

## **Radiotherapy, Cancer and Some Anatomical Structures Related with the Pelvic Floor: An Evaluation of the Scientific Literature**

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### **ABSTRACT**

*Radiotherapy is a cancer treatment that uses high-energy X-rays or other types of ionizing radiation to try to kill the cancer cells in various organs/tissues. PubMed is a database used as a tool in various publications. The aim of this work was to evaluate, in the PubMed, the number of publications (NP) in radiotherapy and cancer in various organs related to the pelvic floor as well as brachytherapy. The searches were performed (August 2008) in the PubMed (<http://www.pubmed.com>) using the words: (i) radiotherapy (RT) or cancer (CA), (ii) RT and CA, (iii) RT and CA and prostate, RT and CA and testis, RT and CA and breast, RT and CA and kidneys, RT and CA and vulva, RT and CA and vagina, RT and CA and penis, RT and CA and uterus, RT and CA and ovary, RT and CA and bladder, and RT and CA and urethra. A search using brachytherapy was also performed. The NP in each subject was determined and was 2178635 to CA and about 9% of them are related with RT. The NP in RT and CA and breast or prostate is bigger than for the other organs, whereas brachytherapy is mainly cited in the studies about CA of prostate, bladder and breast. In conclusion, our findings demonstrate the importance of radiation therapy studies in the cancer of several organs. This information is crucial in understanding the field and demonstrates areas of significant progress or existing gaps of research in radiotherapy treatment of various cancers of the pelvis. Furthermore, it could significantly aid the interprofessional team in the determination of actions related to the treatment of patients that are undertaking radiotherapy, due to the possible complications of this modality of treatment.*

**Key words:** Radiotherapy, Cancer, Pelvic floor, PubMed, Scientific interest

### **INTRODUCTION**

Cancer is a disease that is characterized by the slow rate at which it develops (Shuker, 2007). A unifying feature of cancer is the uncontrolled proliferation and spread of cells, which alters the

normal function of the surrounding or even the distant tissues, ultimately leading to organ failure and death (Schmit; Ahmad, 2007). Moreover, cancer is often considered to be a genetic disease, as a number of genes have now been identified that can increase risk of cancer (Missailidis, 2007).

Cancer treatment varies significantly, depending on the type or stage of cancer, age of the patients and overall conditions. Adjuvant or neoadjuvant therapies are standard treatment for many types of cancer (Heinemann and Moosmann, 2007). Although chemotherapy, surgery and radiotherapy continue to be the mainstay treatments of cancer, a number of additional modalities are currently coming to use and are expected to change the landscape of the anticancer drug market and the ways hospital undertake management of cancer patients (Boulikas et al., 2007).

Radiotherapy can be defined as the use of ionising radiation in the treatment of malignant disease. It can be used both as radical treatment, where the aim is to remove the cancer cells completely and as palliative treatment, where the aim of the radiotherapy is to reduce pain and other discomfort. Radiotherapy is, after surgery, the most widely used and effective means of treating cancers; it is estimated that over 50% of all cancer patients require radiotherapy at some time during their illness (Delaney et al., 2005).

Radiotherapy may be used to treat localized solid tumors, such as cancers of the skin, tongue, larynx, brain, breast, or uterine cervix. It can also be used to treat leukemia and lymphoma (cancers of the blood-forming cells and lymphatic system, respectively) (Denardo and Denardo, 2006). However, radiotherapy is a complex procedure and requires the patients to make a number of hospital visits to complete a full course of treatment (Unak, 2002; Perkins, 2007).

X-rays were the first form of ionizing radiation to be used for the treatment of cancer. Depending on the amount of energy they possess, the rays can be used to destroy cancer cells on the surface of or deeper in the body. The higher the energy of the x-ray beam, the deeper the x-rays can penetrate into the target tissue. The use of instruments to focus a radiation beam (most often x-rays) from an external source on a cancer site is called external beam radiotherapy or teletherapy and is the most commonly used form of radiotherapy (Pandey and Rajan, 2004; Perkins, 2007).

Gamma rays are another form of ionizing radiation used in radiotherapy. Gamma rays are produced spontaneously as certain elements (such as radium, uranium, and cobalt 60) release radiation as they decompose, or decay. Each element decays at a specific rate and gives off energy in the form of gamma rays and other radiation. X-rays and

gamma rays can have the same effect on cancer cells (Pandey and Rajan, 2004; Perkins, 2007).

Another technique for delivering radiation to cancer cells is to place radioactive implants (in different forms) directly in a tumor or body cavity. This is called internal radiotherapy and includes various techniques such as Brachytherapy, interstitial irradiation, and intracavitary irradiation. The term brachy comes from the Greek word for short distance. In this treatment, the radiation dose is concentrated in a small area, and the patient stays in the hospital for a few days or hours. Internal radiotherapy is frequently used for cancers of the tongue, prostate, uterus, and cervix (Kufe et al., 2003; Perkins, 2007). The high relevance of the brachytherapy is that the radiation emitted by the radioactive sources acts over a local short distance within tissues to treat the tumor whilst giving low radiation doses to normal tissues (Perkins, 2007).

The interest of the scientific community in a specific subject can be evaluated by the analysis of the number and the quality of the published papers. Database and literature update systems play a relevant role in promoting the results of a research and how a subject is being used and accepted by the professionals of the area. PubMed (<http://www.ncbi.nlm.nih.gov/entrez/query.fcgi>) a service of the U.S. National Library of Medicine that includes over 18 million citations from MEDLINE and other life science journals for biomedical articles back to the 1950s. PubMed includes, in general, the abstracts of the papers and links to various sites providing full papers and other related resources (<http://www.ncbi.nlm.nih.gov/entrez/query.fcgi>).

Moreover, the information of the PubMed have been used as a tool in various publications to aid the evaluation the scientific interest in specific research areas (Santos-Filho et al., 2003, Santos-Filho et al., 2004, Santos-Filho et al., 2006).

The aim of this work is to evaluate, using PubMed, the current scientific interest in the studies of radiotherapy and cancer in various organs related with the pelvic floor, as well as with the use of the brachytherapy. These findings could provide information to verify the necessity of further studies related with the subjects evaluated or to aid in the determination of actions needed.

## MATERIALS AND METHODS

The searches were performed (August 2008) in the PubMed (<http://www.pubmed.com>) using the words: (i) radiotherapy (RT) or cancer (CA), (ii) RT and CA, (iii) RT and CA and prostate, or testis, or breast, or kidneys, or vulva, or vagina, or penis, or uterus, or ovary, or bladder, or urethra. The number of publications (NP) in RT was divided by the NP in CA. The NP in RT and CA and each organ was divided by the total obtained to RT and CA and a percentage of publication (%P) was obtained.

A search using cancer and brachytherapy was also performed with each organ. The NP in cancer and brachytherapy and each organ was divided by the total obtained to cancer and brachytherapy and a %P was also determined for each subject.

## RESULTS

The NP and the %P in the PubMed involving (i) radiotherapy or Cancer, (ii) radiotherapy and cancer and (iii) cancer and radiotherapy and several organs related with the pelvic floor have been determined. These findings are shown in the Table 1. It has been observed that, although some 50% of all cancer patients are treated at some stage of their treatment by radiotherapy, only about 7.5% of the number of publications about cancer is associated with radiotherapy. Moreover, it is found that the number of studies related to breast cancer is higher than with any of the studied organs, although the studies involving prostate cancer are more numerous in comparison with the remaining organs considered, reflecting, to a certain extend the worldwide incidence of these types of cancer (Cancer Research UK website).

**Table 1** - Number of publications in subjects related with cancer, radiotherapy and some organs.

Subjects	Number of publications	Percentage of publications (%)
Radiotherapy	201362	-
Cancer	2178635	-
RT and CA	163889	7.52
Prostate	8613	5.26
Testis	1053	0.64
Breast	16786	10.24
Kidneys	3608	2.20
Vulva	479	0.29
Vagina	1000	0.61
Penis	587	0.36
Uterus	1559	0.95
Ovary	1248	0.76
Bladder	5622	3.43
Urethra	533	0.33

The searches were performed (August 2008) in the <http://www.ncbi.nlm.nih.gov/entrez/query.fcgi> using the words: (i) radiotherapy (RT) or cancer (CA), (ii) RT and CA, (iii) RT and CA and each organ. The number of publications (NP) and the percentage of publications (%P) for each subject were determined.

In table 2, the NP and the %P related with cancer and brachytherapy and breast, bladder, kidney and other organs related with the pelvic floor is shown. The total NP involving brachytherapy was 10914. There is a strong interest in studies involving mainly prostate cancer and brachytherapy (21.36%), although a smaller but considerable interest is also found in studies of the bladder (6.18%), breast (5.82%), vagina (3.01%), uterus (2.44%), urethra (2.09%) and penis (1.40%).

## DISCUSSION

Radiotherapy is a cancer treatment that uses high-energy X-rays or other types of ionizing radiation to try to kill the cancer cells in various organs/tissues or alleviate related symptoms (Kufe et al., 2003; Perkins, 2007).

**Table 2** - The number of publications and the percentage of publications in subjects related with cancer, brachytherapy and various organs.

Subject	Number of Publications	Percentage of Publications (%)
Prostate	2332	21.36
Testis	5	0.04
Breast	635	5.82
Kidneys	66	0.60
Vulva	41	0.38
Vagina	329	3.01
Penis	153	1.40
Uterus	267	2.44
Ovary	33	0.30
Bladder	675	6.18
Urethra	228	2.09

The searches were performed (August 2008) in the <http://www.ncbi.nlm.nih.gov/entrez/query.fcgi> using the words: (i) RT and CA and brachytherapy, (ii) RT and CA and brachytherapy and prostate, RT and CA and brachytherapy and each organ. The number of publications in RT and CA and Brachytherapy and each organ was divided by the total obtained to RT and CA and Brachytherapy and a percentage of publication was determined for each subject.

The basis of the radiotherapy is the interaction of the ionizing radiation, that deposits energy to injure or destroy cells in the area that is being treated (the "target") by damaging their genetic material (either directly or indirectly), making it impossible for these cells to continue to grow (Kufe et al., 2003; Perkins, 2007). This interaction depends on the energy created by the production of secondary charged particles, usually electrons, which can break chemical bonds and inflict molecular damage (Perkins, 2007).

The progression of the cellular cycle is a very complex but extremely well-orchestrated process and any defects in this process may result in an uncontrolled proliferation of cells that may lead to the development of cancer (Schmit; Ahmad, 2007). There are many different known types of cancer, each one with an etiology, treatment regime and prognosis. Furthermore, cancer can grow undetected for many years in the early stages (Missailidis, 2007). These conditions clearly indicate that various types of investigations are necessary in order to shed light in the different issues pertaining cancer and aid in the early detection, as well as define the best possible form of treatment. The most common form of radiotherapy is the external beam therapy, although other forms of radiation therapy are also available, such as brachytherapy (Perkins, 2007).

The information found in the PubMed has been used as a tool by several investigators in various worthwhile studies that have been published (Gupta and Lewis, 2008; Soran and Durrington,

2008; Pettersson et al., 2008; Madaan et al., 2008). This information can also help in the characterization of statements, as in the *The top 13, What family physicians should know about prostate cancer* that Katz and Katz (2008) have published. In our work, the determination of the number of publications involving cancer and radiotherapy as well as a specific therapy with radiation (brachytherapy) and various organs of interest has permitted access to some important information (Tables I and II).

The analysis of the results in the Table 1 reveal a number of points. First of all, 4 out of 5 of all publications on radiotherapy are related to cancer, which demonstrates an important relation between radiotherapy and cancer. However, although 50% of cancer patients are treated with radiotherapy, radiotherapy papers seem to account for only 7.5% of the published papers found in the PubMed related to cancer. This is less than half the papers published in the PubMed on 'chemotherapy and cancer' (377378 papers), indicating a difference in funding of projects that are heavily subsidized by pharmaceutical industry and government bodies in the area of pharmaceutical development compared to radiotherapy, an issue that should be addressed to bring this area of research in focus and allow continuous technological developments, necessary for the delivery of better radiotherapy approaches. It could also reflect the fact that some radiotherapy approaches are related to instrumentation, which may be far more expensive for University research

and thus remains the focus of industries that develop and sell instrumentation to hospitals.

The elevated NP involving studies with cancer and radiotherapy with breast and prostate could be related to the high prevalence of cancer in these two organs in several countries (Arraras et al., 2008; Matsunoki et al., 2008; Sitas et al., 2008; Lima et al., 2008). Furthermore, with the exception of uterus and ovary, the %P follows closely (within 1%) the world incidence of the studied cancers. (Cancer Research UK website).

The results of the Table II reveals that papers published in cancer and brachytherapy and bladder or vagina or prostate or breast could be related with the anatomical characteristics of these organs in which there are facilities to introduce the radioactive sources in the organs. However, the physical characteristics of the brachytherapy related to the localized radiation dose (Perkins, 2007) could stimulate an increase in the use of this radiation therapy to treat cancer of other organs, though this is limited by the accessibility of the organ in question and its sensitivity to radiation.

In conclusion, these findings show the importance of studies about the radiation therapy of cancer in several organs. Finally, this information could aid the interprofessional team in the determination of actions and decision-making regarding patients that are undertaking radiotherapy, due to the possible complications of this modality of treatment.

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## RESUMO

Radioterapia é uma forma de tratamento para câncer que usa raios X de alta energia ou outros tipos de radiação ionizante para tentar matar as células do câncer em vários órgãos/tecidos. O objetivo desse trabalho foi avaliar, no PubMed, o número de publicações (NP) em radioterapia e câncer em alguns órgãos geralmente relacionados com o assoalho pélvico e com a braquiterapia. A pesquisa foi realizada (Agosto de 2008) no PubMed (<http://www.pubmed.com>) utilizando as palavras: (i) *radiotherapy* (RT) or *cancer* (CA),

(ii) RT and CA, (iii) RT and CA and *prostate*, RT and CA and *testis*, RT and CA and *breast*, RT and CA and *kidneys*, RT and CA and *vulva*, RT and CA and *vagina*, RT and CA and *penis*, RT and CA and *uterus*, RT and CA and *ovary*, RT and CA and *bladder*, and RT and CA and *urethra*. Uma pesquisa usando *brachytherapy* foi também realizada. O NP em cada termo foi determinado e foi 2178635 para CA e aproximadamente 9% estão relacionados com RT. O NP em RT e CA e *breast* ou *prostate* é maior do que outros órgãos e braquiterapia são principalmente citados nos estudos sobre CA de próstata, bexiga e mama. Concluindo, esses achados mostram a importância de estudos sobre a terapia por radiação de câncer em alguns órgãos. Além disso, essas informações poderiam ajudar a equipe interprofissional no desenvolvimento de ações nos pacientes que estão sendo tratados com radioterapia devido às possíveis complicações dessa modalidade de tratamento.

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