**Name of Journal: World Journal of Clinical Oncology**

**ESPS Manuscript NO: 19284**

**Manuscript Type: Editorial**

**Oligometastatic disease, the curative challenge in radiation oncology**

Palacios-Eito A *et al.* Oligometastatic disease in radiation oncology

**Amalia Palacios-Eito, Sonia García-Cabezas**

**Amalia Palacios-Eito, Sonia García-Cabezas,** Servicio de Oncología Radioterápica,Hospital Universitario Reina Sofía,14004 Córdoba, Spain

**Author contributions:** Both authors contributed to this manuscript.

**Conflict-of-interest:** The authors have no conflict of interest related to the manuscript.

**Open-Access:** This article is an open-access article which was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

**Correspondence to: Amalia Palacios-Eito, PhD,** Servicio de Oncología Radioterápica, Hospital Universitario Reina Sofía, Avda. Menéndez Pidal, s/n, 14004, Córdoba, Spain. [amalia.palacios.sspa@juntadeandalucia.es](mailto:amalia.palacios.sspa@juntadeandalucia.es)

**Telephone:** +34-957-011415

**Fax:** +34-957-011414

**Received:** May 3, 2015

**Peer-review started:** May 3, 2015

**First decision:** June 3, 2015

**Revised:** June 17, 2015

**Accepted:** June 30, 2015

**Article in press:**

**Published online:**

**Abstract**

The concept of oligometastatic disease was first described by Hellman and Weichselbaum in 1995. The mere insight of this concept led to the hypothesis that this disease may be cured using local ablative weapons. Surgery has already demonstrated this hypothesis. Surgery limitations, either technical or due to refusal or associated comorbidity, have led to implement alternative ablative options such as stereotactic body radiation therapy (SBRT). SBRT evolved from SRS (stereotactic radiosurgery) because of the need to irradiate extracranial lesions and has been shown to be safe and effective. SBRT achieves local control rates ranging from 70%-90%, but highly variable survival rates depending on the group analyzed. Series with heterogeneous metastatic sites and tumor origin have reported 20% survival rates at 2-3 years, similar to those achieved with surgery. Despite its excellent results, SBRT still faces significant clinical challenges. Its optimal integration with systemic treatment is unknown, and response assessment is very difficult. However, the greatest challenge lies in selection of patients most likely to remain oligometastatic, those who will most benefit from the technique. Biomarkers, molecular signatures, that accurately predict the biological behavior of malignancy are needed. The expression profile of specific miRNAs has been shown to have a potential in this regard.

**Key words:** Oligometastases; Radiotherapy; Stereotactic body radiotherapy; Stereotactic body radiation therapy; Stereotactic ablative body radiotherapy; Curative intent

**© The Author(s) 2015.** Published by Baishideng Publishing Group Inc. All rights reserved.

**Core tip:** Surgery has been shown to be able to cure a proportion of oligometastatic patients. Surgery limitations, either technical or due to refusal, advanced age, or associated comorbidity, have led to progressive implementation of stereotactic body radiation therapy (SBRT) as an alternative local ablative weapon. SBRT has been shown to be safe and effective and to achieve local control rates around 80%, with a variable impact on survival depending on other associated prognostic factors. Despite its good results, SBRT still faces significant clinical challenges, including identification of optimal patients to be treated.

Palacios-Eito A, García-Cabezas S. Oligometastatic disease, the curative challenge in radiation oncology. *World J Clin Oncol* 2015; In press

**EDITORIAL**

The current approach to staging of cancer patients is based on identification of two large groups, patients with local/locoregional tumors and those with distant metastases. This approach stems from the possibility to perform local eradication treatment with curative intent in localized tumors, while metastatic disease is usually treated with palliative intent using systemic drugs. Tumor burden of metastatic disease varies widely for one patient to another, and most systemic treatment schemes do not make differences depending on extent of disease.

The term “oligometastasis” was introduced in 1995 by Hellman and Weichselbaum[1]. Based on their clinical experience, these authors reported an intermediate state of metastatic dissemination between localized disease and multiple dissemination, and considered this as a different clinical entity characterized by a lower capacity of metastatic dissemination. This concept was revised by Niibe *et al*[2] in 2006 as oligo-recurrence. The biggest difference between oligometastases and oligo-recurrences lies in the uncontrolled or controlled primary lesion. They postulated the hypothesis that if this oligometastatic disease is eradicated using local ablative procedures, patient may be cured, as occurs in locoregional tumors. This hypothesis has been supported by surgery by finding that a group of oligometastatic and oligo-recurrence patients may be cured when their metastases are resected. Thus, in a series of over 1000 patients, resection of liver metastases from colorectal cancer achieved 20% survival rates at 10 years[3]. Similarly, 10- and 15-year survival rates of 26% and 22% have been reported in an analysis of more than 5000 patients in The International Registry of Lung Metastases[4]. It may therefore be stated that the oligometastatic status exists, and that a proportion of patients with disseminated disease may be cured. Therapeutic options for local ablation alternative to surgery are currently needed for this purpose. Surgery is associated with significant morbidity and mortality, the group of candidates who are elderly patients with associated comorbidity is increasing, and other patients have already undergone one or more procedures for resection of metastases. Moreover, the cost of this surgery is high[5].

Radiation therapy is, together with radiofrequency, one of the main local ablative options alternative to surgery. Technological development in the past decade, mainly associated to computer systems and advances in radiographic imaging, has allowed for clinical use of a radiotherapeutic technique with high precision and ablative capacity now known as SBRT (stereotactic body radiotherapy)[6] or SABR (stereotactic ablative body radiotherapy), a high‑precision external radiotherapy technique that administers ablative doses (> 100 Gy) in a minimal number of sessions (1-8) with high doses per fraction. SBRT requires specific systems to immobilize patients, as well as guided images to ensure its precision. Sophisticated calculation systems allowing for a high gradient between the doses administered to the tumor tissue and to the surrounding healthy tissue are needed. The name of the procedure (SBRT/SABR) is confusing, because administration under stereotactic conditions is no longer required thanks to the availability of image-guided systems (IGRT). It is a natural evolution of the field of knowledge of cranial stereotactic radiosurgery (SRS), already established because of the need to treat extracranial sites. The non-optimal results of conventional radiotherapy in early non-small cell lung cancer (NSCLC) in patients not amenable to surgery caused this to be the first extracranial indication investigated both in Europe and North America. Both the Nordic Group and the Radiation Therapy Oncology Group (RTOG) showed that in this clinical condition, a dose of 45–54 Gy, administered in three fractions, achieved local control rates of approximately 90% and 3-year survival in 60% of cases, which more than doubled the historical rates achieved with conventional fractionation[7,8].

Radiation therapy with curative intent had never been considered in patients with extracranial oligometastases. Current technological advances allow for aspiring to that ambitious goal, but multiple unresolved challenges still exist[9].

***Results of SBRT in oligometastatic disease***

Limited toxicity, good clinical results, and the experience gained using SBRT in stage I NSCLC have driven use of SBRT for oligometastatic disease. Phase I/II prospective studies have shown SBRT to be a safe and effective treatment for metastases in oligometastatic patients[10-14]. Multiple institutions have reported excellent control rates of irradiated metastases, either pulmonary[15-20], hepatic[11,12], adrenal[21], vertebral[13,14],lymph node[22] or mixed[23-27] (Table 1). The highly diverse prognosis of the population tested makes comparison of survival results impossible. Since Niibe *et al*[28] showed that the most important prognostic factor was the status of the primary lesion, the status of this and whether all tumoral disease is treated with ablative dose should be clarified.

Results of SBRT may be summarized referring to the last systematic review published[29]. This review includes the phase I and II trials available to date and the main case series. Series are highly heterogeneous: They include patients with up to five metastases, distributed in no more than three organs and of diverse histology. Pulmonary and hepatic metastases were most often treated, followed by adrenal gland metastases. Single bone metastases in the spine or nodal metastases were treated in some cases. Local control rates ranging from 70%-90% were reported, with an excellent toxicity profile (> G3 < 5%). Mean survival rate at 2-5 years was 20% (11%-44%), with great variability and closely related to patient selection in each series. Reports show that several metastatic sites may be safely irradiated at the same time, provided the dose limits for healthy organs are respected, and that 25%-30% of patients benefit form a second course of SBRT[23].

No randomized trials are available quantifying the efficacy of SBRT as compared to other local ablative options or its contribution to survival when it is part of a systemic therapy for disseminated disease. Ethical issues and the lack of alternative treatments in most cases make randomization of these patients difficult, and first level evidence may probably never become available. However, SBRT is already part of standard treatment in this group of patients, although its implementation varies widely depending on the hospital because of the technical infrastructure required[6].

***Oligometastatic signature***

Today, selection of patients for SBRT is based on clinical criteria only[30]. Despite the excellent local control achieved, the main progression pattern in these patients is systemic, and a group of them progress rapidly (< 4 mo) to polymetastatic patients. Some clinical factors have been shown to be associated to poorer survival, including brain metastases, “non-adenocarcinoma” histology, and synchronous versus metachronous metastatic disease[31].

Despite these clinical selection criteria, survival rates of approximately 25% show that most patients selected for local aggressive therapy are not cured[29]. A method is needed to objectively categorize patients as oligometastatic or with a trend to progress to polymetastatic patients in short time periods. This would avoid expensive treatments of little clinical benefit and with potential associated toxicity. Alternatively, a group of oligometastatic patients could be initially offered a curative treatment.

Biomarkers that objectively and unequivocally identify oligometastatic patients are needed. miRNAs have provided promising results for this purpose. miRNAs are small single-stranded, non-coding RNA molecules 18 to 22 nucleotides in length that regulate transduction of messenger RNA. miRNAs may therefore be considered as the conductors of the gene expression orchestra. More than 1500 miRNAs have been identified to date in humans. They are involved in regulation of multiple metabolic and cell pathways, particularly those that control the changes occurring during development, embryogenesis, stem cell preservation, differentiation of hemopoietic cells, and brain development. Altered miRNA expression is likely to contribute to human disease and, among other processes, has been related to tumor progression, which includes tumor growth, differentiation, adhesion, apoptosis, invasion, and metastasis formation. miRNA expression profile appears to classify tumors and to reflect their origin and differentiation state[32]. Since altered miRNA expression is related to cancer development and metastasis formation, miRNAs have a great potential to serve as biomarkers. Moreover, it is widely known that tumor tissues release miRNAs to biological fluids (blood, urine and/or saliva) inside exosomes, making them ideal molecular biomarkers for performing non-invasive biopsies, known as liquid biopsies[33]. Several clinical trials are currently analyzing circulating miRNAs in patients with different cancers subject to different therapies (NCT01722851 Circulating miRNAs. ICORG 10-11, V2; NCT01541800 Circulating microRNAs as Disease Markers in Pediatric Cancers; NCT01598285 A Combined GWAS and miRNA for the Identification of Bevacizumab Response Predictors in Metastatic Breast Cancer) to use them as patterns to stratify cancer patients and monitor the efficacy of treatment with a non-invasive method[34].

To date, only the Lussier and Weichselbaum group in Chicago has tested miRNA profiles in tissues from oligometastatic and polymetastatic patients. In 2011 they identified a list of miRNAs that reflects the metastatic progression rate in oligometastatic patients treated with SBRT[35]. One year later, these same authors validated in two case series their prioritized list of miRNAs and were able to predict metastatic behavior in a homogeneous study where only pulmonary metastases treated with surgical resection were included[36]. After a recent combined analysis of both databases[37], this group concluded that oligometastases and polymetastases are different biological conditions and have therefore different molecular profiles which are partly regulated by miRNAs. In this study, they were able to successfully stratify patients treated with surgery or SBRT with oligometastases and polymetastases based on their different miRNA expression. Authors recognize that the study is limited by the small sample analyzed. These are the only databases of miRNAs associated to oligometastases available to date[37].

In conclusion, use of SBRT in oligometastatic disease still faces many challenges: The standard dose scheme and fractionation has not been established, assessment of the local response achieved is very difficult, and the optimal form of integration with systemic treatment is unknown. However, the key factor is probably the identification of the group of patients in whom this local treatment may potentially be curative or provide long survival, delaying or avoiding systemic treatment. Objective parameters for adequate identification of candidate patients are needed.

**REFERENCES**

1 **Hellman S**, Weichselbaum RR. Oligometastases. *J Clin Oncol* 1995; **13**: 8-10 [PMID: 7799047]

2 **Niibe Y**, Hayakawa K. Oligometastases and oligo-recurrence: the new era of cancer therapy. *Jpn J Clin Oncol* 2010; **40**: 107-111 [PMID: 20047860 DOI: 10.1093/jjco/hyp167]

3 **Fong Y**, Fortner J, Sun RL, Brennan MF, Blumgart LH. Clinical score for predicting recurrence after hepatic resection for metastatic colorectal cancer: analysis of 1001 consecutive cases. *Ann Surg* 1999; **230**: 309-18; discussion 318-21 [PMID: 10493478]

4 **Pastorino U**, Buyse M, Friedel G, Ginsberg RJ, Girard P, Goldstraw P, Johnston M, McCormack P, Pass H, Putnam JB. Long-term results of lung metastasectomy: prognostic analyses based on 5206 cases. *J Thorac Cardiovasc Surg* 1997; **113**: 37-49 [PMID: 9011700]

5 **Bijlani A**, Aguzzi G, Schaal DW, Romanelli P. Stereotactic radiosurgery and stereotactic body radiation therapy cost-effectiveness results. *Front Oncol* 2013; **3**: 77 [PMID: 23580234 DOI: 10.3389/fonc.2013.00077]

6 **Buyyounouski MK**, Balter P, Lewis B, D'Ambrosio DJ, Dilling TJ, Miller RC, Schefter T, Tomé W, Harris EE, Price RA, Konski AA, Wallner PE. Stereotactic body radiotherapy for early-stage non-small-cell lung cancer: report of the ASTRO Emerging Technology Committee. *Int J Radiat Oncol Biol Phys* 2010; **78**: 3-10 [PMID: 20643514 DOI: 10.1016/j.ijrobp.2010.04.010]

7 **Baumann P**, Nyman J, Hoyer M, Wennberg B, Gagliardi G, Lax I, Drugge N, Ekberg L, Friesland S, Johansson KA, Lund JA, Morhed E, Nilsson K, Levin N, Paludan M, Sederholm C, Traberg A, Wittgren L, Lewensohn R. Outcome in a prospective phase II trial of medically inoperable stage I non-small-cell lung cancer patients treated with stereotactic body radiotherapy. *J Clin Oncol* 2009; **27**: 3290-3296 [PMID: 19414667 DOI: 10.1200/JCO.2008.21.5681]

8 **Timmerman R**, Paulus R, Galvin J, Michalski J, Straube W, Bradley J, Fakiris A, Bezjak A, Videtic G, Johnstone D, Fowler J, Gore E, Choy H. Stereotactic body radiation therapy for inoperable early stage lung cancer. *JAMA* 2010; **303**: 1070-1076 [PMID: 20233825 DOI: 10.1001/jama.2010.261]

9 **Lewis SL**, Porceddu S, Nakamura N, Palma DA, Lo SS, Hoskin P, Moghanaki D, Chmura SJ, Salama JK. Definitive Stereotactic Body Radiotherapy (SBRT) for Extracranial Oligometastases: An International Survey of & gt; 1000 Radiation Oncologists. *Am J Clin Oncol* 2015: 1-5 [PMID: 25647831 DOI: 10.1097/COC.0000000000000169]

10 **Okunieff P**, Petersen AL, Philip A, Milano MT, Katz AW, Boros L, Schell MC. Stereotactic Body Radiation Therapy (SBRT) for lung metastases. *Acta Oncol* 2006; **45**: 808-817 [PMID: 16982544 DOI: 10.1080/02841860600908954]

11 **Rusthoven KE**, Kavanagh BD, Burri SH, Chen C, Cardenes H, Chidel MA, Pugh TJ, Kane M, Gaspar LE, Schefter TE. Multi-institutional phase I/II trial of stereotactic body radiation therapy for lung metastases. *J Clin Oncol* 2009; **27**: 1579-1584 [PMID: 19255320 DOI: 10.1200/JCO.2008.19.6386]

12 **Lee MT**, Kim JJ, Dinniwell R, Brierley J, Lockwood G, Wong R, Cummings B, Ringash J, Tse RV, Knox JJ, Dawson LA. Phase I study of individualized stereotactic body radiotherapy of liver metastases. *J Clin Oncol* 2009; **27**: 1585-1591 [PMID: 19255313 DOI: 10.1200/JCO.2008.20.0600]

13 **Wang XS**, Rhines LD, Shiu AS, Yang JN, Selek U, Gning I, Liu P, Allen PK, Azeem SS, Brown PD, Sharp HJ, Weksberg DC, Cleeland CS, Chang EL. Stereotactic body radiation therapy for management of spinal metastases in patients without spinal cord compression: a phase 1-2 trial. *Lancet Oncol* 2012; **13**: 395-402 [PMID: 22285199 DOI: 10.1016/S1470-2045(11)70384-9]

14 **Schipani S**, Wen W, Jin JY, Kim JK, Ryu S. Spine radiosurgery: a dosimetric analysis in 124 patients who received 18 Gy. *Int J Radiat Oncol Biol Phys* 2012; **84**: e571-e576 [PMID: 22975607 DOI: 10.1016/j.ijrobp.2012.06.049]

15 **Baschnagel AM**, Mangona VS, Robertson JM, Welsh RJ, Kestin LL, Grills IS. Lung metastases treated with image-guided stereotactic body radiation therapy. *Clin Oncol* (R Coll Radiol) 2013; **25**: 236-241 [PMID: 23352916 DOI: 10.1016/j.clon.2012.12.005]

16 **Navarria P**, Ascolese AM, Tomatis S, Cozzi L, De Rose F, Mancosu P, Alongi F, Clerici E, Lobefalo F, Tozzi A, Reggiori G, Fogliata A, Scorsetti M. Stereotactic body radiotherapy (sbrt) in lung oligometastatic patients: role of local treatments. *Radiat Oncol* 2014; **9**: 91 [PMID: 24694067]

17 **Norihisa Y**, Nagata Y, Takayama K, Matsuo Y, Sakamoto T, Sakamoto M, Mizowaki T, Yano S, Hiraoka M. Stereotactic body radiotherapy for oligometastatic lung tumors. *Int J Radiat Oncol Biol Phys* 2008; **72**: 398-403 [PMID: 18374506 DOI: 10.1016/j.ijrobp.2008.01.002]

18 **Ricardi U**, Filippi AR, Guarneri A, Ragona R, Mantovani C, Giglioli F, Botticella A, Ciammella P, Iftode C, Buffoni L, Ruffini E, Scagliotti GV. Stereotactic body radiation therapy for lung metastases. *Lung Cancer* 2012; **75**: 77-81 [PMID: 21726918 DOI: 10.1016/j.lungcan.2011.04.021]

19 **Takeda A**, Kunieda E, Ohashi T, Aoki Y, Koike N, Takeda T. Stereotactic body radiotherapy (SBRT) for oligometastatic lung tumors from colorectal cancer and other primary cancers in comparison with primary lung cancer. *Radiother Oncol* 2011; **101**: 255-259 [PMID: 21641064 DOI: 10.1016/j.radonc.2011.05.033]

20 **Zhang Y**, Xiao JP, Zhang HZ, Yin WB, Hu YM, Song YX, Zhang K, Liao ZX, Li YX. Stereotactic body radiation therapy favors long-term overall survival in patients with lung metastases: five-year experience of a single-institution. *Chin Med J* (Engl) 2011; **124**: 4132-4137 [PMID: 22340374]

21 **Casamassima F**, Livi L, Masciullo S, Menichelli C, Masi L, Meattini I, Bonucci I, Agresti B, Simontacchi G, Doro R. Stereotactic radiotherapy for adrenal gland metastases: university of Florence experience. *Int J Radiat Oncol Biol Phys* 2012; **82**: 919-923 [PMID: 21300473 DOI: 10.1016/j.ijrobp.2010.11.060]

22 **Jereczek-Fossa BA**, Piperno G, Ronchi S, Catalano G, Fodor C, Cambria R, Fossati Ing P, Gherardi F, Alterio D, Zerini D, Garibaldi C, Baroni G, De Cobelli O, Orecchia R. Linac-based stereotactic body radiotherapy for oligometastatic patients with single abdominal lymph node recurrent cancer. *Am J Clin Oncol* 2014; **37**: 227-233 [PMID: 22992626 DOI: 10.1097/COC.0b013e3182610878]

23 **Salama JK**, Milano MT. Radical irradiation of extracranial oligometastases. *J Clin Oncol* 2014; **32**: 2902-2912 [PMID: 25113765 DOI: 10.1200/JCO.2014.55.9567]

24 **Singh D**, Chen Y, Hare MZ, Usuki KY, Zhang H, Lundquist T, Joyce N, Schell MC, Milano MT. Local control rates with five-fraction stereotactic body radiotherapy for oligometastatic cancer to the lung. *J Thorac Dis* 2014; **6**: 369-374 [PMID: 24688781]

25 **Siva S**, MacManus M, Ball D. Stereotactic radiotherapy for pulmonary oligometastases: a systematic review. *J Thorac Oncol* 2010; **5**: 1091-1099 [PMID: 20479693 DOI: 10.1097/JTO.0b013e3181de7143]

26 **Milano MT**, Katz AW, Zhang H, Okunieff P. Oligometastases treated with stereotactic body radiotherapy: long-term follow-up of prospective study. *Int J Radiat Oncol Biol Phys* 2012; **83**: 878-886 [PMID: 22172903 DOI: 10.1016/j.ijrobp.2011.08.036]

27 **Greco C**, Zelefsky MJ, Lovelock M, Fuks Z, Hunt M, Rosenzweig K, Zatcky J, Kim B, Yamada Y. Predictors of local control after single-dose stereotactic image-guided intensity-modulated radiotherapy for extracranial metastases. *Int J Radiat Oncol Biol Phys* 2011; **79**: 1151-1157 [PMID: 20510537 DOI: 10.1016/j.ijrobp.2009.12.038]

28 **Niibe Y**, Chang JY. Novel insights of oligometastases and oligo-recurrence and review of the literature. *Pulm Med* 2012; **2012**: 261096 [PMID: 22966429 DOI: 10.1155/2012/261096]

29 **Tree AC**, Khoo VS, Eeles RA, Ahmed M, Dearnaley DP, Hawkins MA, Huddart RA, Nutting CM, Ostler PJ, van As NJ. Stereotactic body radiotherapy for oligometastases. *Lancet Oncol* 2013; **14**: e28-e37 [PMID: 23276369 DOI: 10.1016/S1470-2045(12)70510-7]

30 **Navarria P**, De Rose F, Ascolese AM. SBRT for lung oligometastases: Who is the perfect candidate? *Rep Practical Oncol Radiother* 2014 [DOI: 10.1016/j.rpor.2014.11.005]

31 **de Vin T**, Engels B, Gevaert T, Storme G, De Ridder M. Stereotactic radiotherapy for oligometastatic cancer: a prognostic model for survival. *Ann Oncol* 2014; **25**: 467-471 [PMID: 24355488 DOI: 10.1093/annonc/mdt537]

32 **Abdullah-Sayani A**, Bueno-de-Mesquita JM, van de Vijver MJ. Technology Insight: tuning into the genetic orchestra using microarrays--limitations of DNA microarrays in clinical practice. *Nat Clin Pract Oncol* 2006; **3**: 501-516 [PMID: 16955089 DOI: 10.1038/ncponc0587]

33 **Schwarzenbach H**, Nishida N, Calin GA, Pantel K. Clinical relevance of circulating cell-free microRNAs in cancer. *Nat Rev Clin Oncol* 2014; **11**: 145-156 [PMID: 24492836 DOI: 10.1038/nrclinonc.2014.5]

34 **Hayes J**, Peruzzi PP, Lawler S. MicroRNAs in cancer: biomarkers, functions and therapy. *Trends Mol Med* 2014; **20**: 460-469 [PMID: 25027972 DOI: 10.1016/j.molmed.2014.06.005]

35 **Lussier YA**, Xing HR, Salama JK, Khodarev NN, Huang Y, Zhang Q, Khan SA, Yang X, Hasselle MD, Darga TE, Malik R, Fan H, Perakis S, Filippo M, Corbin K, Lee Y, Posner MC, Chmura SJ, Hellman S, Weichselbaum RR. MicroRNA expression characterizes oligometastasis(es). *PLoS One* 2011; **6**: e28650 [PMID: 22174856 DOI: 10.1371/journal.pone.0028650]

36 **Lussier YA**, Khodarev NN, Regan K, Corbin K, Li H, Ganai S, Khan SA, Gnerlich JL, Darga TE, Fan H, Karpenko O, Paty PB, Posner MC, Chmura SJ, Hellman S, Ferguson MK, Weichselbaum RR. Oligo- and polymetastatic progression in lung metastasis(es) patients is associated with specific microRNAs. *PLoS One* 2012; **7**: e50141 [PMID: 23251360 DOI: 10.1371/journal.pone.0050141]

37 **Uppal A**, Ferguson MK, Posner MC, Hellman S, Khodarev NN, Weichselbaum RR. Towards a molecular basis of oligometastatic disease: potential role of micro-RNAs. *Clin Exp Metastasis* 2014; **31**: 735-748 [PMID: 24968866]

**P-Reviewer:** Niibe Y, Strigari L, Supiot S **S-Editor:** Ji FF **L-Editor: E-Editor:**

**Table 1 Summary of selected series of stereotactic body radiation therapy**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Author (yr) | No. of patients (number of lesions) | Primary site | | | Treated site (s) | Total dose (Gy) | | Local control | Toxicity |
| SBRT for mixed oligometastatic sites | | | | | | | | | |
| Milano *et al*[26]  (2012) | 121 (293) | All (mostly breast and colorectal) | | | Mostly Liver lung,lymph nodes | | Median 50 Gy in 10 fr | 74% (2y)  65% (6y) | G3 in 1 patient |
| Greco *et al*[27]  (2011) | 103 (126) | All (mostly prostate, renal, colorectal | | | Majority bone, lymph node, soft tissue | | 18-24 Gy in 1 fr | 64% (82% if > 22 Gy) (2y) | G3 late <4% |
| SBRT for lung oligometastases | | | | | | | | | |
| Norihisa *et al*[17] (2008) | 34 (43) | All (mostly lung) | | | Lung | | 48 Gy/4 fr-60 Gy/5 fr | 90% (2y) | G2, 12%/G3, 3% |
| Navarria *et al*[16]  (2014) | 76 (118) | All (mostly colorectal) | | | Lung | | 60 Gy/3 fr (perpherical) < 2 cm 48 Gy/4 fr (perpherical) 60 Gy/8 fr (central) | 89% (3y) | G1, 80% |
| SBRT for liver oligometastases | | | | | | | | | |
| Rusthoven *et al*[11]  (2009) | 47 (63) | | | All (mostly colorectal and lung) | liver | | 36-60 Gy /3 fr | 92% (2y) | ≥ G3 in 1 patient |
| Lee  *et al*[12]  (2009) | 68 | | | All (mostly colorectal and breast) | liver | | Median 41.8 Gy (range 27.7-60 Gy/6 fr/2w) | 71% (1y) | G3 in 8 patients  G4 in 1 patient |
| SBRT for spinal metastases | | | | | | | | | |
| Wang  *et al*[13]  (2012) | 149 (166) | | Mixed (mostly renal, breast and NSCL) | | Spine | | 27-30 Gy in 3 fr | 72.4% (2y) | G3 in 6 patient |
| Schipani  *et al*[14]  (2012) | 124 (165) | | Mixed (mostly lung and prostate) | | Spine | | 18 Gy in 1 fr | 92% (1y) | G2-G4, 0% |
| SBRT for adrenal oligometastases | | | | | | | | | |
| Casamassima  *et al*[21] (2012) | 48 | Mixed (mostly NSCLC and colon) | | | Adrenal | | 36 Gy in 3 fr (most common dose) | 90% (2y) | G2 in 1 patient  (adrenal insufficiency) |
| SBRT for lymph-node oligometastases | | | | | | | | | |
| Jereczek-Fossa  *et al*[22] (2014) | 69 (94) | Mixed (mostly urological, gastrointestinal and gynecologic) | | | Single abdominal lymph node recurrence | | Median 24 Gy in 3 fr | 64.3% (3 y) | G3 acute in 2 patients  G4 late in 1 patient |

SBRT: Stereotactic body radiation therapy; NSCLC: Non-small cell lung cancer.