As early as several days after the publication of the information concerning Roentgen's discovery the first radiological examinations were performed in Poland. The new method was immediately introduced into medical practice, including gastroenterology. In that pioneer period the most important works were those by Walery Jaworski who was the first man in the world to perform an X-ray of gall stones as well as the stomach with the use of a contrast medium. In its more-than-a-hundred-year history Polish gastrointestinal radiology has attempted not only to catch up with the world science, but it also has made a considerable contribution to its development.

Key words: radiology, gastrointestinal radiology, radiography, fluoroscopy, angiography, interventional radiology, US, CT, MRI

INTRODUCTION

On January 8, 1896 (three days after the publication of Roentgen's discovery in Vienna's Die Presse) Cracow-based Czas, as the first Polish newspaper, reprinted that spectacular report. In a short note the methods of obtaining the rays, their basic physical properties and hypothetical applications were presented (1). It was also stated that "the problem, although it seems an All Fools' Day joke, is seriously considered in serious circles." Acting on that information a professor of chemistry of the Jagiellonian University Karol Olszewski (the man who was the first one, along with W. Wróblewski, to liquefy air) repeated Roentgen's experiment (Fig. 1). He constructed a device generating X-rays (Fig. 2) and successfully took pictures of various objects and one of a human hand. The information about those experiments was published by Czas on January 21, 1896.
(2). The descriptions of those experiments as well as pictures taken at that time have been retained. The first Polish X-ray picture is assumed to be the picture of a metal a lizard-shaped paper-weight (Fig. 2).

On the first days of February 1896 professor Olszewski, at the order of a professor of surgery of the Jagiellonian University Alfred Obaliński, performed an X-ray picture in a patient with the suspicion of a dislocation of the elbow joint.
The examination confirmed the suspicion. It was the first Polish X-ray picture taken for clinical purposes. On February 22, 1896 Przegląd Lekarski (Medical Review) published an article "The use of the Roentgen rays for Diagnostic Purposes" by professor Alfred Obaliński (Fig. 3). It was the first scientific article on the medical application of X-rays (3).

Towards the end of January 1896 radiological investigations were successfully performed also in other Polish medical centres - Warsaw and Poznan. After the clinical usefulness of X-rays was shown the new diagnostic method was introduced into medical practice. Between February and June 1896 radiological laboratories were established in large and best known Polish hospitals.

The first radiological examinations of the abdomen were not very useful because of the poor permeability of X-rays due to a very low performance of the device applied. Not more than the presence of foreign bodies was detected. Most frequently, such objects were revealed in the oesophagus. The methodology of the oesophagus examination in the search for foreign bodies was presented by Mieczysław Nartowski in his textbook issued in Cracow in 1900 (4). In the 19th century the diagnosis of gastroptosis (Glenard disease) was often made, which required the determination of the location of the lower margin of the stomach. One of the first doctors to deal with that problem and find a practical solution was Walery Jaworski. Under the guidance of X-rays he placed in the stomach a probe into which he inserted a metal wire. Jaworski was an eminent gastrologist, a professor of the Medical Department of the Jagiellonian University, Cracow. In February 1896 he
established the first radiological laboratory in Poland, located in a University Clinic building, and started applying X-rays in clinical practice on a routine basis.

The most spectacular fact, placing him among the pioneers of the world radiology, was the description of bile concrements (gallstones) and the examination of the stomach with the use of a contrast medium. Jaworski postulated that bile concrements "produce shadows only when they are composed of calcium compounds or blood pigment;" he also noted that cholesterine or mucous concrements are permeable for X-rays and may not, therefore, be easily visualised." Furthermore, he made a practical observation that "in order to visualise concrements in the body a picture is much more reliable than the screen" (5).

The technique of examining the stomach with the use of a contrast medium was a pioneer method introduced by Jaworski. That medium was carbon dioxide in the form of soda water administered into the stomach through a probe. Jaworski described it in the following way: "In order for the stomach to be well visible we will distend it strongly with soda water or lathering powder. The bright place on the screen corresponding to the stomach will become enlarged and take a form of a distended bladder" (5). With the use of his examinations he presented changes in the stomach, including the so-called hourglass stomach. Both examinations were the first ones in the world. Their results were presented by
Jaworski in the articles of August 21 and 28, 1897 and in a textbook published in 1899 (6) "An Outline of Pathology and Therapy of the Stomach" (Fig. 4).

In the years 1898-99 bismuth as a contrast medium was introduced into clinical practice. In Poland, its application for the evaluation of the motor function of the stomach was described by W. Kozłowski in 1898 (7). The examination of the stomach with the use of bismuth was also recommended in textbooks by other Cracow doctors (4, 8) - Nartowski (1900) and Frommer (1902). In 1910 Polish radiologists started to use barium as a contrast medium. The author of the first Polish works (1921-27) describing the radiological diagnostics of the stomach and duodenum, with the particular consideration of ulcer and cancer, was E. Misiewicz (Meisels) from Lvov. In the years 1928-29 C. Murczyński (Teofil Bluhbaum) from Cracow introduced a colloid solution of thorium (thorotrast) for imaging the mucosa of the gastrointestinal tract. That method gained considerable publicity, but was not accepted due to its adverse effect (9).

In 1921 A. Bocage patented the technique of tomography. Yet it was a Cracow radiologist (the later first professor of radiology in Poland, the head of the Chair of Radiology in Poznań) K. Mayer who presented, as early as 1914, the principles of taking pictures using a layer technique. In his book published in 1916 he described the principles and practical uses of that technique, being considerably ahead of the world radiology (10). Tomography was not of practical use in

Fig. 5. Percutaneous cholangiography (Czas 1902)
gastrointestinal radiology. Mayer, however, applied it for the search for deposits of heavy metals in the wall of the intestines and parenchymal organs in the cases of intoxication. His many-year studies were described by him in 1926 in the work "Roentgen and radium examinations in poisoning" (10).

Attempts of double contrast examinations of the stomach and duodenum in the 1920s did not arouse a particular interest in Poland. It was not until the introduction of the modern contrast media in the 1950s and 60s that an increased interest in that method was aroused. It became widely used at the turn of the 70s (11).

The small intestine had long presented a significant problem in radiological diagnostics. Some progress in that field was provided by the technique called barium enteroclysis introduced in 1929. It was rarely used in Poland. Attempts of developing her own method were made by M. Leszczyńska-Dobrzańska from Warsaw in 1968. She used a suspension of a contrast medium and air inserted by a catheter. A breakthrough was a technique of administering large amounts of barium with methyl cellulose in 1978 by Herlinger. In 1979 that technique was applied by S. Leszczyński from Warsaw (12).

Contrast medium examinations of the large intestine were performed in Poland with the use of, initially, bismuth and then barium. The double contrast method in common radiological practice in Poland was introduced by S. Leszczyński from Warsaw (13). A series of his articles describing the double contrast technique for the examination of the gastrointestinal tract made it easier for that technique to be adopted in Poland. In 1967 he also described a device of his own invention, that had been used for two years then, making it possible for one person to perform a double contrast examination of the large intestine (14).

In the 1920s a technique of examination of the abdominal cavity with the use of pneumoperitoneum was applied. In 1922 G. Drozdowicz obtained a doctor's degree for the dissertation "Artificial pneumoperitoneum in radiological diagnostics" (15).

Radiological examinations of bile ducts in Poland were started by W. Jaworski, who described as early as 1897 opaque concrements in bile ducts (5). In the 1930s cholecystography (16), in the 1960s cholangiography, and in the 1970s percutaneous cholangiography (Fig. 5) and endoscopic retrograde cholangiography were introduced in Poland. The author of works concerning the bile ducts that appeared in the 1950s and 60s was L. Smajkiewicz from Lublin (8).

In the 1970s angiographic units were installed in large hospitals in Poland, that allowed wider application of angiography in gastrointestinal radiology as well as interventional techniques. Many of those procedures had been used previously, but it was not until state-of-the-art devices became available that those important branches of radiology could be developed. The application of Seldinger's technique (direct percutaneous arterial puncture) made it possible to catheterise and visualise visceral arteries. It provided the possibility of evaluating the arteries themselves and diagnosing pathologies of them as well as assessing the parenchymal organs supplied by them. The administration of spasmytic agents through a catheter placed in arteries in order to control bleeding, the embolisation
of vessel malformations, aneurysms and tumours as well as the widening of stenosed arteries with the use of balloon-tipped catheters become available. Splenoportography was continued and TIPS was introduced. Abscess drainage, cyst evacuation and obliteration as well as balloon widening of bile ducts were performed. The leading role in that respect was played by The Department of Radiology, Medical University, Lublin (Klamut, Szcerbo-Trojanowska) and the one in Warsaw (Bówkiewicz, Pruszyński, Rowiński). Soon other centres followed the suit - Katowice (Wawrzynek, Baron), Poznań (Karwowski), Szczecin (Niezabitowski), Cracow (Urbanik), Gdańsk (Pętlak, Kunicki), Łódź (Kaurzel). In the 1980s the technique of digital subtraction angiography (DSA) was introduced. In 2000 the first DSA angiograph was installed in Poland using the rapid rotation technique with 3D reconstruction.

The history of the application of ultrasonography in Poland for imaging abdominal pathologies dates back to 1976 when an US device was purchased by the Medical University, Warsaw. The pioneers of this technique were A. Rakoczy, W. Jakubowski, E. Bażko and M. Elwertowski. Soon the method started to be increasingly available and commonly used. The greatest merits for the development of paediatric ultrasonography in Poland with respect to the abdominal cavity were for A. Marciniński from Warsaw. US-guided interventional procedures were started, particularly fine-needle aspiration biopsy as well as percutaneous puncture and drainage. Progress in ultrasonography was used in US gastrological diagnostics with the application of Doppler US, Power Doppler, intraoperative US as well as endoluminal US. It is worth noting that in Poland ultrasonographic examinations

Fig 6. Three-dimensional (3D) reconstruction of the colon - CT colonography. (Urbanik A. et. al., 1999)
were performed as early as the 1960s (mainly in obstetrics and gynaecology). A considerable contribution to the world ultrasonography was made by the team headed by professor L. Filipczyński from Warsaw. In 1966 a Polish ultrasonographic device was produced, and in 1976 quantitative measurements of arterial blood flow were performed as the first ones in the world (17).

The first computed tomograph in Poland was installed in the Medical University, Poznań in 1979. It was the first device of that kind to be installed in an East European country. The results of the first CT examinations were published by the team headed by J. Wójtowicz from Poznań (18). One of the first works, in 1981, was "The application of computed tomography for liver examination"(19). In the following years computed tomography devices were supplied to university hospitals and then to larger health care centres. Computed tomography provided a great contribution to the diagnostics of the abdominal cavity. The opportunity offered by that imaging technique was taken advantage of in Poland. In the mid-nineties the much exploited CT devices were replaced by a newer generation machines working in helical technology. At the purchase the necessity of having a satellite consoles for postprocessing (Fig. 6) as well as advanced software was always taken into consideration. In 1998 a team from the University Hospital, Cracow, headed by A. Urbanik, introduced to medical practice, for the first time in Poland, the technique of virtual endoscopy (Fig. 7) (20). It was used in the form of virtual gastroscopy, colonoscopy and the endoscopy of the bile ducts. The results of the first experiments were published in the Polish Journal of Radiology in 1999 and presented at European conferences. The same team introduced CT angiography for the diagnostics of abdominal blood vessels (Fig. 8) (21).
In 1991 two magnetic resonance (MR) devices were installed in Warsaw as the first ones in Poland. In the same year a team headed by J. Walecki published the first Polish article concerning that technology. The work was entitled "Magnetic Resonance Tomography in Liver Diagnostics - own experiences" (22). Walecki contributed a lot to the development of MR tomography in Poland.

A considerable advantage of MR was the possibility of non-invasive imaging of the bile ducts using MRCP (Fig. 9). In 2000 a monograph concerning that problem was published in Cracow. Its authors were A. Urbanik and I. Herman-

Fig. 8. CT angiography - the obstruction of the upper mesenteric artery. (Urbanik A. et. al., 2002)

Fig. 9. MRCP - biliary calculosis. (Herman-Sucharska I et. al., 2000)
Sucharska, who gathered the most comprehensive data in Poland (23). They also developed a protocol of imaging bile ducts using MR virtual endoscopy (Fig. 10). Another MR technique, used in gastrointestinal radiology for liver evaluation (the assessment of its metabolism) was spectroscopy. The first examinations in Poland using that technique were performed by teams from Białystok headed by Polakow and Walecki (the technique of MR proton spectroscopy) and from Cracow headed by A. Urbanik (the technique of MR proton and phosphor spectroscopy) (Fig. 11).

In 2003 in the Centre of Oncology, Bydgoszcz the first PET/CT device was started in Poland and abdominal examinations were initiated using that method. In the more-than-a-hundred-year history of Polish gastrointestinal radiology, besides new techniques, the successive publications have been very important. They have enabled the development of that discipline in Poland, providing a basis for staff training and qualification upgrading. They have made it possible for Polish radiologists to learn about the latest trends in the world radiology. A number of those publications were of pioneer character and they have contributed a great deal to the world gastroenterology.

A considerable contribution to the world bibliography was provided by the publications by W. Jaworski (his article "The diagnostic value of X-raying" and chapter in the textbook "An Outline of Pathology and Therapy of the Stomach") (5, 6). The Cracow doctors M. Nartowski (4) and Artur Frommer (8), in their textbooks of 1900 and 1902, respectively, presented the contemporary knowledge about the diagnostics of the gastrointestinal tract. In the years 1921-27 E. Misiewicz (Meisels) from Lvov published a series of articles describing the

\[ \text{Fig. 10. MR Virtual endoscopy of the bile ducts - biliary calculosis. (Urbanik A. et. al., 2002)} \]
radiodiagnoses of the stomach and the duodenum, with the particular consideration of ulcer and cancer (24, 25).

In 1923 in Warsaw a textbook "Roentgen Diagnostics of the Alimentary System Diseases" appeared (26). Its author was Z. Grudziński, an outstanding Polish radiologist. In 1926 he established Polish Journal of Radiology and developed a unique method of localising foreign bodies in the eyeball that has been used until now.

In 1929 W. Kruszewska and M. Werkenthin from Warsaw, specialising in phthisiology, published a valuable work describing lesions of the large intestine characteristic for tuberculosis. All the cases (45 patients) were documented with an autopsy examination (27).

A textbook of 1931 by S. Rubinrot contained a good chapter dealing with radiological diagnostics of the gastrointestinal tract (28). In 1947 the first edition of the first Polish post-war textbook of radiology, "Clinical Radiology," by C. Murczyński appeared. In its extended version of 1952-54 there was a separate volume dealing with gastroenterological diagnostics (29).

In 1949 in Wrocław Z. Kubrakiewicz published an innovative and high-quality doctor's dissertation "Benign stomach neoplasms in the radiological picture." The Polish authors who dealt with the oesophagus were M. Bielecki from Gdańsk and Z. Milewicz from Wrocław. Mielecki's contribution was the development of specific methods of roentgen imaging of the dysfunction and organic lesions of the cardia region. Milewicz, in turn, dealt with the problem of the oesophagus combustion; he was the first author in the Polish bibliography to develop the semiotics of artificial oesophagus. In the Medical University, Szczecin, Z. Domański developed roentgen kinematographic examinations of swallowing
dysfunction after the operative treatment of cancer. The result of his many-year examinations was his assistant professor's degree dissertation of 1983. The author of pioneer works dealing with the radiological diagnostics of the gastrointestinal tract was W. Grabowski from Gdańsk. It was the first monograph of 1955 "Physiopathological and clinical changes following gastrectomy due to peptic ulcer disease" and another of 1962 "Roentgen Diagnostics of Hepatic Cirrhosis." Both of them presented a high world level. Another pioneer work was the one by J. Dobek from Łódź who was the first author in the world to perform the examinations of the whole gastrointestinal tract in patients with a history of hepatitis; he found hypotonia. A number of publications concerning acute abdomen were published by B. Benendo-Kapuścińska from Warsaw. In his monograph (30), Janusz Buraczewski from Warsaw presented some aspects of the diagnostics of the alimentary system neoplasms. In 1984 the first volume, out the three ones, of the textbook "Radiology" edited by S. Leszczyński from Warsaw was published. That volume contained vast review of the data on the radiological diagnostics of the alimentary system (31). Another important textbook was "Magnetic Resonance and Computed Tomography" of 1997 by J. Walecki (Warsaw) and A. Ziemiański (Poznań); it was the first one in the Polish bibliography to present the practical use of the latest methods, including gastrointestinal radiology (32).

In May 2003 "A Lexicon of Radiology and Imaging Diagnostics" by B. Pruszyński and J. Walecki was published; a large chapter in it deals with the diagnostics of the abdominal cavity (33).

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