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Review

Patterns of care of radiotherapy in México

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ABSTRACT

Aim: This survey is performed to learn about the structure of radiotherapy in México.
Background: Radiation oncology practice is increasing because of the higher incidence of cancer. There is no published data about radiotherapy in México.
Materials and methods: A questionnaire was sent to the 83 registered centers in the database of the Mexican regulatory agency. One out of the 32 states has no radiotherapy. 27 centers from 14 states provided their answers.
Results: 829 patients are treated annually with any radiotherapy modality in each center. Two centers have one cobalt machine, 7 have a cobalt and a linac and 10 have more than one linac. Five centers use 2D planning systems, 22 use 3D; 9, conventional simulators; 22, CT based simulation, and 1 center has no simulation. Most of the centers verify beams with films, electronic portal image devices and cone beam CTs are also used. Intensity modulated and image guided radiotherapy are performed in 5 states. Breast, prostate, cervix, lung, rectum and head and neck cancer are the six most common locations. There are 45 public and 38 private centers, 2 dedicated to children. Two gamma knife units, 5 Novalis systems, 1 tomotherapy and 2 cyberknife machines are working. All centers have at least one radiation oncologist, one physicist and one radiotherapist.
Conclusions: Definitive conclusions cannot be drawn from this limited feedback due to a low participation of centers. This survey about radiotherapy in Mexico shows the heterogeneity of equipment as well as medical and technical staff in the whole country.

1. Background

The increase in the use of ionizing radiation for cancer treatment is a worldwide phenomenon, because of a higher incidence as the life expectancy increases as well as earlier diagnoses and treatments.

Surveys could show patterns of care across the world and could be useful to improve the availability and quality of health care. Based on them, it is possible to create processes to develop measurements of quality of care, to define practice standards, to identify areas in need of improvement and to continuously assess accomplishments, based on clinical parameters. Results can create collaboration among disciplines and provide ways to enhance future surveys. Surveys may be directed to the structure (equipment and personnel), process (how patients are evaluated and treated) and outcome (results for patients).[1]

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The International Atomic Energy Agency (IAEA) carried out in 2004 a general survey of RT equipment, facilities and staffing in Latin America for infrastructure.[2]

There are no studies in México that examine patterns of practice for radiation oncology.

2. Aim

Given the lack of current data on patterns of care in this discipline in Mexico, we performed the present study focusing on the structure.

3. Materials and methods

This is a descriptive pattern of care survey. It was conducted through a questionnaire directly sent electronically to each radiotherapy center, institute and public and private hospital using the data base from registered services in the National Commission of Nuclear Security and Safeguards (CNSNS),[3] which is the regulatory agency in México to health providers and to venders. The information regarding radiation oncologists was obtained from the Mexican Certification Board on Radiotherapy AC (CMCR).

4. Results

A total of 83 Mexican centers are included in the CNSNS data base. There are radiotherapy centers in all the states except two: Tlaxcala and Quintana Roo, in the latter, the installation of the first linac is taking place.

There are two centers in Mexico City specialized in children (aged up to 18 years).

27 centers answered the questionnaire, from 14 states: Mexico City 7 centers, Nuevo León 3 centers, Guanajuato 3 centers, Tamaulipas 2 centers, Jalisco 2 centers and single centers from Estado de México, Hidalgo, Querétaro, Sonora, Chihuahua, Coahuila, Colima, Aguascalientes, Puebla and Morelos.

The mean number of patients per year in all radiotherapy modalities is 829 (350–2177).

4.1. *Facilities and equipment*

There are 2 gamma knife units in the country and five dedicated Novalis systems for intracranial diseases. There is one tomotherapy unit in the north of the country and 2 cyber-knife machines, one in Mexico City and one in the northeast of the country. Intensity modulated radiotherapy and Image Guided radiotherapy is used in 5 states.

Low dose rate brachytherapy with iodine for prostate is performed in 2 centers, both in México City.

Information about brachytherapy revealed that treatments with low dose rate cesium sources manual applications and high dose rate iridium afterloading systems are performed, both primarily for gynecological treatments.

The responses of the 27 centers showed that there are 2 facilities equipped only with cobalt machines and 7 centers with both cobalt machines and linacs. Recently, the use of Linacs have become more common, currently there are 40 of them. 10 centers have more than one linac, 3 have three and one has 4.

The information from venders show: Elekta, 13 linacs working and 9 in the process of installation, Varian, 33 and 10, respectively, and Siemens 8 linacs working.

There are 5 centers that use 2D planning systems, the others use 3D. There are 9 conventional simulators, CT based simulation is performed in 22 centers; one center has no simulation at all. Most of the centers verify beams with films, but there are electronic portal image devices and cone beam CTs.

4.2. *Anatomical sites treated*

One of the centers that responded is a children's hospital, 5 most frequent locations treated there are Medulloblastoma, astrocytomas, Rabdomyosarcomas, Wilms tumors and Retinoblastoma. The responses from the rest of the centers show that breast cancer is the most frequent location in 23 centers. Prostate cancer is the first cause in one center and the second cause in 19, cervix uteri is the first cause of radiation in 2 centers and the second cause in 8, which shows the epidemiological change in this country. Lung cancer is the second cause in 2 centers and the third cause in 8. Regarding gastrointestinal tumors, the 4th tumor most treated with radiotherapy in 17 centers is rectum and in 2, stomach cancer. Head and neck cancer is the fifth cause in 9 centers, lymphoma in 6 centers, metastases and central nervous system tumours in 2 centers.

4.3. *Workloads and staffing levels*

Most of the centers[9] work 16 h, 9 centers work 12 h, 3 centers work 8, 10 and 14 h, respectively.

The Board has 217 certificated radiation oncologists, 17 have passed away. There were 42 women, 175 men.

The numbers of medical physicists employed are the following: 1 in 9 centers, 2 in 7, 3 in 4, 4 in 3, 5 in 1, and 6 in 2. The centers with more physicists are public, with more than one machine.

Three centers have one technician per machine, the others have more than one and there are 5 dosimetrists. In some cases radiotherapists have a self-trainee education; they are radiology technicians who work in radiotherapy, otherwise they receive training in a dedicated oncology institution.

4.4. *Type of cancer center*

The CNSNS database has 45 public and 38 private registered centers. There are six centers, 3 in México City and 3 in other regions of the country, where radiation oncologists are trained. Medical physicists obtain the master degree in 2 public universities.

5. Discussion

This study yields preliminary, detailed information on human and material resources available for radiotherapy in México. To our knowledge, the current report is the first to describe

patterns of clinical practice for radiotherapy in México. The data presented here is unique and provide useful information about the current state of radiotherapy in México.

Studies on a pattern of care allow to draw reliable picture of current status of radiotherapy delivery in a country or region.[4–10] The results support the comparison with other countries and arise awareness in the society and authorities. Such effort leads to improvement and optimization of organization of delivery of radiotherapy and may improve the treatment outcome.[11–16] Radiotherapy is an essential part of the treatment of cancer. Patients with cancer in low and middle-income regions could have a greater need for radiotherapy because of the more advanced stage at presentation. They also need more extensive social support.[17–19] Safe and effective development of services would benefit from links with established facilities in other countries, access to information, such as free online journal access and better education of all medical staff about roles and benefits of radiotherapy.[20]

According to the World Bank, México is a medium income country, the second largest in Latin America,[21] with 1,964,375 km^2 and the population of 112,336,538 in 2010, including 48% of men and 52% of women. There is a demographic transition where the population pyramid is growing towards adult age. There are 32 states in the country; the most densely populated are México City and the state of México, which surrounds the city. Cancer is the second leading cause of death in Mexico after cardiovascular diseases. In 2008, the age-world-standardized incidence rate (ASR (W)) per 100,000 for cancer incidence in Mexico was 128.4, not including non-melanoma skin cancer. A total of 127,600 new cancer cases were diagnosed. The main causes of death from cancer in males are lung, prostate, and stomach primaries, while for females, breast, cervical, and liver cancers.[22,23]

According to Globocan 2008, the estimated age-standardized incidence and mortality rates for both sexes showed that the most frequent tumor locations are prostate, breast, cervix uteri, lung and stomach.[24]

In this survey, breast cancer accounted for the vast majority of treatments. As described elsewhere, radiation therapy has a fundamental role in patients with locally advanced breast cancer after initial systemic treatment and surgery, as well as in those diagnosed early for conservative approach. In patients with metastatic disease to the bone, brain and soft tissue, radiation is an effective tool for palliation.[25–27]

In particular, for gynecological tumors, the cervix uteri and the endometrium, were the two most common sites, requiring in most cases the combination of external radiotherapy and brachytherapy. A descriptive survey on brachytherapy in Latin America has been already published by Guedea et al.[28]

Among the male tumors, prostate is the most frequent one and most cases are treated with external beam irradiation, maybe because brachytherapy is available only in a few centers and the majority of the cases are presented for adjuvant or salvage treatment,[29] however, this subject is beyond the scope of this article.

Another issue of importance is to make a reasonable and medical evidence-based balance justifying the purchase and implementation of the newest technology in the region of limited resources where foremost attention has to be directed to provide the cancer care to all society members.[12,13,30–32]

6. Conclusions

Unfortunately, the main limitation of this study is the low participation of some centers, explained in some cases because of a busy schedule, lack of interest or technological issues. Therefore, we cannot draw definitive conclusions for this limited feedback. We received reliable information regarding the current status of the structure process of radiotherapy in Mexico that gives us a general idea of the heterogeneity of equipment and kinds of treatments, as well as medical and technical staff in the whole country.

7. Future actions

A more sample data regarding the structure, process and outcome in radiation oncology in Mexico has to be collected in a near future, by motivation of doctors and by an accessible method to obtain information. A next attempt could focus on obtaining a wider database regarding the process of care.

Conflict of interest

None declared.

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None declared.

Appendix.

Lesbia Rivera (Centro Oncológico Estatal ISSEMYN), Heynar Pérez (Hospital infantil de México Federico Gómez), Mario Rodríguez (Centro Oncológico de Qro. Sade y Sucursal Pachuca), Vinicio Toledo (Hospital San Javier), Aurora Aldana (Hospital Angeles del Pedregal), Marco Ramírez (Hospital Regional De Alta Especialidad Del Bajío), Rosalía Souto (Unidad Medica De Alta Especialidad IMSS UMAE 1 León Guanajuato), Jorge Rodríguez Peral (Hospital Regional No. 1, IMSS, Cd. Obregón, Son., Oncoservicios de los Mochis, RadioOncología San José), Luis Bayardo (Centro Médico de Occidente), Armando Fernández (Centro Médico Nacional "20 De Noviembre" ISSSTE). Manuel Flores (INCan), Julia Sáenz (Hospital UMAE 25, IMSS, Christus Muguerza Alta Especialidad), Francisco Velasco (Centro Oncológico de Tamaulipas, Centro de Radioterapia de Tampico), Mauricio Durán (Instituto Estatal de Cancerología Colima), Javier Aguirre (Centro Oncológico de Chihuahua/CIMA), Lázaro Gómez (Servicios Oncológicos De Aguascalientes), Enrique Ventura (UMAE HE NO 71 Torreón Coah.), Juan Manuel Hernández López (unidad de Oncologia SSA, Puebla UMAE), Federico Maldonado (Servicio de Radioterapia del Hospital Central Militar), Héctor Cortés (Instituto Oncológico de Morelos).

REFERENCES

1. Behrend S, Coia L. Patterns of care in radiation oncology. *Semin Oncol Nurs* 1999;**15**(4):303–12.
2. Zubizarreta EH, Poitevin A, Levin CV. Overview of radiotherapy resources in Latin America: a survey by the International Atomic Energy Agency (IAEA). *Radiother Oncol* 2004;**73**:97–100.
3. http://www.cnsns.gob.mx
4. Guedea F, Ventura M, Polo A, et al. Patterns of care for brachytherapy in Europe (PC BE) in Spain and Poland: comparative result. *Rep Pract Oncol Radiother* 2007;**12**(1):39–45.
5. Guedea F, Ventura M, Marchetti C, et al. Patterns of care for brachytherapy in Europe, in Spain and Italy: comparative results. *Tumori* 2007;**93**(5):439–44.
6. Peiffert D, Mazeron JJ, Guedea F, Nisin R. Brachytherapy in France in 2002: results of the ESTRO-PCBE questionnaire. *Cancer/Radiotherapy* 2007;**11**(3):146–9.
7. Guedea F, Hoskin P, Mazeron JJ, et al. Brachytherapy in the United Kingdom and Spain: a subset analysis of a European pattern of care survey. *Clin Transl Oncol: Off Publ Feder Spanish Oncol Soc Natl Cancer Inst Mexico* 2009;**11**(8):534–8.
8. Vanselaar JLM, Slotman BJ, Guedea F, Ventura M, Londres B, Francois G. Patterns of care study for brachytherapy: results of the questionnaire for the years 2002 and 2007 in The Netherlands. *J Contemp Brachyther* 2010;**2**(4):145–52.
9. Guedea F, Venselaar J, Hoskin P, et al. Patterns of care for brachytherapy in Europe: updated results. *Radiother Oncol* 2010;**97**(3):514–20.
10. Guedea F, Torrecilla JL, Londres B, Ventura M, Bilbao P, Borras JM. Patterns of care brachyherapy in Europe: updated results for Spain. *Clin Transl Oncol* 2012;**14**(1):36–42.
11. Malicki J. Staffing for quality: overview. In: Pawlicki T, Dunscombe P, Mundt A, Scalliet P, editors. *W quality and safety in radiotherapy*. United Kingdom: Taylor & Francis; 2010.
12. Malicki J, Litoborski M, Bogusz-Czerniewicz M, Świeżewski A. Cost-effectiveness of the modification is the quality assurance system in radiotherapy in the example of in vivo dosimetry. *Phys Med* 2009;**25**(4):201–6.
13. Khader J, Farah N, Salem A. Bladder preservation by concurrent chemoradiation for muscle-invasive bladder cancer: applicability in low-income countries. *Rep Pract Oncol Radiother* 2011;**16**:178–83.
14. Guedea F. Recent developments in brachytherapy. *Rep Pract Oncol Radiother* 2011;**16**:203–6.
15. Kowalik A, Konstanty E. Basic tests in mammography as a tool in quality. *Rep Pract Oncol Radiother* 2010;**15**:145–52.
16. Joseph B, Supe SS, Ramachandra A. Cyberknife: a double edged sword? *Rep Pract Oncol Radiother* 2010;**15**:93–7.
17. Guedea MTD, Damacena FA, Carbajal MMM, et al. Social support needs of Mexican elders family caregivers. *Psicol Soc* 2009;**21**(2):242–9.
18. Bernad D, Zysnarska M, Adamek R. Social support for cancer – selected problems. *Rep Pract Oncol Radiother* 2011;**15**(2): 47–50.
19. Stańczyk MM. Music therapy in supportive cancer care. *Rep Pract Oncol Radiother* 2011;**16**:170–2.
20. Barton MB, Frommer M, Shafig J. Role of radiotherapy in cancer in low-income and middle-income countries. *Lancet Oncol* 2008;**7**(7):584–95.
21. www.worldbank.org/en/country/mexico
22. www.inegi.org.mx/
23. Pan American Health Organization Country Health Profiles; 2010.
24. www.globocan.iarc.fr
25. Bese NS, Munshi A, Munshi A, Budrukkar A. Breast radiation therapy guideline implementation in low- and middle-income countries. *Cancer* 2008;**113**(8 Suppl.): 2304–14.
26. Anderson BO, Cazap E, El Saghir NS, Yip CH, Khaled HM. Optimisation of breast cancer management in low-resource and middle-resource countries: executive summary of the Breast Health Global Initiative consensus, 2012. *Lancet Oncol* 2011;**12**(4):387–98.
27. Yip CH, Cazap E, Anderson BO, et al. Breast cancer management in middle-resource countries (MRCs): consensus from the Breast health Global Initiative. *Breast* 2011;**Suppl. 2**:S12–9.
28. Guedea F, Ventura M, Londres B, et al. Overview of brachytherapy resources in Latin America: a patterns-of-care survey. *Brachytherapy* 2011;**10**(September–October (5)):363–8.
29. Pow-Sang M, Destefano V, Astigueta JC, et al. Prostate cancer in Latin America. *Acta Urol Esp* 2009;**33**:1057–61.
30. Thwaites DI, Malicki J. Physics and technology in ESTRO and in radiotherapy and oncology: past, present and into the 4th dimension. *Radiother Oncol* 2011;**100**(3):327–32.
31. Malicki J. The importance of accurate treatment planning, delivery, and dose verification. *Rep Pract Oncol Radiother* 2012;**17**(2):63–5.
32. Prijic S, Sersa G. Magnetic nanoparticles as targeted delivery systems in oncology. *Radiol Oncol* 2011;**45**(1):1–16.