

# The History of Radical Hysterectomy

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■ **Abstract:** Carcinoma of the uterine cervix provides one of the few examples in medical history of a method of treatment that was once discarded by most of the medical profession and was later reclaimed. In addition, radical hysterectomy (RH) competed with radical vaginal hysterectomy during the early history of RH. The primitive form of RH was first described by Clark and Reis in 1895. Radical hysterectomy was then described in detail and performed by Wertheim, more than 100 years ago. Afterward, RH was abandoned for the treatment of carcinomas because of the use of radiotherapy; however, RH was then modified and repopularized by Meigs in the 1950s. The surgical principles of this operation have undergone only minor modifications throughout the years and remained the basis of the surgical approach used by gynecologic oncologists today. The history of the treatment of cervical carcinoma and the history of RH are unique in medicine. Because of the efforts of the surgeons and scientists, cervical carcinoma has become rarer, and its mortality rate has decreased, although it is still common in undeveloped countries. The history of the treatment of cervical carcinoma includes 3 Nobel Prize winners and 1 Nobel Prize nominee. We therefore think that knowledge of the historical development of this field will inspire and contribute to the education of future generations. In this article, the historical development of the surgical treatment of cervical carcinoma, the contributors to this surgical procedure, and the pioneers of the surgical and medical treatment of cervical carcinoma are summarized; pictures and illustrations are also provided. Our aim was to inform the gynecologic oncology community about the pioneers that devoted their professional lives to develop of these techniques. ■

**Key Words:** cervical carcinoma, radical hysterectomy, history, Ernst Wertheim, trachelectomy

Carcinoma of the uterine cervix provides one of the few examples in medical history of a method of treatment that was once discarded by most of the medical profession and was later reclaimed. Radical hysterectomy (RH), abandoned by almost all gynecologists after the advent of radiotherapy (RT) in the early part of the 20th century, has undergone a resurgence during the last decade, and now it has a place of equal importance along with RT in the treatment of cervical cancer. In addition, radical abdominal competed with radical vaginal surgery during the early history of RH. Radical vaginal surgery was abandoned by the gynecologic community after the widespread acceptance of its abdominal counterpart [1–3].

The primitive form of RH was first described by Clark and Reis in 1895. Radical hysterectomy was then described in detail and performed by Wertheim, more than 100 years ago. Afterward, RH was abandoned for the treatment of carcinomas owing to the use of RT; however, RH was then modified and popularized by Meigs in the 1950s. This operation yields 5-year survival rates of 75% to 90%, in most cases. The surgical principles of this operation have undergone only minor modifications throughout the years and remained the basis of the surgical approach used by gynecologic oncologists today [1–3].

In this article, the historical development of the surgical treatment of cervical carcinoma, the contributors to this surgical procedure, and the pioneers of the surgical and medical treatment of cervical carcinoma are summarized; pictures and illustrations are also provided. Our aim was to inform the gynecologic oncology community about the pioneers who devoted

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The authors have no conflict of interest to declare.

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*Journal of Lower Genital Tract Disease, Volume 15, Number 3, 2011, 235–245*

their professional lives to the development of these techniques.

### PIONEERING DEVELOPMENTS IN SURGICAL AND GYNECOLOGIC ONCOLOGY

Surgery was the only treatment option for malignant diseases for many years. John Hunter who was a surgeon in 18th century first suggested that cancer might be cured if tumors did not invade the surrounding tissue; however, at that time, surgery was a very risky procedure. Pain, infection, hemorrhage, and the lack of effective antibiotics, anesthetics, and blood transfusion products limited the usefulness and success of surgery until the 1840s. In 1846, John Collins Warren performed the first major cancer operation under general anesthesia, removing a patient's cancerous salivary glands.

The following century saw rapid progress and is often referred to as “the century of the surgeon.” These advances led to a large increase in the number of patients who survived surgery. The development of antiseptic techniques by Joseph Lister in 1867, the ability to transfuse blood in the 1930s, and the discovery of antibiotics in the 1940s are all milestones in the history of surgery. The field of cancer surgery, or surgical oncology, also improved along with these advances. The pioneering work of Theodore Billroth in Austria between 1860 and 1890 led to the first successful operations to remove the stomach and esophagus. In the United States, William Halsted observed in 1889 that breast cancer recurred more often in women who only had their tumors removed, not the surrounding tissue. He developed a technique called the *radical mastectomy*—surgical removal of the tumor, breast, overlying skin, and muscle. This procedure remained the mainstay of breast cancer treatment until very recently. At the same time, English surgeon Stephen Paget discovered that cancer cells could spread through the blood and lymph systems but could only grow in a few organs. He drew the brilliant analogy between cancer spread and seeds that are carried in all directions but only live and grow if they fall on congenial soil [1–3].

Although hysterectomy was first mentioned in Greek articles nearly 2000 years ago, there is no proof that it was actually performed. Early and usually fatal attempts at vaginal hysterectomy are recorded during the 16th century. Ephraim McDowell (Figure 1) could be considered the founder of surgical gynecology. He was the first to successfully remove an ovarian tumor (1809), demonstrating the feasibility of elective abdominal surgery (Figure 2). The origins of vaginal and abdominal hyster-

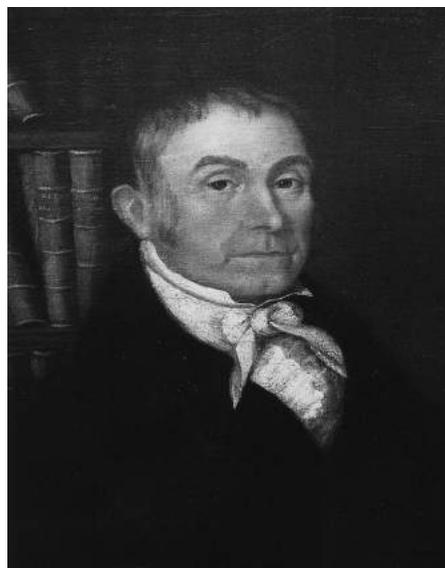


Figure 1. Ephraim McDowell [4].

ectomy are traced to the 19th century and the pioneering work of Langenbeck and Clay. The first successful vaginal hysterectomy was performed in 1813 by Conrad Langenbeck. Charles Clay (1801–1893) of Manchester, England, was one of the earliest successful practitioners of abdominal hysterectomy in Europe. In 1878, Wilhelm Alexander Freund performed the first abdominal extirpation of a cancerous uterus and standardized the technique for total abdominal hysterectomy [5].

In 1895, John Clark, of the Department of Gynecology at Johns Hopkins Hospital, and Emil Ries, one of Freund's students, noted the spread of cervical cancer to the tissues and lymph nodes beyond the limits of excision of the standard hysterectomy. They each developed a more radical hysterectomy, removing more of the broad ligament, vagina, and associated pelvic lymph nodes. Then, Wertheim and Schauta developed and standardized the details of abdominal and vaginal RH techniques. The use of RT for the treatment of cervical carcinoma led to the demise of surgery for cervical carcinoma; however, Meigs popularized radical abdominal hysterectomy for cervical carcinoma in the 1940s. Piver and Rutledge classified the types of RH in the 1970s. Moreover, the advent of laparoscopic oncologic surgery revitalized the popularity of RH in gynecologic oncology. Today, RH can be performed both laparoscopically and robotically [5].

Although RH is oncologically adequate for the surgical treatment of early-stage cervical carcinoma, recent studies question the reliability of RH due to high rates of anogenital and sexual complications and poor



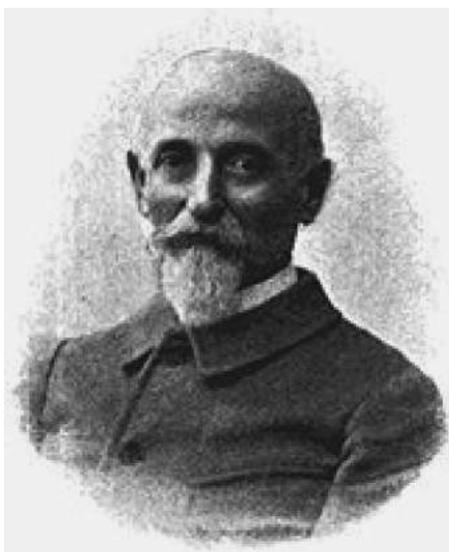
**Figure 2.** The world's first abdominal hysterectomy. *The Dawn of Abdominal Surgery* by Dean Cornell [4].

quality of life. On the other hand, cervical carcinoma can be observed in patients during their reproductive years, and their fertility cannot be preserved if they undergo RH. To reduce postoperative complication rates, to increase postoperative quality of life, and to preserve fertility, some new concepts have been suggested during the last 2 decades, such as nerve-sparing RH and radical vaginal trachelectomy [3, 5].

### PIONEERS OF RH

#### Wilhelm Alexander Freund

Wilhelm Alexander Freund (1833–1917) (Figure 3) was a German gynecologist who was originally from Krap-



**Figure 3.** Wilhelm Alexander Freund.

pitz, Silesia. He earned his medical degree at the University of Breslau in 1855 and then practiced medicine in Breslau. In 1879, he moved to Strasbourg, where he was a professor of gynecology and obstetrics. He died in Berlin.

In January 1878, Freund performed the first abdominal extirpation of a cancerous uterus, leading the way to a new era in the field of surgical gynecology. He developed a standardized technique for total abdominal hysterectomy, which he published in 1878. This involved the use of clamps and systematic suturing of the broad ligament, uterine vessels, and the cardinal and uterosacral ligaments. Twenty years later, in 1898, the Austrian gynecologist Ernst Wertheim became the first physician to completely extirpate a uterus via the abdomen [3, 5–7].

#### Karl Pawlik

Karl Pawlik (Figure 4), a gynecologist from Prague, is well known for the first description of blind ureteric catheterization in females under digital control in 1886, and he performed the first planned cystectomy in a patient with bladder cancer. Pawlik performed radical vaginal hysterectomy (RVH) in 1880 and published his first 3 cases 1889.

Today, it is generally accepted that Schauta was the first to systematically perform RVH, that Stockel modified Schauta's RVH, and that Peham/Amreich extended the radicality of this technique [8, 9].

#### Ernst Wertheim

Ernst Wertheim (February 21, 1864, to February 15, 1920) (Figure 5) was an Austrian gynecologist who was born in Graz. In 1888, he received his doctorate from the University of Graz and subsequently became an assistant in the Department of General and Experimental



**Figure 4.** Karl Pawlik.



**Figure 5.** Ernst Wertheim.

Pathology. In 1889, he worked under Otto Kahler (1849–1893) at the Second University Clinic in Vienna, and in 1892, he became certified for gynecology and obstetrics. In 1897, he became chief surgeon at Bettina Pavilions der Elisabeth-Klinik, Department of Gynecological, and in 1910, he became the director of the First Women's University Clinic in Vienna. In 1898, Wertheim performed his first radical abdominal hysterectomy for cervical cancer. This operation involved removal of the uterus, parametrium, tissues surrounding the upper vagina, and pelvic lymph nodes (Figure 6). Subsequently, "Wertheim operation" became a fairly common, although risky, procedure for cervical cancer.



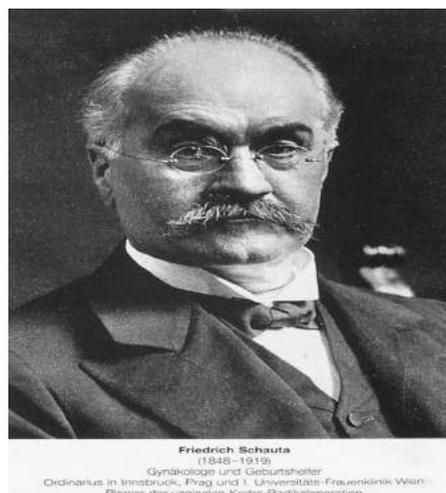
**Figure 6.** *Wertheim Performing a Gynecological Operation* by the Austrian portraitist John Quincey Adams. The surgeon Ernst Wertheim is assisted by his private assistant Theodor Micholitsch (first assistant) and by Wilhelm Weibel (second assistant). The names of the surgeon performing the anesthesia and of the surgical nurse who is handing him the instruments—a sister of the order of the Sisters of Saint Vincent of Paul—are unknown. The painting—signed 1907—was painted during Ernst Wertheim's period as head of the Gynecology Department (the Bettina-Stiftungspavillon) at the Kaiserin-Elisabeth-Spital, Vienna [10].

Wertheim was small, energetic, and extremely disciplined and demanding, with a difficult disposition; he performed surgery nervously and without surgical gloves for fear of losing sensitivity in his fingertips. Between 1900 and 1910, he published a score of articles and discussions dealing with various aspects of the diseases; his writings on the subject culminated in a monograph published in 1911 entitled, *Die erweiterte abdominale Operation bei Carcinoma colli*, which was based on 500 cases.

Wertheim worked for a period in Prague as an assistant to Schauta. When Schauta was invited to Vienna in 1891 to be head of the First Universitäts-Frauenklinik, Wertheim went along with him and continued to serve as his assistant until 1897. By this time, Schauta had an international reputation and did not accept any challenges to his authority. An intense rivalry developed between Schauta and Wertheim, concerning whether cancer of the cervix should be treated with vaginal or abdominal surgery. Their disagreement caused considerable antagonism to develop between them. In 1897, Wertheim gained his independence when he was appointed head of the Elizabeth Hospital and was later made the chief of the Second Universitäts-Frauenklinik. On November 16, 1898, Wertheim carried out his first full-extended abdominal RH. In 1911, Wertheim reported a 50% operability rate, 18.6% mortality rate, and 42.4% 5-year cure rate in a series of 500 cases operated on. Wertheim died on February 15, 1920, at the age of 56 because of the influenza pandemic [3, 5, 11–14].

### Friedrich Schauta

Friedrich Schauta (Figure 7) was referred to as "a teacher in the shadow of his student" by professor Schaller [15].



**Figure 7.** Friedrich Schauta.



**Figure 8.** The author of the article standing next to the graves of Wertheim and Schauta.

He studied medicine at Vienna, Innsbruck, and Würzburg. He received his medical degree in 1874 in Vienna and began as an apprentice in surgery at the Surgical Institute of Hofrat von Dumreicher. Later, he focused his attention on gynecology, and from 1876 to 1881, he worked at the obstetrical and gynecologic clinic at The University of Vienna. In 1887, Schauta accepted a call to succeed August Breisky (1832–1889) in Prague.

Schauta performed his first extensive RVH in 1901 on a 43-year-old woman and reported on 564 cases in 1908 with a 48.7% operability rate, 10.8% mortality rate, and 39.7% 5-year cure rate. Operative mortality was 9.8%, and most of the patients died because of peritonitis and sepsis. The intraoperative bladder and bowel injury rate was 10.6%. Furthermore, the mean operability rate ranged from 33.3% to 68.6% between 1901 and 1910 [8, 15].

He was a mentor to Ernst Wertheim and the pioneer of radical vaginal surgery; however, his surgical technique was almost forgotten, and his student (Wertheim) became more famous than he did; Wertheim's surgical procedure became more popular and remains so, even today. Nonetheless, the introduction of laparoscopy into oncologic surgery and its use in vaginal surgery gave a second life to Schauta's RVH as a technique in gynecologic oncologic surgery. Nowadays, some centers perform RVH together with laparoscopic lymph node dissection. He died in 1919 and is buried side-by-side with Wertheim (Figure 8) [8, 15–17].

#### Hidekazu Okabayashi

Hidekazu Okabayashi (Figure 9) modified the Wertheim operation and extended the radicality of the operation in 1921. Okabayashi's surgical technique was character-

ized by the extensive resection of the parametria and separation of the posterior leaf of the vesicouterine ligament. This essential step enabled the bladder to be completely separated from the ureter and the lateral side of the cervix and vagina. His surgical technique was widely performed in Japan; however, it did not become a popular approach in the West [18].

In 1961, Kobayashi, then at Tokyo University, modified the Okabayashi RH and identified the principles for the prevention of bladder dysfunction. Kobayashi preserved the pelvic splanchnic nerves by separating the vascular part and the neural part of the cardinal ligament during resection of parametrial tissues. Then, in 1983, Fujiwara emphasized the importance of preserving the bladder branch of the inferior hypogastric plexus and pelvic splanchnic nerves. This concept was also included in the description of the Tokyo method.

The Tokyo method modification of Okabayashi's RH technique, which was described by Sakamoto (a student of Kobayashi), could be considered a minor modification of the Kobayashi method. Sakamoto noted that, after pelvic lymphadenectomy, cardinal ligaments could be seen as 2 main parts: vascular and neural. Another crucial component of the Tokyo method is cutting of the vascular part of the cardinal ligament while preserving the autonomic nerves within the neural part of the cardinal ligament; however, with this technique, the sympathetic branches of the pelvic nerves (hypogastric nerves) cannot be preserved. Elevated postoperative residual urine 1 month after surgery occurred in 63% of patients in the

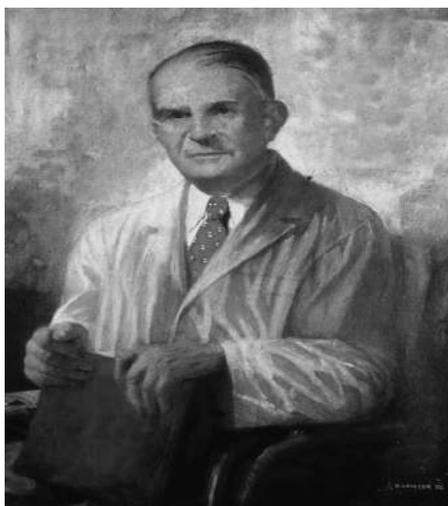


**Figure 9.** Hidekazu Okabayashi.

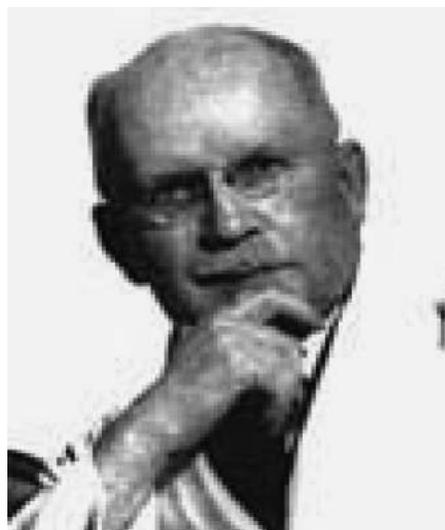
nerve-sparing group and in 90% of the non-nerve-sparing group [18–22].

Subsequently, Yabuki et al. proposed new terminology and another modification of nerve-sparing RH. The terminology of parametrial dissection was changed, and they proposed 2 connective tissue systems for the classification of the ligaments of the uterus—the suspensory system and the supporting system—instead of the classic ligament system. The suspensory system is a true musculofascial complex, which provides the connections of the bladder, uterus, and rectum dorsoventrally. The supporting system includes a ligamentous complex consisting of the lamina ligamenti umbilicalis lateralis and the cardinal and lateral ligaments. This nerve-sparing surgical procedure was designed according to the continuity of the uterine support system and was performed by first excising the fascia and then dissecting the denuded areolar tissue with an ultrasonic surgical aspirator. They also preserved the vesical nerve branch after careful dissection of the deep layer of the vesicouterine ligament [18–22].

All these nerve-sparing techniques are based on the Okabayashi RH developed in Japan. Recently, Fujii published the technical details of the Okabayashi RH, together with 2 excellent video presentations: one that demonstrates the principles of Japanese nerve-sparing RH, and a historical video, which is of Okabayashi himself. Furthermore, Fujii et al. described in detail how to identify the vesicouterine ligament during RH, which is essential for the preservation of the bladder's autonomic nerves. Moreover, Fujii et al. first showed how to preserve pelvic autonomic nerves, only dividing the uterine branch from the inferior hypogastric plexus [18–22].



**Figure 10.** Isidor Alfred Amreich.



**Figure 11.** Walter Stockel.

#### **Isidor Alfred Amreich**

Isidor Alfred Amreich (1885–1972) (Figure 10) was an Austrian gynecologist, who, in the 1920s, improved Schauta's technique and extended the radicality of the operation for the treatment of cervical and endometrial carcinomas [23].

#### **Walter Stoeckel**

Walter Stoeckel (Figure 11), a German gynecologist and obstetrician, was born in 1871 and died on February 12, 1961. He completed his preclinical study in Leipzig, München, and Jena and then moved on to the Albertus-Universität in Königsberg, where he graduated in 1895. He was certified for obstetrics and gynecology in 1903 at Erlangen and in 1904 at Berlin, becoming Professor Extraordinary in 1905.

In 1926, he was appointed to the most important German Chair of Gynecology at the Berlin Charité. Under his leadership, extensive rebuilding was undertaken, which resulted in a modern women's clinic. Stoeckel extensively modified Schauta's RVH technique and identified some of the essential steps of RVH [24].

#### **Joe Vincent Meigs**

Joe Vincent Meigs received an AB degree from Princeton in 1915 and his MD from Harvard Medical School in 1919. He received postgraduate training in gynecology at Massachusetts General Hospital. In 1930, the problem of radiation resistance and the recurrence of cancer in previously irradiated patients led Joe Vincent Meigs to reconsider and reevaluate the role of surgery

in the treatment of cervical carcinoma. Meigs initiated a full-scale research program. He visited surgeons in Europe and was impressed with the logic of Ernst Wertheim's operative procedure.

Meigs combined bilateral pelvic lymph node dissection with the standard Wertheim operation and, in 1944, published an article that reestablished the surgical approach for the treatment of cervical carcinoma. Meigs modified the Wertheim hysterectomy by adding more extensive pelvic lymphadenectomy, as recommended by Joseph Taussig. Meigs encountered no surgery-related mortality in his series of 47 patients and observed positive lymph nodes in 17% ( $n = 8$ ) of his patients. His initial series was extended to include 100 patients, and the mortality rate remained 0%, with 5-year survival rates of 81.1% for stage I and 61.8% for stage II cancers [25].

#### Alexander Brunschwig

Alexander Brunschwig (Figure 12) was born in 1901 in Texas. Brunschwig received his MD in 1927, the same year he joined the staff of Boston City Hospital as a pathology resident. There he performed autopsies on many patients who died of cancer and first developed his special interest in oncology. Dr Brunschwig spent 1930–1931 at the University of Strasbourg in France as a National Research Council Fellow and then went to the University of Chicago. At Chicago, he was promoted to professor of surgery in 1940. In 1947, Brunschwig moved to New York to become chief of gynecology at Memorial Hospital for Cancer and Allied Diseases and professor of clinical surgery at Cornell University, where he would remain for the remainder of his life.

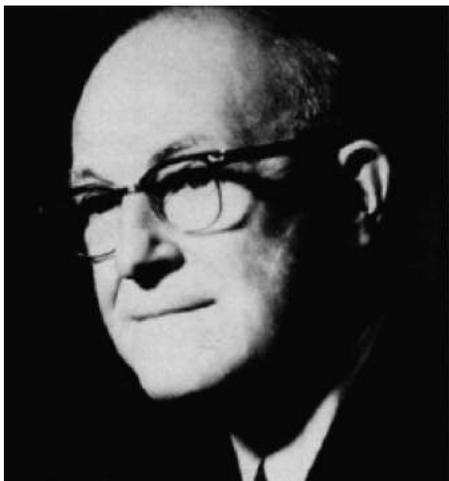


Figure 12. Alexander Brunschwig.

In 1948, he began the series of operations that came to be known as the “Brunschwig pelvic exenteration.” Cancer arising in the cervix and endometrium was frequently confined to the lower pelvis; Brunschwig hypothesized that ultraradical dissection of organs in the pelvic area might eradicate the disease. His radical surgery stirred up harsh, frequently bitter criticism, which even questioned the moral right to perform such extensive procedures. He himself termed the operation “brutal and cruel, but one that saved lives.” Pelvic exenteration is considered by some as one of the breakthroughs in gynecologic oncology of the last-quarter century.

During his long career, Brunschwig wrote more than 400 articles on diverse subjects such as bone tumors, physiology (placental, pancreatic, gastric adrenal), wound healing, metabolism, host resistance, radiation therapy, and estrus studies in mice. He was the author of 4 texts, including, *The Surgery of Pancreatic Tumors*, which was inspired by the death of his father because of pancreatic cancer. The founder of 2 important gynecologic societies, he was also an officer and member of countless more. Brunschwig was the recipient of honorary degrees from many universities and 40 major awards, including the James Ewing Society Medal in 1966 and the Lucy Wortham James Prize for clinical research in 1962. Recognition was international, and he was honored by many foreign governments and medical societies. Dr Brunschwig died of a coronary artery occlusion on August 7, 1969, at the age of 67 [26–28].

#### Daniel Dargent

Daniel Dargent (1937–2005) was the pioneer of both the conservative surgical management of cervical carcinoma and the use of the sentinel node concept in the management of cervical carcinoma.

Classic surgical management of early-stage cervical carcinoma requires extirpation of the uterus and cervix, along with radical resection of the parametrial tissues and upper vagina, together with complete bilateral pelvic lymphadenectomy (if pelvic lymph nodes are positive, some authors advocate periaortic lymphadenectomy as well). Although radical surgery and/or RT have been the cornerstone of the treatment of cervical carcinoma, both of these modalities irreversibly destroy the reproductive capacity of women. The first successful systematic conservative surgical approach for invasive cervical carcinoma was reported by Dargent in 1994. This operation was referred to as radical vaginal trachelectomy and included a laparoscopic pelvic lymphadenectomy,

followed by removal of the cervix and surrounding parametria to protect the corpus of the uterus and the ovaries [22, 29].

### SCIENTIST WHO INFLUENCED THE DIAGNOSIS AND MANAGEMENT OF CERVICAL CARCINOMA

#### Marie Curie

Marie Skłodowska Curie (1867–1934) (Figure 13) was a Polish-born physicist and chemist. She was a pioneer in the field of radioactivity and the first person honored with 2 Nobel Prizes. She was the first woman to serve as professor at the University of Paris. Her achievements include the creation of a theory of radioactivity, techniques for isolating radioactive isotopes, and the discovery of 2 new elements: polonium and radium. Under her direction, the world's first studies were conducted into the treatment of some type of cancers, using radioactive isotopes [30].

#### Wilhelm Röntgen

Wilhelm Röntgen (Figure 14) discovered x-rays in 1896. A short time later, Emil Grubbé, in Chicago, became the first person to use radiation to treat cancer. Three years later, 2 Swedish physicians used RT to cure several patients with head and neck cancer. In 1901, Röntgen was awarded the Nobel Prize for his discovery [2].



Figure 13. Marie Curie.



Figure 14. Wilhelm Conrad Röntgen.

#### George Nikolas Papanicolaou

George Nikolas Papanicolaou (Figure 15) was born in 1883 in Kyme, Greece. He attended school in Greece and obtained his medical degree from the University of Athens at the age of 21 years. He earned his PhD degree in Zoology in Munich. After the Balkan War, Papanicolaou became an assistant in the Department of Anatomy at New York's Cornell Medical School in 1913 and continued to work in this department for 47 years. In 1943, he published his findings and conclusions in the



Figure 15. George N. Papanicolaou.



**Figure 16.** Hans P. Hinselmann.

famous monograph, *Diagnosis of Uterine Cancer by the Vaginal Smear*. This diagnostic procedure was named the Pap test, and he is accepted as the inventor of the Pap test or Pap smear. Today, the Pap test is accepted as a basic screening test, and it may protect millions of women from cervical cancer. He was nominated for the Nobel Prize in medicine, but unfortunately, he was not awarded it [31, 32].

#### Hans Peter Hinselmann

Hans Peter Hinselmann (Figure 16) was born in Germany in 1884. He received his medical degree from the University of Kiel in 1908. He became a professor of gynecology at the University of Bonn until 1925, at which time he became the director of the Gynecology Department of Hamburg-Altona, a position he held until 1946. He is the designer and the founder of colposcopy. Colposcopy is a diagnostic procedure used to examine a magnified view of the cervix and the tissues of the vagina and vulva. Many premalignant and malignant lesions in these areas have a characteristic appearance that can be detected with colposcopy. He produced a primitive colposcope in 1924, and then he reported his results in 1925. Hinselmann observed that acetic acid and some other solutions act as possible contrast agents that aid the identification of abnormalities in the cervix and that acetic acid may turn abnormal areas white because of protein alterations; he called this the “acetic acid test.” He was also aware of the Schiller test and he included the Lugol iodine as an adjunct to his colposcopic examinations. He combined the acetic acid test

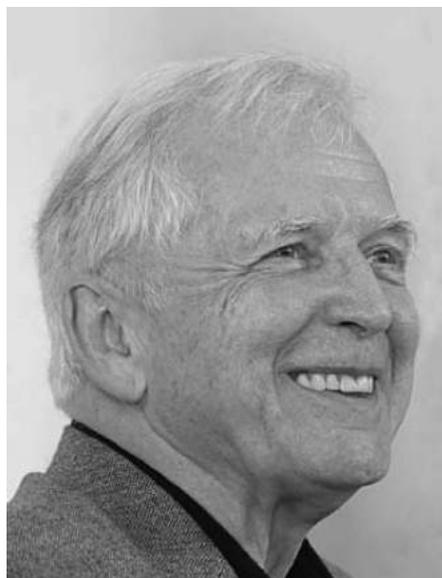
with colposcopy. Today, colposcopy is crucial to the management of patients with abnormal cervical cytologic findings based on Pap test results [33].

#### Walter Schiller

Walter Schiller was born in Vienna in 1887. He received his MD in 1912 from the University of Vienna. He became the director of laboratories at the Second Obstetric and Gynecology Clinic at the University of Vienna after World War I. He immigrated to the United States in 1937 and served as the director of laboratories at New York Jewish Hospital and subsequently became the director of Anatomic Pathology at Cook County Hospital until 1944. By 1928, Schiller became aware that abnormal squamous cells lose their glycogen content. Extrapolating this to applying iodine to clinically document a lack of glycogen, he eventually wrote, “normal epithelium stains a deep, dark brown, while epithelium, especially carcinoma, does not take up the stain, but instead remains light.” Today, the Schiller test is an important component of colposcopy practice. Lugol iodine solution is applied to the cervix under direct vision. Normal cervical mucosa contains glycogen and stains brown, whereas abnormal areas, such as early-stage cervical cancers, do not take up the stain. Abnormal areas can then be examined by biopsy and examined histologically. He died in 1961 [33].

#### Harald zur Hausen

Harald zur Hausen (Figure 17) was born in 1936 and received his medical degree from the University of



**Figure 17.** Harald zur Hausen.

Düsseldorf. He and his collaborators discovered the relationship between human papillomavirus and cervical carcinoma. This discovery led to an understanding of the mechanisms of cervical preinvasive and invasive neoplasias, and the development of human papillomavirus vaccine for the prevention of cervical carcinomas. This discovery won him the Nobel Prize in 2008. He is Professor Emeritus and was a former Chairman of the German Cancer Research Center, Heidelberg [34].

### CURRENT PIONEERS AND CONTRIBUTORS TO NEW MODIFICATIONS OF RH

During the last 2 decades, new surgical procedures (radical vaginal trachelectomy, nerve-sparing hysterectomy, total mesometrial resection, laterally extended endopelvic resection, laparoscopic-assisted RVH, laparoscopic lumboaortic lymph node dissection, and laparoscopic pelvic exenteration) have been proposed for the management of both early- and late-stage cervical carcinoma. Because the aim of this review was to provide a historical perspective, not to explore new developments, we only provide the names and the contributions of the current pioneers of gynecologic oncologic surgery in the Table 1. More

information can be found in our previous publications [18–22].

### CONCLUSIONS

The history of the treatment of cervical carcinoma and the history of RH are unique in medicine. Because of the effort of the above-mentioned surgeons and scientists, cervical carcinoma has become rarer and its mortality rate has decreased, although it is still common in less developed parts of the world. The history of the treatment of cervical carcinoma includes 3 Nobel Prize winners and 1 Nobel Prize nominee. Furthermore, with the advent of human papillomavirus vaccination, the aim of scientists is now to eradicate this cancer. We therefore think that knowledge of the historical development of this field will inspire and contribute to the education of future generations.

### NOTE

We are grateful to these pioneers and all the contributors to the development of RH. We must emphasize that we could only include those for whom information was available on the World Wide Web and in publication form. We did not intend to slight other relevant individuals not included because of a lack of obtainable information.

**TABLE 1. Living Pioneers of RH and Their Contributions to RH and the Management of Cervical Carcinoma**

Pioneer	Contribution to the surgical management of cervical carcinoma
Germany	
Hockel	Nerve-sparing RH, total mesometrial resection, and laterally extended endopelvic resection
Schneider	
Possover	This team is the pioneer of laparoscopy-assisted RVH and laparoscopy-assisted nerve-sparing RVH
Kohler	
France	
Querleu	This team is the pioneer of laparoscopic lymph node dissection in cervical carcinoma and extraperitoneal lumboaortic lymph node dissection in advanced cervical carcinoma
Leblanc	
Pomel	Laparoscopic pelvic exenteration and laparoscopy-assisted Miami pouch
Japan	
Fujii	Apprentice of Okabayashi and one of Japan's pioneers of nerve-sparing RH
Yabuki	
Kato	Description of the surgical anatomy of the cardinal and vesicouterine ligament, and their relationship with pelvic nerves
Murakami	
Hungary	
Ungar and Palfalvi	Description of laterally extended parametrectomy
Italy	
Raspagliesi	Nerve-sparing radical vaginectomy
The Netherlands	
Trimbos and Kenter	Anatomic basis for nerve-sparing RH based on immunohistochemistry
United Kingdom	
Smith	Pioneer of radical abdominal trachelectomy
Norway	
Sert	Pioneer of robotic RH

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