acute toxicity can be more but generally manageable. Large randomized trial is also needed to evaluate potential benefit of better locoregional control which can be expected with interdigitated brachytherapy schedule.