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History of radiotherapy in Poland. A brief outline of the problem

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Abstract

Objectives: The aim of this paper is to give brief outline on the history of radiotherapy in Poland from its beginnings until first decades of the second half of 20th century.

Methods: The study is based on comparative and reconstructive analyses of literature, papers and communications dealing with the history of radiotherapy in Poland.

Results: The history of radiotherapy in Poland can be perceived as a gradual process of shaping research centres and practical (clinical) application of radiotherapeutics. The Radium Institute in Warsaw, as well as radiotherapy centers in Poznań and Kraków gained key importance in the period up to the outbreak of World War II. After the end of the war, Gliwice became another important place for the history of the radiotherapy and oncology in Poland.

Conclusions: Radiotherapy was early recognized by Polish physicians as promising in clinical treatment. It should be a subject of further studies, especially when formative period, thus before First World War, is analysed.

Keywords: history of medicine; radiotherapy; radium; X-rays.

Introduction

Radiotherapy (RT), known under other name as radiation therapy, has its roots in the last decade of 19th century when the discovery of X-rays in 1895 by Wilhelm Conrad Roentgen and study of the phenomenon of radioactivity, started in 1896, by Antoine Henri Becquerel heralded new epoch in physics. It took only two years, when Maria Skłodowska-Curie and her husband Pierre Curie discovered the radium as a source of radiations announcing in 1898 results of their research to the scientific community. In the epoch of the multiple advances in the realm of

technology and basic sciences public attention was immediately focused on those revolutionary braking points and possibilities which came with them. The medical world was eager to test X-rays and radioactivity phenomena in therapy and diagnostics.

X-rays

It should be noted that as early as opening months of 1896 American lecturer in chemistry and physics Emil Herman Grubbé (1875–1960) was ready to treat a patient with breast cancer with X-rays, which then were still a kind of mystery. If it was really applied remains uncertain because the case history documentation is nonexistent [1]. The first confirmed X-ray therapy in the advanced cancer of the stomach was performed in July 1896 by French Victor Despeignes (1866–1937) [2]. Then in November the very same year German Voigt reported on the treatment of a patient with cancer of the pharynx, which in his opinion was to some degree successful, however only short information was published and the proper scientific paper never occurred [1]. In the very same month, the Viennese dermatologist Leopold Freund (1868–1943) was to explore X-ray therapy method on nonmalignant disease giving the treatment of the hairy nevus (*nevus pigmentosus piliferus*) [3]. Then in 1898 Charles Thurston Holland (1863–1941) performed successful X-ray therapy of lupus.

It was December 1899 when Swedish general practitioners: Tage Sjögren (1859–1939) and Thor Stenbeck (1864–1914) were to use X-ray in the therapy of two patients – first with basal cell nose cancer, second suffering from squamous cell carcinoma of the cheek. His technique, depending on the smaller doses of radiation applied over a longer period, would later be called fractionated radiotherapy [4, 5].

One of the most important and influential researchers in the early period of RT was Danish physician Niels Ryberg Finsen (1860–1904) who was in 1893 advocating for the deeper investigation of the potential therapeutic effect of light for treatment of different diseases. After Roentgen discovery, in 1896 he extended his research now experimenting with directed light rays. Using a system of quartz crystals lens he was able to separate UV and construct a facility based on electric carbon arcs lamp

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which could radiate ultraviolet light with the beneficial effect when treating lupus vulgaris [6, 7].

Finsen is now regarded as a pioneer of the phototherapy and his idea of using a special lamp for shifting rays in the right direction was to be most influential for the future RT techniques. In 1903 he was awarded a Nobel Prize. In the beginning of 20th century X-ray were already tested used in therapy of various diseases in many countries. It was before World War I when German gynecologist and radiologist Heinrich E. Albers-Schönberg (1865–1921) to avoid dispersion of X-rays constructed special tubes, which allowed concentration of rays for more localized radiation of pathological lesions.

Historical roots of brachytherapy – the very beginnings

One of the first scientists who advocated the use of radioactive isotopes for cancer treatment was Pierre Curie [8]. In October 1900, a pioneer of dental radiography, Otto Walkhoff (1860–1934) had noticed a skin reaction following a deliberate application of a radium source [9–11]. At the same time next German researcher Friedrich Giesel (1852–1927) described biological effects when strapping some amount of the radium salt to his inner forearm for a duration of 2 h [12, 13]. Then Becquerel, who was accidentally carrying a tube of radium in his vest pocket, experienced a severe skin burn. That opened discussion on the direct impact of radiation on the biological structures. In 1901 the first general report on the physiologic effects of radium rays was delivered by Becquerel and Curie [14]. In the meantime, the French physician Henri A. Danlos (1814–1912), collaborating with physicist Eugène Bloch (1878–1944), working together at Hôpital Saint-Louis in Paris, were probably the first to perform local application of a sealed radium source with aim to treat a patient with the nonmalignant skin condition, *lupus erythematosus* [15]. Their report published 1901 can be considered the beginning of brachytherapy era, however, it is possible that American William Francis (1852–1936) could begin radium therapy even earlier [16].

In 1903, Nicholas Senn (1844–1908) used irradiation treatment in the leukemia and was convinced that his therapy was working [17]. In the same year Margaret A. Cleaves (1848–1917) in New York applied radium intracavitary for the treatment of carcinoma of the cervix, and therefore this procedure is often regarded as the turning point in the modern gynecologic brachytherapy [18, 19], while Semen Wiktorovich Goldberg and Efim Semenovich London

cured with radium therapy, as they claimed, two patients with the basal cell carcinoma of the skin face [16, 20].

In 1905 Robert Abbé (1851–1928), talented American surgeon, implanted radium directly into a tumor tissue. From that moment he became strongly convinced that radiotherapy is the future for cancer treatment. In later years Abbé suffered from an aplastic anemia, which was probably resulting of long-term exposition to radiation. In the same year Louis Wickham (1861–1913) i Paul Degrais (1874–1954) started new technique – crossfire action, which enabled radiotherapy to be more efficient in curing deeply localized tissues. It was 1911 when Herman Fermor Lawrence in his monograph entitled *Radium: How & When to Use* published first diagram of this method. As was observed, two crossing beams give much better results, than the single one. Finally, named as *crossfire deep therapy technique*, came to voice in the years before first world war, used not only for the brachytherapy but was also adopted for X-ray radiotherapy [21].

In Europe the very same enthusiasm for the new and promising therapy was shared. From 1906 French physician from Lyon Claudius Regaud (1870–1940) was advocating for the use of irradiation in the cancer treatment. He reported that undifferentiated cells (spermatogonia) are more radiosensitive if compared to differentiated spermatozoid cells [22, 23]. In next years he conducted a series of experiments and observations showing that resulting in the conclusion that ram's testes could be sterilized without causing major burns to the scrotal skin [23]. Simultaneously, different types of applicators were tested in form of needles, buttons, coils, and tubes to name only those mostly tested.

When in 1909, Radium Institute in Paris (Institut du Radium) was established it heralded the new era of institutional attitude to theoretical and practical aspects of radiotherapy. It was just before World War I broke up when in 1913 in America Standard Chemical Company began commercially marketing radium, which, as was advertised, as multipurpose treatment agent suitable for medical use.

First steps in Poland

One of earliest papers devoted to radiotherapy in Poland were concentrating to the benefits of cure by X-ray radiation of hemorrhoids (written by Łapiński) [24] and different skin diseases e.g. furuncle, rosacea, and lichen planus (written by Baschkopf) [24]. Next Stanisław Boczar presented a lecture at ninth Meeting of Polish Physicians and Naturalists held in Cracow in 1900. Based on four cases of favus clinical trials, Boczar was positive that exposition to

X-rays has curative effect; although he points those long-term expositions can result in skin burns [25]. In the same 1900 Mieczysław Nartowski (1868–1929) in his monograph on radiology gives some attention for radiotherapy. He points on indications for the use of X-rays in the treatment of patients. Diseases like sycosis, favus, and lupus vulgaris were among those which could be healed by this method [26].

Three years later Robert Bernhardt published his report based on 41 cases when X-ray therapy was implemented to treat different skin diseases conditions. He was convinced that best results could be achieved when cancerous and lupus tissue was exposed [27]. Then in 1905 Adam Kozerski presented then most up to date observations concerning measuring the exposure time to X-rays and proper selection of a single dose of irradiation [28]. His communication should be seen the first on polish soil discussion on scientific frames for radiotherapy practice [29].

Four years later in 1909 Adam Karwowski delivered one of most detailed paper concerned with the most efficient X-ray therapy, who enlisted many diseases which, as was thought, could be properly cured. Hirsutism and hypertrichosis, tinea capitis (herpes tonsurans), and favus were mentioned in the first place. Then warts and sarcomas together with tinea pedis were grouped. Tuberculosis was the other subject of deeper investigation concerning possibilities for the brachytherapy [30].

Radium institute in Warsaw

In 1906 the Committee for Studies and Cancer Control (from 1921 renamed Polish Committee for Cancer Control) was established in Warsaw. The initiative came from Nicolaus Rejchman and Joseph Jaworski giving administrative and scientific grounds for future radiotherapy in Poland. It was again in 1921 when Society of Radium Institute was established, which focused on the idea of erecting the modern Radium Institute in Warsaw, which would enclose research, clinical and tutorial divisions aiming for the theoretical and practical radiotherapy. In 1924 in close cooperation with Polish Committee for Cancer Control, The National Donation Committee came to live to rise funds for future construction work. Whole idea was from the beginning strongly supported by then twice Nobel Prize winner Maria Skłodowska-Curie [31]. Many influential and publicly recognizable people took part in this effort. Among them President of Poland prof. Stanislaw Wojciechowski and Marshal Józef Piłsudski. In 1925 cornerstones were laid, but it took some time to finish construction plan, which was given in detail by Maria Skłodowska-Curie and Claude Regaud [31]. In 1932 Radium Institute in Warsaw

could finally admit the first patient, and two years later research division of Institute became fully operational. Dr Franciszek Łukaszczyk (1897–1956), highly educated radiologist, pupil, and coworker of Claudius Regaud with whom he was conducting the scientific research in the Laboratory Pasteur, was appointed the director of Radium Institute. Regarded as a pioneer of modern radiotherapy in Poland, Dr. Łukaszczyk also became a head of the clinical division, while the Pathology Laboratory was established under Dr. Józef Laskowski (1900–1970). Soon Dr. Hanna Noblinówna became a member of the institute team. At that time five X-ray machines and 166 radium charges, in the form of platinum needles and tubes, were at the disposition of physicians [29, 32]. Until the end of 1933, according to the Dr. Łukaszczyk report, over 1,000 patients were examined, of which nearly 700 were admitted for treatment. These numbers could be achieved thanks to the generosity of Maria Skłodowska-Curie who donated 1 g of radium.

In the second half of the 1930s, the Institute developed dynamically rising number of clinical beds, opening new labs, and starting several research-therapy projects. In 1937 there were seven physicians working; except Łukaszczyk, Laskowski, and Nobilówna the staff has been strengthened by Adam Kukliński, Anna Madejczyk, Jerzy Szabunia, and Józef Towpik [29, 33]. The new biological lab was headed by then dr Zygmunt Zakrzewski (1904–1955) leading experimental research aiming at the carcinogenesis in the animal model and tissue cultures. In 1937 The Laboratory for Measurements of Radioactive Bodies was established and ruled by Maria Skłodowska-Curie's former student, Cezary Pawłowski (1895–1981) [29, 33].

In the clinical ward the number of beds was growing and before World War II there were 90 of them in the disposition. Even operating only few years, the Institute team had achieved good scientific and clinical results. As Łukaszczyk recalls: “In 1938, nearly 400 early and neglected cases of skin cancer treated with radium, cured in 83% of patients with several years of follow-up were announced [...]. Several publications concerned the management of such a common and socially important cancer of the uterus” [34]. Development in breast cancer early diagnosis was clearly marked, the strict rules for radiotherapy of the laryngeal cancer at various stages of development were prepared and clinical description and radiotherapy schemas for lung cancers were delivered with great precision [34]. In Physical Lab first radioactive isotopes of silver, phosphor, and manganese were produced. The medical program developed in Institute was so successful that further plans for future expansion were initiated. The outbreak of the Second World War thwarted these projects.

When in 1939 Hitler invaded Poland Łukaszczyk was forced to close Institute. Soon it was reopened but now under German management and under new name: Municipal Cancer Hospital. Łukaszczyk and his coworkers managed to hide some of precious radium and in hard conditions of German occupation were continuing their job. When in summer 1944 the Warsaw Uprising broke out, again risking his health and life, Łukaszczyk secretly smuggled out of the city over 1 g of radium [35]. Buildings of Radium Institute were damaged, burned out, and completely looted. When war ended Dr Łukaszczyk moved to Cracow so to continue his work in Gabriel Narutowicz Hospital using saved radioactive samples, but in 1947 he returned to Warsaw to help Radium Institute to be reborn from the ashes [36]. As its director, he held this post until his death in 1956.

In the post-war years, the Radium Institute quickly rebuilt its prewar potential. First, in 1946 clinical division was opened. Then in summer of 1947 histopathological laboratory was again in service, and by November X-ray therapy division was operational together with surgery ward. In 1950–1951 the Department of Cancer Biology, headed by Stanisław Wiśłocki and the Department of Medical Physics, headed again by Cezary Pawłowski, were already operational [37]. In 1957, the Isotope Lab created by prof. Władysław Jasiński (1916–1989) was established. It was a starting point for the nuclear medicine in Poland. Jasiński, future professor and member of Polish Academy of Science, was an author of the first textbook on the clinical use of radioisotopes in oncology [38]. In 1967 Radiochemistry Laboratory was created by then associate professor Janusz Szymendera. In 1974 professor Szymendera became head of the Nuclear Medicine Department [39].

To modern oncology

As early as late 1940s there were plans to create one central institution to fight cancer. In 1951 the Council of Ministers decided to combine the Radium Institute in Warsaw with the Institute of Oncology in Kraków and the National Cancer Institute in Gliwice, creating one Maria Skłodowska-Curie Institute of Oncology, with two branches – in Cracow and Gliwice.

Cracow

Professor Walery Jaworski (1849–1924), one of most eminent Polish physicians, then heading the Clinic of

Internal Diseases at the Jagiellonian University in Cracow, was deeply interested in diagnostic possibilities of X-rays, being one of pioneers of the medical radiology in Poland. There is no doubt that he followed the latest scientific reports concerned with that field, delivering first paper focused on X-rays as early as 1897 [40]. In 1906 Jaworski decided to write a letter to Maria Skłodowska-Curie. In return Skłodowska-Curie sends a letter to Cracow in which she explains to Professor Jaworski the technical details of the effectiveness of radium therapy depending on the form in which it is used. Jaworski was willing to test the radium in the clinical practice, but he never got enough funds and could buy no more than few milligrams. However, with this amount of radioactive element Jaworski was able to show, that radium has bactericidal properties [41].

Jaworski was not the only member of the Medical Faculty of the Jagiellonian University interested in the radiotherapy. In 1921 eminent gynecologist and obstetrician Aleksander Rosner (1867–1930) in one of the letters to Maria Skłodowska-Curie has written: “In 1913, on behalf of the Jagiellonian University, I started my efforts to obtain a certain amount of radium for the research purposes of our theoretical departments and for medicinal purposes in our clinics. [...] At that time, we intended to establish a kind of radium division at the University, which could be used equally by theoretical facilities and clinics. [...] Theoretical departments of the Faculty of Medicine included: the institute of physiology, anatomy, biology, embryology and general pathology, and the clinics: surgical, gynecological, otolaryngological, internal and psychiatric institutes” [42].

Rosner invited to the Warsaw Committee, which was then gathering around project which finally led to creation of famous Radium Institute, was asking Maria Skłodowska-Curie, if it would be possible to plan the second to Warsaw center for radiotherapy in Cracow [42]. Even if gaining some attention to his proposals Rosner’s declaration, mostly due to economic reasons, remained only theoretical. Nevertheless in 1923 Dr Henryk Wachtel (1890–1977) was already struggling for the professional Radium Institute in Cracow, which finally was established in 1924 and was operational until 1930. The Institute was a private venture led by a medical consortium [43]. Wachtel was coauthor together with Konstanty Zakrzewski (1876–1948) of the influential textbook – *O pierwiastkach promieniotwórczych i o leczeniu promieniami radium* which was published in 1925. Feliks Murdziński, working then in Institute, informed that radium therapy was more effective than X-ray therapy in the lupus treatment [44].

It was in 1936 when Gynecological Clinic of Jagiellonian University was finally moved to the new localization and the division of radiotherapy was established. It was

here dr Emil Wyrobek (1906–1974), who specialized in radiology and radiotherapy, taking postgraduate studies in the field of oncology and became main figure. In 1939 he published review paper on the benefits of radium therapy in oncology, underlying the importance of the mutual interrelation between histopathological, clinical, and technical knowledge [45, 46].

In 1950, following existing institutions in Warsaw and Paris, oncological division in Cracow was established. Named as Department of the Maria Skłodowska-Curie Institute of Oncology became fully operational year later under Emil Wyrobek as its first director. Division of radium and X-ray therapy, surgical ward and diagnostic labs were fully operational [46]. In 1954 Hanna Kołodziejska-Wertheim (1914–2004) was nominated a head of the department. She became interested in modern radiology during the Second World War working then together with Łukaszczyk and was one of the leading figures during the reconstruction of the institute in Warsaw in first afterwar years. In Cracow Kołodziejska-Wertheim succeeded in transformation the department into oncological institute [47]. In 1971 new radiotherapy pavilion was completed, in which a cobalt 60 tele-gammothery machine was installed.

Gliwice

In 1947 the National Cancer Institute was erected on basis of the prewar gynecological hospital. Stanisław Bylina (1903–1978) was its organizer and first director. He became interested in oncology and radiotherapy in 1930s and just before the war broke-up he was to prepare plans for the Radium Institute of the Bracka Company in Silesia and he got the ordinance of the Surgical Department in Chorzów. At the same the launch of Silesian Radium Institute was decided but the German invasion of Poland shattered this project. When war ended the idea for creation of Cancer Control Institute was again in value and Stanisław Bylina was back in Gliwice, where he continued works on the radiotherapy methods in the cancer treatment. In 1948, 10 devices for deep X-ray therapy and one diagnostic device were purchased [48].

In 1951, the Institute was taken over by Jeremi Świącki (1913–1991). Department of Radiotherapy was for a short time headed by Dr. Władysław Jasiński. Then doctor, later associate professor, Andrzej Hliniak (1926–2005) took this post and worked in Gliwice until 1980, when he moved to Warsaw [49]. Over the years of his scientific activity, he became one of most important figures in the field of radiation therapy in Poland. His unique research program

dealing with problems emerging in the field of clinical radiobiology, especially focused on the modification of fractionating the radiation dose methods [47, 49, 50]. In 1960s Irene Czubalska (1926–2004), who was well trained in the radiotherapy methods of the Manchester school, introduced them in Gliwice in the treatment of cervical cancer [51].

Already in 1949, The Department of Cancer Control Organization was established and in the mid-1950s it was renamed the Department of Cancer Epidemiology. Under the leadership of Jerzy Staszewski it became one of most advanced scientific centers, gaining soon international fame. In 1962 cobalt therapy and palliative care system were introduced [52]. High dose and split-course palliative radiotherapy was introduced in Poland in late 1960s, and in the mid-1970s, Dr. P. Rattka was the first in Poland to design and made fully operational unique *Selectron* apparatus designated for brachytherapy using the *after-loading method* [52].

Łódź

It should be remembered that beginning history of radiotherapy in Poland wasn't just limited to Warsaw and Cracow or Gliwice. In fact, in 1913 in Łódź on initiative of pastor Rudolf Gundlach (1850–1922), with the financial help of Herbst family, the radium medical clinic was to be created. However, these plans were hindered by the war. In 1927 the Cancer Control Society of Łódź was founded. Juliusz Lange, to whom belongs the initiative and first plans for Society, became the first chairman of the Society's board. The 250 mg of radium was purchased for needs of future therapy and the Radium Treatment Institute was established. In 1937 Research Laboratory, headed by Kazimierz Ścieśński began its work [53].

Poznań

Karol Mayer (1882–1946), mostly remembered for his pioneering work on the radiological tomography techniques, began his radiological works in Cracow, later becoming the first professor of radiology in Poland at the University in Poznań, was also an inventor of the special rotation beds suitable for X-ray diagnostic and radiotherapy [46]. From 1921 onwards, then working in Poznań, Mayer used his so named *rotation therapy* with X-rays in 1933, and then in 1939 it was applied with the use of radium. Results of this method were given in detail [54]. Radiodiagnostics and

radiotherapy were also present in the Gynecology and Obstetrics Clinic and Orthopedic Clinic.

In the interwar period in Poznań there were other medical organizations like Radium Institute of the Union Healthcare Center, which was run under authority of Kazimierz Węchowski [54] or Radiology Department, which since 1921 was owned and run by Tadeusz Alkiewicz (1891–1959). From 1924 onwards he also organized and headed radiographic diagnostics and radium therapy at Elisabeth Sisters Hospital in Poznań.

After second world, from 1952 Oncology Center in Poznań headed by Czesław Wojnerowicz (1917–2010), who before was working at the Radium Institute in Warsaw, was operational. Three departments: Gynecologic, General and Surgery with 100 beds in total were established. In 1950s brachytherapy and deep X-ray therapy were already standard procedures [54].

Vilnius

In 1931 on initiative of prof. Kazimierz Pelczar Research and Therapeutic Institute for Cancer Control in Vilnius was opened. It consisted of X-ray therapeutic ward and a surgical ward, where radium treatment was introduced. From 1933 dr. Włodzimierz Biełozabski was given authority over Research and Treatment Department. Soon X-ray machine for deep therapy was working. Three years later brachytherapy was introduced, when 33 mg of radium was purchased. That made skin cancers and cancers of the female reproductive organ treatment possible. On the other hand, the X-ray therapy was mostly used when cervical cancer and breast cancer were diagnosed. In 1931 there were only 12 clinical beds, then in 1939 the number of beds was 90 [55].

Lviv

In 1921 in Gynecological and Obstetrics Clinic at Lviv University prof. Kazimierz Bocheński organized first X-ray, then radium therapy programs. Radiotherapy was also introduced in the Clinic of Internal Diseases and Surgical Clinic [56].

In 1929 Association of the Polish Cancer Control Institute in Lviv was established. It's on the initiative of Association, and especially Dr Andrzej Podhorecki, in 1931 St. Lawrence's Institute in State Public Hospital at Lviv started its activity. The Institute had a 16-bed ward and offered to its patients X-ray therapy. The radium treatment was planned in the nearest future. Dr Kazimierz Węchowski was nominated as a chief physician of the Institute [57]. His

works were focused mainly on the technical aspects of radiotherapy and oncological statistics.

In Lviv worked Emil Meisels (Misiewicz) (1890–1950) who became well known and valued radiologist, whose works on radiotherapy were highly appreciated [58]. Meisels was investigating several problems connected with radiotherapy, among them sensitivity of white blood cells to X-rays in Hodgkin lymphoma treatment [59] and several works on comparative studies on results achieved with different radiological techniques in oncology [60].

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