

# Brachytherapy in Greater Poland Cancer Centre and in Poznan – the past and the presence

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## Abstract

The aim of this article is to describe the history of brachytherapy in Poznań from the beginning of 20<sup>th</sup> century. Among the most important medical and oncological institutions that were created in Poznań at the beginning of twentieth century were: Surgical Clinic of Poznań University (City Hospital, Poznań), Transfiguration of the Lord Hospital (Poznań) and Radiology Faculty of Poznań University (Poznań). After the World War II in 1953 at Garbary Street hospital three new departments were established: Surgery, Gynecology and General Departments. At that time, radium treatment was introduced to Gynecology and General Departments and it was applied in therapy till the early nineties, in spite of introducing LDR and HDR brachytherapy in seventies and eighties. The intense development of brachytherapy took place in late nineties, when brachytherapy treatment of non-gynecological tumors started. Today's condition of brachytherapy at Greater Poland Cancer Centre (GCC) is presented in this article, too.

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## Purpose

Brachytherapy has its own place in history, since Maria Skłodowska-Curie discovered radium at the turn of nineteenth century. Maria Skłodowska-Curie (born in Warsaw, 1867) was first out of many women to win the recognition of world science (Figs. 1-2). Graduated from Sorbonne, Paris, Skłodowska-Curie was conducting pioneer researches with radioactive elements such as radium and



**Fig. 1.** Maria Skłodowska-Curie (1867-1934)



**Fig. 2.** Maria Skłodowska-Curie with Pierre Curie (1859-1906)

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polonium, which helped to understand physical phenomenon of radioactivity. In the whole history of science she was truly a remarkable woman and probably the most famous one as well. She was the first woman in Europe to obtain natural science doctorate degree and at the same time first woman to win Nobel Prize in physics (1903). She was the first woman-lecturer, professor and Head of Laboratory at Sorbonne, Paris and first person ever to win twice the Nobel Prize (1911 – second Nobel Prize in chemistry). She was also the first mother of daughter-Nobel Prize winner and first woman buried at Parisian Pantheon.

Almost 100 years old history of brachytherapy in Poznań is worth studying and investigating. Its development as well as progress in this field in Poland is credited to Maria Skłodowska-Curie.

### At the beginning of twentieth century

Till the year of 1932, approximately 3 grams of radium was gathered in Poland (Fig. 3). However, the fact of its dividing and dispersal within several institutions as well as preparation activity, totally unadapted to control treatment and complete lack of knowledge in matter of impact of radiation on human tissues, caused – as recalled by the first director of Radiation Institute, prof. Franciszek Łukaszczyk (1897-1956) – *obtained results to be far from regularity, in most of the cases accidental; many of the doctors were to pay for their work with disability or death* [1]. Radiological Laboratory which opened in 1913 in Warsaw as a part of Warsaw Science Society was the main institution for physical researches of radium radioactivity. Till the 1926 the official Head of this Laboratory was Maria Skłodowska-Curie, after that year she was the Honorary Head of this institution. She donated 100 mg of radium bromide to the Radiological Laboratory. Upon her wish and under her honorary presidency, in 1921 a legal unit was created called Radium Institute Society. In December 1923, on 25<sup>th</sup> anniversary of radium discovery, Cancer Combat Polish Committee issued an appeal to the Polish community to raise funds for "Nation Gift for Maria Skłodowska-Curie" which was the Maria Skłodowska-Curie Radium Institute. The scientist turned for help to a famous American journalist Ms. Maloney and thanks to well organized subscription among Poles in America and friends of Poland, enough of funds were raised to purchase 1 gram of radium. In 1929 Maria Skłodowska-Curie received these funds from the President of the United States – Herbert Hoover, who strongly supported the subscription. Radium of total weight of



Fig. 3. Examples of radium probes

1033,21 mg was purchased in Belgian factory "Union Miniere du Haut Katanga" and the price was reduced exclusively for Maria Skłodowska-Curie. The radioactive element was in a set of tubes and needles which allowed so called "Parisian way of treatment" and was labeled as a RMS (abbreviation: Maria Skłodowska Radium) [1]. The first "European" radium that was manufactured by Maria Skłodowska-Curie originated from Czech uranium ore, extracted from Joachimowa. At that time uranium ore was mine also in Belgian Kongo and in Colorado, USA and was sent by waterway to chemical factory in Oolen, Antwerp [2, 3].

According to Supady [4], among the most important medical institutions of clinical and outpatient oncologic health care in Poland during 1918-1939, were several institutions in Poznań such as: Surgical Clinic of Poznań University – City Hospital, Poznań (1921-1923), Transfiguration of the Lord Hospital, Poznań (1923-1939), and Medical Radiology Faculty of Poznań University, Poznań (1920-1939). In Greater Poland region, among many doctors to take up tumor treatment and modern system of oncologic medical practice were Prof. Karol Mayer and Prof. Antoni Jurasz Junior. They've given the rise to radiotherapy in Poznań and made a great effort in order to create Radium Institute in Poznań. At that time, Prof. Karol Mayer in his Radiology Clinic, put pioneer way of irradiation into practice, while Prof. Antoni Jurasz Junior in Surgical Clinic opened new Radium Department and, apart from possessing 144 mg of radium, had a X-ray apparatus for deep X-ray therapy. Irradiation therapy in Radium Department was under dr Stanisław Bylina supervision [2, 5]. In 1921 Prof. Karol Mayer was appointed associate professor of Medical Radiology Faculty of Poznań University and after 15 years became the full professor.



Fig. 4. Karol Mayer (1882-1946), establisher of the first Polish Radiology Professorship



Fig. 5. Karol Mayer with Maria Skłodowska-Curie in Paris

It was the turning point in prof. Karol Mayer's professional biography (Figs. 4-5) [2]. He was among the first scientists in the world who evolved theoretical foundations and introduced to clinical practice rotating therapy of X-rays (1933) and radium (1939). He also published his scientific results of tumor treatment with the use of different therapy methods [2, 3]. Another outstanding individuality among radiologists of non-university trend was Tadeusz Alkiewicz, who since 1921 was the owner of Radiology Department that treated patients throughout inter-war period. He was also the co-founder of Polish Medical Radiologic Association. From 1924 he was administrating Radiology Department of 7<sup>th</sup> Army District Hospital and conducting radiographic diagnostics and radium therapy at Elisabeth Sisters Hospital. At that time, Warsaw and Poznań - as a academic cities - were in the lead in providing the most resilient radiological units [2]. Dr Tadeusz Alkiewicz was writing about radioactive bodies in a 15<sup>th</sup> issue of magazine "Greater Poland Illustration": *We all have heard about radium- this mysterious radioactive substance, which discovery created real revolution in science. We also know that radium possesses different healing properties and it is used for treatment in many illnesses. Unfortunately, that's all what we know and we are not able to appraise the work of many scientists, who often dedicate their life in the name of scientific studies. At the same time, we are not able to comprehend the significance of Radium Institute as well as creating other scientific departments only for radiologic researches. Till recently, application of radium was indeed something remarkable. Such therapy was available only in Paris. Later on, the United States adopted this way of treatment, buying all accessible quantity of radium, during I World War. Today, every big city in Poland has radium, for example Poznań takes pride in possessing the most amount of it and for the longest time, since 1912* [6]. Kazimierz Węchowski, Józef Jagielski and Stanisław Kozłowski were among the remaining non-academic trend radiologists of inter-war period in Poznań. Kazimierz Węchowski was the first Head of Radium

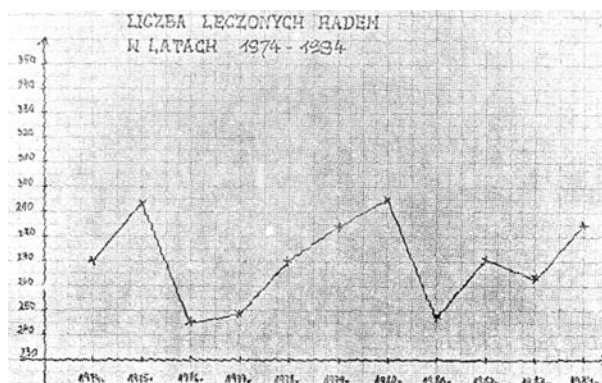


Fig. 6. Patients treated with radium in GCC from 1974 to 1984

Institute of Union Clinic at 12 Fredry Street; later on he moved to Lwow and organized Radium Institute there.

### After II World War

Unfortunately, there is not much informations about radiotherapy in Poznań in years 1945-1952, but it this a well known fact that between 1947 and 1948, as a part of international help from UNRRA (United Nations Relief and Rehabilitation Administration), three transports of radium arrived from Canada. At that time Poland received 17 gram of radium and that was the actual foundation for organizing a domestic chain of oncologic centers. In 1952, for the first time since the war, a cancer prevention campaign was created and it recommended to establish new Oncological Centre in Poznań. In January 1952 dr Czesław Wojnerowicz, who during German occupation worked at Radium Institute in Warsaw, was leading the initial organizing work for the new Hospital [2, 3]. In March 1952 a decision was taken in order to transform Life Insurance Hospital in Poznań at Garbary Street (previously Raczyński Street), into a medical oncologic institution. At the end of 1953, three departments were already operating: Gynecologic, General and Surgery with 100 beds in total. Laboratory of Clinical Pathology was formed and Curie-therapy rooms (Gynecologic and General Departments) were partially equipped. In 1958-1959 the Radiotherapy Department was reconstructed and outfitted with four deep X-ray therapy and one superficial therapy apparatuses. In radium therapy rooms a prototypical automatic protective devises were used which reduced the risk of staff exposure to the radioactive beams. From 1953 till 1978, the total amount of 1 020 353 of irradiative sessions was carried out, in which 750 029 of X-ray sessions, 258 809 of cobalt sessions and 11 246 of caesium sessions. However, radium irradiations were applied to 13 160 patients. Figure 6 shows the total amount of radium treated patients in years 1974-1984. Within years 1953-1978, Oncologic Gynecology Department treated patients with gynecological tumors, that were not qualified for surgery. Pre-surgery radium irradiation was also used. The preliminary independent beam treatment that include radium application, telegammatherapy and radium beam treatment followed by cobalt and ceasium

therapy, were initially conducted according to modified Parisian technique. Later on, the Heyman's method (Stockholm) was used [2, 3]. General Oncologic Department treated patients with all types of tumors, qualified to beam therapy as an exclusive way of treatment, but also as a combined treatment with chemotherapy and surgery. The Department was in possession of radiation sources used for lips and mouth brachytherapy. Unfortunately, no published treatment results of that time are available at present [2, 3].

### Nowadays

The Greater Poland Cancer Centre admitted his first patients in the early fifties. From that time onward, brachytherapy was present in the treatment of malignant cancers, in which radium was used as a basic way of therapy. During that time, till the nineties, brachytherapy was used only in cases of gynecologic tumors. In the seventies, the Centre bought his first LDR selectron, equipped with 137-Cesium isotope. This significant purchase allowed safe and automatic use of radiation sources. In the nineties, after getting devices of new generation – HDR and PDR microselectrons, the amount of treated patients increased essentially. The range of tumors treatment was widely extended to meet the standard level of renowned Cancer Centers of European Union.

On the 8<sup>th</sup> of May 1999, for the first time brachytherapy was used in non-gynecological tumors – in advanced lung cancer. Brachytherapy Laboratory was created, as a part of 1<sup>st</sup> General Radiotherapy Unit and was operating till the 1<sup>st</sup> of June 2005. During 6 years of operational time of the Laboratory, two doctors were engaged in non-gynecological brachytherapy: Janusz Skowronek, MD, and Krystyna Adamska, MD, along with the nurses: Lidia Rogozik, Barbara Majewska and Emilia Szczepka. With

great collaboration of medical physicist – Grzegorz Zwierzchowski, MD, who is working in the Department from the beginning. The entire team has introduced to clinical practice many innovative ways of brachytherapy, such as: development of Pulsed Dose Rate (PDR) brachytherapy as one of the first Centers in Poland, endovascular brachytherapy and new technique of biliary ducts brachytherapy. For the first time PDR therapy was used in treatment of malignant glioma recurrences. Significant part of all our patients with advanced lung cancers and oesophageal cancers had a chance to receive palliative HDR treatment [7].

The new Brachytherapy Department was created on the 1<sup>st</sup> of June 2005. It is situated on the 1<sup>st</sup> floor at newly constructed part of the Hospital. It is one out of five existing modern Brachytherapy Departments in Poland, equipped with unique brachytherapy systems. In 2006, we have treated 1131 patients; in 2007 the amount was 1299 and in 2008 – 1404, which made 1/5 of all patients irradiated in our Centre (Figs. 7-8). More than 50% of all our patients are treated with a radical presumption. The Department offers nearly all the modern ways of therapy that are equally available in most famous Oncologic Centers of the world. Since 1<sup>st</sup> of June 2005, the Head of the Department is Janusz Skowronek, MD, PhD, Ass. Prof.

### Present offer of GCC Brachytherapy Department

1. Interstitial brachytherapy of prostate cancer (HDR and permanent implants).
2. Interstitial brachytherapy of breast cancer.
3. Interstitial brachytherapy of penile cancer.
4. Interstitial brachytherapy of advanced abdominal malignances, including pancreas, recurrences of colorectal cancer and retroperitoneal sarcomas.
5. Interstitial brachytherapy of lip cancer.
6. Interstitial brachytherapy of brain tumors.

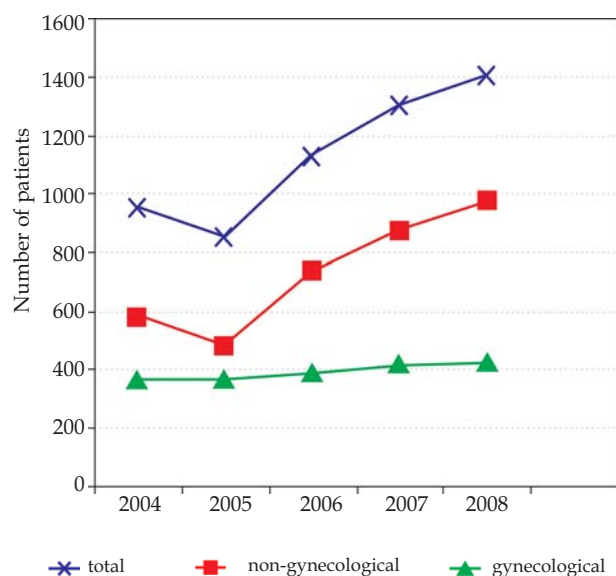


Fig. 7. Patients treated with brachytherapy in GCC in years 2004-2008

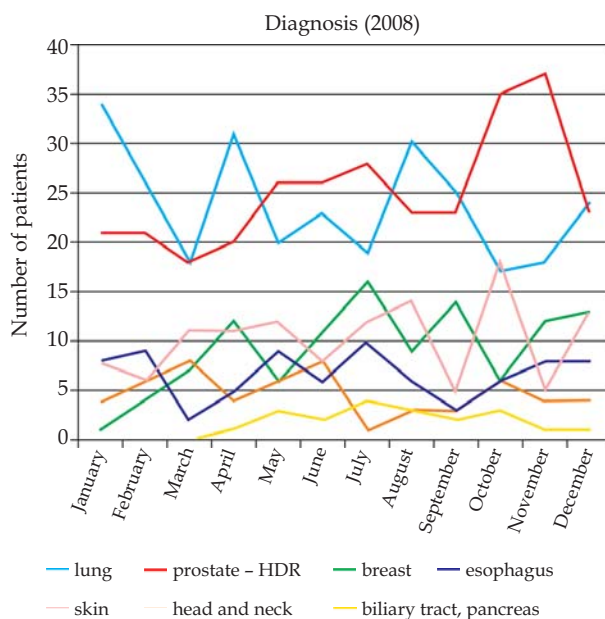


Fig. 8. Localisation of non-gynecological tumors treated with brachytherapy in GCC in year 2008

7. Interstitial and superficial brachytherapy of head & neck cancers.
8. Interstitial and superficial brachytherapy of skin cancer.
9. Endoluminal brachytherapy of tracheal and pulmonary cancers.
10. Endoluminal brachytherapy of esophageal cancer.
11. Endoluminal brachytherapy of bile duct cancer.
12. Endoluminal and interstitial brachytherapy of anal cancer.
13. Endoluminal and interstitial brachytherapy of gynecological cancers (Department of Gynecological Radiotherapy).
14. Interstitial and superficial hyperthermia combined with brachytherapy, EBRT and/or chemotherapy.
15. Diagnostic and therapeutic bronchoscopy [7].

### Brachytherapy Department Structure

The GCC Brachytherapy Department contains two bunkers devoted to HDR brachytherapy; one for PDR brachytherapy (the second one is in Gynecological Department), operating theatre for placing applications under local or general anesthesia; Laboratory of Treatment Planning and Brachytherapeutic Dosimetry (under auspices of Medical Physics Department); Laboratory of Hyperthermia; Laboratory of Endoscopy; out-patient clinic; two wards (6 beds); duty room; nurse's station; secretary's office, Head of Department's Office; archives (Figs. 9-10). The GCC enclose four professional brachytherapy devices: two units of microelectrons HDR (High Dose Rate), microelectron PDR (Pulsed Dose Rate) and selectron LDR (Low Dose Rate) – both located in a shielding rooms of Gynecological Radiotherapy Department (Head; Andrzej Roszak, MD, PhD, Ass. Prof.). The purchase of second PDR unit is in future plans.

The Department is in possession of modern technology appliances, such as computer software for treatment planning: PLATO, Oncentra Masterplan, Oncentra Prostate, Anatomy Modeling, Integrated Brachytherapy Unit (IBU); a device for radiological verification: PHILIPS ENDURA; two "real time" planning systems: SWIFT for

brachytherapy of prostate cancer, and SPOT software for permanent implants treatment (Figs. 11-14).

### The Staff

Brachytherapy procedures demands close collaboration of all team members. In GCC, brachytherapy is conducted by a team of highly specialized medical staff that includes physicians (radiation oncologists), medical physicists, X-ray technicians and nurses. Additionally, the team is in constant cooperation with a consultant pulmonologist. Our personnel is trained in the best national and foreign Centers. The staff includes: 5 physicians (additionally 2 in Gynecological Department), 4 medical physicists, 13 nurses, X-ray technicians and 2 medical secretaries [7] (Fig. 15).

### The Scientific Research

Over forty scientific articles have been published by our team members from 1999 till 2007. We prepared more than 80 conference presentations and lectures relating to brachytherapy. The Head of the Department completed his registration and conferment procedure for an assistant professor degree. Other doctoral degrees are presently being conducted. All members of the Department take active part in annual Polish and International scientific conferences. The Department takes part in a multicentric trials, such as phase II study (PBIG Trial) on prostate cancer HDR monotherapy. The team members are also involved in numerous EU projects like EMPIRION or QUESTRO. The Department provides classes given to medical, health science and biotechnology students from University of Medical Sciences in Poznań as well as to physics students from Poznań and Torun Universities.

### Cooperation

The staff of GCC Brachytherapy Department gain and expand their experience and knowledge in collaboration with other Polish and foreign Centers, especially with Brachytherapy Departments in Bydgoszcz, Gliwice and



Fig. 9. Brachytherapy Department, 2008



Fig. 10. Shielding room for Pulsed Dose Brachytherapy (PDR)



Fig. 11. SWIFT planning system (Nucletron®)



Fig. 12. Integrated Brachytherapy Unit (IBU) (Nucletron®)



Fig. 13. X-ray Unit with C-arm (Phillips®)



Fig. 14. Laboratory of Treatment Planning and Dosimetry of Brachytherapy Department



Fig. 15. Brachytherapy team at work

Warsaw. We've also established good cooperation with Institute of Oncology in Barcelona (Spain), University of Vienna (Austria) and University of Utrecht (Netherlands). The HDR/PDR brachytherapy of central nervous system tumors is applied in collaboration with Clinic of Neurosurgery of University of Medical Sciences



Fig. 16. Hyperthermia Unit (BSD 500 - BSD Medical®)

(UMS) in Poznań; PDR brachytherapy of bile duct cancers in collaboration with Municipal Hospital in Poznań; HDR/PDR brachytherapy of head & neck cancers in cooperation with GCC Head & Neck Cancers Department and Clinic of ENT and Laryngeal Oncology of UMS in Poznań [7].

### Introducing new treatment methods

Exceptional and outstanding achievements of GCC Brachytherapy Department team members (first introduction of treatment methods in local region) can be listed as follows: 1. Development of modern technique of Pulsed Dose Rate (PDR) brachytherapy in different types of malignant tumors – in GCC since 1<sup>st</sup> of July 2000 (treatment conducted in 4 centers in Poland). 2. Development of HDR/PDR interstitial brachytherapy of central nervous system malignancies (in cooperation with Clinic of Neurosurgery, UMS Poznań); 3. Brachytherapy of coronary arteries restenoses (in collaboration with Cardiology Clinic of UMS, Poznań and Laboratory of Hemodynamic of "Józef Struś" Municipal Hospital in Poznań – treatment conducted in 3 centers in Poland) and peripheral arteries restenoses (in cooperation with Clinic of Vascular Surgery, UMS Poznań); 4. Interstitial HDR brachytherapy of prostate cancer. 5. HDR/PDR brachytherapy of bile duct cancer (in cooperation with Municipal Hospital in Poznań – the first routinely applied type of treatment in Poland); 6. HDR/PDR brachytherapy of head & neck cancers (in collaboration with ETC and Laryngeal Oncology Clinic, UMS Poznań). 7. HDR/PDR brachytherapy of breast cancer. 8. Interstitial prostate brachytherapy with permanent implants (seeds) application. The GCC Brachytherapy Department as one out of three centers in Poland to use modern hyperthermia unit (BSD – 400/500, BSD Medical) in therapy of selected group of patients. This type of treatment meets the standard level of the best equipped oncology centers in Europe (Fig. 16).

In December 2008 as a part of Brachytherapy Department and being the first in the Mideastern Europe, we've created a diagnostic and medical background that permits the implantation of radioactive sources I-125 under the control of ultrasound TRUS in prostate cancer treatment. The GCC Brachytherapy Department is the first one in Poland to use such innovative type of treatment.

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