

respectively. A total of 35 ptes had local recurrence, and 50 ptes had distant metastasis. A total of 14 ptes had died. In relation to side effects, 3 ptes had localized moist desquamation, skin pigmentation was observed in 4 ptes, and telangiectasias were observed in 7 ptes. Breast fibrosis was presented in 2% of ptes. Cosmesis results were considered good or excellent in 82% of ptes.

Conclusions: LDR-BQT as a boost-treatment modality achieved high long term local control, overall survival and disease free survival in ptes with preserving-breast cancer stage I and II, without late effects and good/excellent cosmesis results.

30 oral

Long term results of high-dose rate (HDR) brachytherapy (BQT) boost in preserving-breast cancer patients (ptes): The experience of Radiation Oncology Medical Institute (IMOR) of Barcelona.

L. Henriquez, B. Guix, J.I. Tello, A. Martinez, J.A. Lejarcegui, F. Finestres
IMOR, Radiation Oncology, Barcelona, Spain

Introduction: Stage I and II preserving-breast cancer ptes with histological risk factors are treated with external beam radiotherapy (EBR) and BQT boost with HDR. The aim of the study was to analyze long term results of a prospective group of stage I and II breast cancer patients, in terms of local control, survival, as well as cosmesis and side effects.

Material and methods: Between December 1991 and December 2000, 294 ptes were treated with conservative surgery, and EBR 50,4 Gy/28 fr over 5,5 wks, followed by BQT boost with HDR-BQT. All ptes had infiltrating ductal carcinoma of the breast, tumoral size < 4 cm, with or without intraductal component. After 2-3 weeks of completion EBR, HDR-BQT total dose was given depend on histological risk factors. Ptes without intraductal component or surgical margin less than 1 cm received 18 Gy with 200-250 cGy/1r in 2-3 fr per day in 3-5 days (group 1). Ptes with intraductal component or surgical margin greater than 1 cm received 20-22 Gy with the same fractionation (group 2). HDR-BQT boost total doses were calculated following the lineal quadratic model to be equivalent to LDR in terms of early/late effects. The dose was prescribed at the isodose of 85% of the basal dose rate with geometric optimization of dose distribution. Ptes within BQT treatment were in an outpatient basis. All ptes completed treatment, and no pte was lost to follow-up. Symmetry, fibrosis, and colour of the breast were evaluated by medical staff to assess cosmesis results as very bad, bad, good or excellent.

Results: With a median follow-up of 70 months (range 4 and 12 months), actuarial overall survival at 9 years HDR-BQT boost was 99%, disease-free survival was 88% and local control rate was 91%. A total of 15 ptes had local recurrence, 11 ptes had distant metastasis, and 3 ptes had died. In relation to side effects, 3 ptes had localized moist desquamation, 8 ptes skin pigmentation, and 5 ptes telangiectasias. Breast fibrosis was presented in 1,8% of ptes. Cosmesis results were considered good or excellent in 96% of ptes.

Conclusions: HDR-BQT is an effective modality of treatment for tumor bed boost in preserving-breast cancer, because it achieved a high long-term local control and survival in stage I and II breast cancer ptes. The outpatient basis modality, radioprotection to staff, and the better radiobiological effects of HDR on tissue than LDR-BQT, are some of the important aspects to be considered when HDR-BQT is used.

31 oral

Brachytherapy boost parameters and local recurrence in breast cancer patients treated with conservative surgery and radiotherapy

M. Maher¹, F. Campana², E. Mouret-Fourme², R. Dendale¹, J. Vilcoq², A. Fourquet²

¹Mater Private Hospital, Dublin, Ireland

²Institut Curie, Paris, France

Purpose: the aim of this study was to examine the relationship between local recurrence of breast cancer and the technical aspects of low dose rate brachytherapy boost in patients undergoing treatment with conservative surgery and post-operative radiotherapy. Parameters analyzed included the number of lines/planes implanted, implant volume, 192Ir activity employed, total length of 192Ir used, implant duration, dose delivered and location of implant within the treated breast. All clinical parameters were also analyzed for significance to local recurrence.

Methods & materials: we present a retrospective series of 290 breast cancer patients treated in Institut Curie between 1982-1995, whose treatment incorporated a brachytherapy boost to the tumor bed. All patients had an iridium 192 interstitial implant following post-operative external beam radiotherapy (52.2 Gy, 29 fractions of 180cGy). Patients were selected for treat-

ment with brachytherapy boost because of invasive tumor at the margin of excision (18.9%), DCIS involved margins (24.5%), invasive tumor within 3mm of the resection margin (31.4%) or the presence of a combination of factors which increase risk of local recurrence, such as tumor size, tumor grade, axillary nodes and/or negative oestrogen receptors in the remaining 25.2% of patients whose margin of excision was greater than 3mm. The median age of the study group was 52 years with a median clinical tumor dimension at presentation of 2cms. The median number of radioactive lines implanted was 4, median total length of 20cms, delivering a median of 20 Gy in accordance with the Paris dosimetry system.

Results: at median follow-up of 80 months, the 7 year overall survival was 89.2%, the freedom from local recurrence 82.7%, survival without metastases 84.9% and the disease free survival was 72.5%. Factors found on multivariate analysis to be statistically significant in predicting for local recurrence were brachytherapy treatment volume (p=0.0019), age less than 40 years (p=0.0002) and high grade histology (p=0.026). Brachytherapy implant dose, activity of 192-Ir, overall treatment time, total length of 192-Ir used, number of planes implanted and all other clinical parameters examined had no statistically significant impact on the local recurrence rate. However, brachytherapy treatment volume was found to be significant at 16.500 mm³ and the factors governing this volume which were found to be significant were the length and thickness of the isodose volume but not the width.

Conclusion: brachytherapy treatment volume was found to have a critical threshold of 16.500 mm³ and the parameters, isodose length and thickness were also found to be significant. The only reliable method of obtaining this critical volume of 16.500 mm³ in interstitial breast brachytherapy is with a two plane implant. Although there was no excess of breast cancer recurrences in the upper inner quadrant or axillary tail in this series, these locations confer anatomical constraints which often preclude a two plane implant. It is therefore the recommendation of the authors that when interstitial brachytherapy is undertaken as a boost in breast cancer patients, a two plane implant should be carried out to ensure the critical volume of 16.500 mm³ is achieved.

32 oral

An improved conformal therapy with geometrically optimized stepping source techniques and dose normalization and its implication on risk of fibrosis for interstitial breast implants

B. Pieters¹, A. Saarnak², M. Steggerda², J. Borger²

¹Academic Medical Center/ University of Amsterdam, Radiotherapy, Amsterdam, The Netherlands

²The Netherlands Cancer Institute / Antoni van Leeuwenhoek Huis, Radiotherapy, Amsterdam, The Netherlands

Introduction. It is well known that a boost has a negative impact on cosmesis in the breast conserving treatment of breast cancer. It has also been shown that for interstitial breast implants the treated volume is an important prognostic factor for cosmesis. In this study the conformity to a defined planning target volume (PTV) for different implant geometries and the effect of dose normalization were investigated. Using clinical data an estimation of the risk for fibrosis for the different implants was assessed.

Material and Methods. The dose distributions of four implant geometries were compared for a PTV of 48 cm³. Implants #1 and #2 had linear sources arranged in a triangular pattern of equal lengths and lengths adapted to the shape of the PTV. Implants #3 and #4 were squared pattern arranged implants with linear sources and a stepping source with geometric optimized dwell times. The active lengths were adapted to the shape of the PTV. Using implant #4 for PTVs of different volumes, the reference dose (RD) was normalized to 85% and 91% of the mean central dose (MCD) respecting full coverage of the PTV. Normalization to a higher isodose than the conventional 85% of the MCD was chosen to improve dose uniformity. Volumetric parameters were derived from cumulative dose-volume histograms and used to estimate the risk for moderate to severe fibrosis. Results. Comparing implants #2, #3, and #4 with #1, the treated volume (V(100)) encompassed by the reference isodose was reduced by 22%, 35%, and 37%, respectively. The conformation number increased being 0.30, 0.39, 0.47, and 0.48 for implants #1, #2, #3, and #4, respectively. The V(100) was not different when comparing dose normalization to 91% and 85% of the MCD. The average reduction of the volumes receiving a dose of at least 125% (V(125)) of the RD when the dose was normalized to 91% compared to 85% of the MCD was 18%. Comparing implant #1 with #4 the risk to develop moderate to severe fibrosis was decreased from 60% to 45%. Unfortunately there is no clinical data to assess the effect of a more uniform dose distribution on cosmesis.

Conclusion. A conformal treatment to a PTV could be best achieved with a geometrically optimized stepping source plan with needles arranged in a squared pattern. Reduction of high dose volumes within the implant was

obtained by normalizing the RD to 91% instead of 85% of the MCD. With more conformal implant geometries the risk on moderate to severe fibrosis can substantially be reduced.

MISCELLANEOUS

33 oral

RENO: A European surveillance registry of coronary brachytherapy with the Novoste™ Beta-Cath™ System.

*V. Coen*¹, *W. Sauerwein*², *R. Orrechia*³, *P. Von Rottkay*⁴, *P. Coucke*⁵, *M. Ehnert*⁶, *M. Donsbach*⁷, *P. Urban*⁸, *P. Levendag*¹

¹University Hospital Rotterdam/Daniel den Hoed Cancer Centre, The Netherlands

²Zentrum für Strahlungstherapie Universitätsklinikum Essen, Germany

³Department of Medicine Centro Cuore Columbus Milan, Italy

⁴Mueller Hospital München, Germany

⁵Department of Medicine C.H.U.V. Lausanne, Switzerland

⁶St. Georg Hospital Hamburg, Germany

⁷St Johannes Hospital Dortmund, Germany

⁸Cardiovascular Department La Tour Hospital Meyrin-Geneva, Switzerland

Intravascular brachytherapy (VBT) has proven to be an effective mode of preventing restenosis following Percutaneous Coronary Intervention (PCI), but there are no data as yet concerning the application of VBT in routine clinical practice. Between April 1999 and September 2000, 1036 consecutive patients treated in 47 European centres with the Novoste Beta-Cath™ system were included in RENO, the single available registry of VBT. The 6 months follow-up data have so far been obtained for 546 patients. 785 (76.7%) patients were males, and mean age was 61.9±10.2 years. 248 (26.3%) had unstable angina and 238 (23.4%) were diabetics. 1030 (94.1%) target lesions were in native vessels and 65 (5.9%) in a bypass graft. 196 (17.9%) were de novo lesions, 46 (4.2%) restenotic and 850 (77.6%) in-stent restenosis. Mean estimated reference diameter was 3.2±0.5mm, and mean estimated lesion length was 19.2±12.0mm.

VBT was successful in 1035/1084 lesions (95.5%) and geographical miss occurred for 67 (6.2%). A dose of 18.8±3.2Gy was delivered at 2mm from the source axis using a 30mm (182 lesions) a 40 mm (869 lesions) or a 60 mm (42 lesions) source train. A pullback stepping manoeuvre was used for 167 (15.5%) procedures. The dwell time had to be fractionated due of ischemia for 40 procedures (3.7%). A new stent was implanted for 327 (30%) lesions.

In-hospital MACE rate (Major Adverse Cardiac Events) was 20/1036 patients (1.9%). At discharge, aspirin and clopidogrel were usually given for at least 6 months. At 6 months follow-up MACE rate was 106/546 (19.4%). Angiographic follow-up was available for 412/546 patients (75.4%); non-occlusive restenosis in 16.8% and total occlusion in 5.7% of cases. A combined end-point for late (30-180 days) definite or suspected target vessel closure was reached in 36 (6.6%) patients. At 6-month follow-up, for 96 eligible patients treated with a pullback stepping procedure MACE rate was 32.3%. Angiographic follow-up was performed in 81 of eligible patients (85.3%); restenosis rate was 34.6%, including 12.3% late total occlusions. These data, derived from a large cohort of unselected consecutive patients, suggest that the good results of recent randomised controlled trials can be replicated in routine clinical practice.

34 oral

Long lesions treated using Sr/Y90 source trains, a sub-analysis of RENO: a European Surveillance Registry with the Novoste™ Beta-Cath™ system

A. Colombo, *G. Stankovic*, *P. Serruys*, *T. Schiele*, *E. Eeckhout*, *S. Silber*, *R. Bonan*, *P. Urban*

Centro Cuore Columbus, Milan, Italy

The RENO registry with the Novoste™ Beta-Cath™ system has been established to keep track of all patients undergoing Beta-Cath brachytherapy not suitable for inclusion in any Beta-Cath trial.

From the total of 1036 patients included so far in this registry, brachytherapy was delivered with the pullback technique in 162 of these patients (15.6%) due to the lesion length.

This report presents the acute and 6 month follow-up data of these 162 patients in whom 185 lesions (171 located in native coronary arteries and 14 in by-pass grafts) were treated with this technique (1.14 lesion/patient). Mean age was 61.8±10.9 years and 133 were male (82.1%). 36 patients (22.2%) had diabetes and 37 (22.8%) had unstable angina. 47 lesions were de novo, 10 were restenotic, and 126 were in-stent restenosis. Reference

vessel size was 3.24±0.6 mm and mean lesion length was 32.78± 18.99 mm.

Radiation treatment was performed utilizing a 30 mm (17.4% of lesions), 40 mm (77.7% of lesions), or 60 mm (4.9% of lesions) long source train, with a mean dwell time of 7.29±1.24 min delivering 18.94±3.04 Gy at 2 mm from the center of the source.

Procedures were successful in 177 lesions (96.7%). Stents were implanted in 83 lesions (45.9%). Geographic miss was noticed in 9 lesions (4.9%). In-hospital outcome: two patients (1.2%) had myocardial infarction, and two patients (1.2%) had repeat PTCA. There were no deaths or CABG. 96 patients were eligible for 6-month follow-up. The overall incidence of MACEs (death, myocardial infarction and TVR, including in-hospital events) was 32.%. Three patients died (3.1%), 4 patients (4.2%) suffered myocardial infarction, and 27 patients (28.1%) underwent repeat target vessel revascularization (23 had rePTCA and 4 had CABG). Angiographic follow-up was performed in 81 of eligible patients (85.3%). Angiographic restenosis rate was 34.6%, which includes an incidence of late total occlusions of 12.3%.

Conclusions: these preliminary results seem to support the fact that the pullback technique can be safely performed with this beta delivery system. The follow-up events appear acceptable considering the length of the lesions treated and the high incidence of in-stent restenosis in the baseline population.

35 oral

High dose rate brachytherapy is a curative treatment for small invasive or in situ endobronchial carcinoma

*F. Lorchel*¹, *D. Spaëth*², *P. Scheid*³, *P. Aletti*¹, *D. Peiffer*¹

¹Department of brachytherapy, ²Medical Oncology, Alexis Vautrin Cancer Institute, ³Pneumology, University Hospital, 54511 Vandoeuvre-Les-Nancy, France

Introduction: high dose rate brachytherapy (HDR) is an option for treatment of small invasive or in situ endobronchial carcinoma. This retrospective study analyses the results of 33 consecutive patients treated with curative intent by this technique in our institute and followed up more than one year. Material and methods: between July 1994 and October 1999, 34 tumours were treated by HDR alone with usual schedule delivering 6 fractions of 5 Gy prescribed at 1cm from the catheters over 3 to 6 weeks. In 31 patients, surgical treatment was excluded because of histologic consideration (in situ carcinoma), history of pneumonectomy or general contraindications. Two patients were treated because of positive margin after surgery. All the tumors were Tis-T1 N0. Most of the treatment used a spacer on the catheters. A dosimetry with optimization was performed for each patient and at each fraction.

Results: the locations of tumors were as follow: 2 tracheals, 4 main bronchials, 20 lobars, and 8 segmentals. One catheter was used for 15 cases, 2 for 12 cases, 3 for 6 cases and 4 for 1 case. The median follow-up was 15 months (range, 5-49 months). The local control (endoscopic and histologic) was 94% at 2 months and 80% at 6 months after the treatment. Local disease failure occurred in 9 patients (29%) at a median time of 9 months. Two patients developed metastasis. The 1-year and 2-year overall survival rate by Kaplan-Meier method were 78% and 57.5% respectively. The 1-year and 2-year specific survival rates were 93% and 66%. Acute complications included 1 pneumothorax, late effects were 6 infections and 12 bronchial stenoses. There were neither hemoptysis, neither lethal complications.

Conclusion: on the basis of strict selection of patients, HDR is a curative treatment for small invasive or in situ endobronchial carcinoma. It allows high local control and survival rates without serious toxicity. Therefore, it offers a good alternative for treatment with curative intent in inoperable patients.

36 oral

Conformal endorectal high dose rate brachytherapy treatment of locally advanced and resectable rectal carcinoma using 3D treatment planning

T. Vuong, *B.A. Moflah*, *P. Fava*, *M.D.C. Evans*, *L. Souhami*, *E. Podgorsak*

McGill University, Montreal, Canada

Purpose: to develop a conformal endorectal brachytherapy technique, by combining 3D treatment planning and high dose rate brachytherapy, in order to achieve tumor downstaging in patients with locally advanced rectal cancer.

Material and methods: 45 patients with newly diagnosed resectable adenocarcinoma of the rectum (T2-4) were treated with preoperative high dose rate afterloading endorectal brachytherapy. Pre-treatment imaging included pelvic MRI and endoscopic rectal ultrasound. Tumors were circumferential in 13 patients, semi-circumferential in 28 patients and less than semi-