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Between Cardiology and Urology: Werner Forssmann's Double Career

Keywords

History of medicine · Nobel prize · Self-experiment · History
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Abstract

Werner Forssmann (1904–1979) was awarded the Nobel Prize for his self-experiments in catheterization of the heart and thus entered the annals of medicine. But he had turned to urology long before he received the Nobel Prize. Who was this person associated with both cardiology and urology? It is precisely this question that the present article explores with the help of both new and reevaluated primary sources. In 1999 Truss et al. already published an article in the World Journal of Urology about the many and varied facets of Forssmann's life and work. Our article ties in with that of Truss et al. and expands the body of knowledge concerning Forssmann and his work. Werner Forssmann as one of the 2 urologists besides Charles B. Huggins who have ever won the Nobel Prize deserves a complete and comprehensive analysis of his life and his life's work. Within German Urology, the culture of remembrance on Werner Forssmann is an important component and with every newly re-

vealed and interpreted source we get to know better who this urologist was and what role he played in the scientific community.

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A Short Journey through Forssmann's Life

Forssmann was born in 1904 in Berlin, where he also studied medicine. After completing his studies in 1928, he practiced at the hospital Auguste-Victoria-Krankenhaus in Eberswalde. Here he performed his self-experiments. A documentation of his experimentation entitled "The Probing of the Right Heart" was published in 1929 in "Klinische Wochenschrift" [1]. After his self-experiments, Forssmann worked for several months at the Charité in Berlin under the direction of Ferdinand Sauerbruch (1875–1951) before he returned to Eberswalde. Another brief intermezzo at the Charité followed before he completed his training as an assistant surgeon in Mainz in 1933. After some negative experiences, Forssmann ended his surgical career and changed to urology. He worked in this field under Karl Heusch (1894–1986) at

the Rudolf Virchow Hospital in Berlin and after that as a senior physician with Albert Fromme (1881–1966) in a surgical ward in Dresden. From 1937 onwards, Forssmann worked with Kurt Strauss (1901–1944) at the Robert Koch Hospital in Berlin before he was drafted into military service in 1939. After his time as a medical officer during World War II, he had to spend some time in an American prisoner-of-war camp before being reunited with his family in Wambach, a village in the Black Forest. After denazification, Forssmann worked as a urologist at the Diakonieklinik in Bad Kreuznach (1950–1957). After receiving the Nobel Prize in 1956, he became chief physician in a surgical ward of the Evangelical Hospital in Düsseldorf. Following retirement, he lived in the Black Forest until his death from a heart attack in 1979.

Early Practice

Forssmann wrote his doctoral thesis at the Moabit Hospital in Berlin during his practical year (1929). He studied the effect of liver feeding (*Leberfütterung*) on the red blood cell count and cholesterol level in the serum of healthy humans. The subject had nothing to do with his later studies, but at that time he was strongly interested in internal medicine and would have specialized in this field if the opportunity to do so had existed. Notably, the dissertation consisted of self-experiments: Forssmann and other students had to drink 1 L of a liver-based liquid in order to investigate subsequent changes in their blood values. Forssmann received his doctor's degree for his first self-experiments. His second self-experimentation was obviously not only more dangerous but also more successful—leading to the Nobel Prize in 1956 for the development of a procedure that allowed cardiac catheterization.

The Self-Experimentation and the Reactions of the Contemporary Scientific Community

After realizing that he would not find a job in internal medicine, Forssmann worked briefly at a private gynecological clinic in Spandau. Then he began his training as an assistant doctor in the surgical department of the Auguste-Viktoria-Krankenhaus in Eberswalde, which was led by the senior physician Sanitätsrat Schneider. In his autobiography, Forssmann explained that the atmosphere in Eberswalde was exactly right “to let good ideas mature” [2] (Fig. 1). In the spring of 1929, Forssmann carried out his self-experiment by introducing a urethral

Fig. 1. Forssmann during his time in Eberswalde (kindly supported by Prof. Dr. Wolf-Georg Forssmann, private archive of the Forssmann family).

catheter into his right cubital vein up to his right atrium, putting his life at risk. He had help from a nurse who was not privy to his plans to carry out a self-experiment, and the procedure was documented by X-rays. He was successful and safely passed the catheter into his heart.

Shortly after his self-experiment, Forssmann sent his article to the journal “*Klinische Wochenschrift*.” In his autobiography, Forssmann describes Schneider's warning: The latter advised him to concentrate on the therapeutic possibilities of his new method because of ethical aspects, which might be raised by other scientists. Moreover, he predicted that most people would try to “dismember” him because they could not deal with such a new and exceptional procedure [2]. Furthermore, Schneider advised him to address questions about metabolism and clinical issues only marginally to prevent other scientists from picking and choosing ideas for their own re-

Fig. 2. Photography of Werner Forssmann (kindly supported by Prof. Dr. Wolf-Georg Forssmann, private archive of the Forssmann family).

search that other scientists would pick and choose. After the publication of his article, Forssmann made a further attempt to enter the field of internal medicine. Although he was helped by Schneider, he failed. Instead, he was offered a position in the surgical department under Ferdinand Sauerbruch, which he accepted. In November 1929, the tabloid magazine “Nachtausgabe” also reported on Forssmann’s catheterization. In his autobiography, Forssmann wrote about the period after the publication of the article. He stated that both the German and the foreign press had “got to grips” with him [2]. He also reported that the “Berliner Illustrierte” (a Berlin magazine) had offered him 1,000 Reichsmark to print his X-rays, but he had refused the offer. While the self-experiment seemed to arouse interest on the part of the media, this soon declined again.

Two incidents occurred directly after the publication of the article: Forssmann had to deal with priority claims by Unger, Bleichröder and Loeb and he had to cope with dismissal from his position by Sauerbruch. He dealt with the first problem by releasing an appendix to his article, in which he pointed out that Unger, Bleichröder and Loeb had already conducted unpublished experiments in 1912 on artery probing with ureter catheters. The second confrontation culminated in Sauerbruch’s famous statement that “With such experiments you might habilitate in a circus, but not in a decent German hospital” [2]. Thereupon Forssmann returned to Schneider in Eberswalde. During his time at the Charité Forssmann had got to know Willi Felix and subsequently kept him as a friend and patron. Felix was interested in Forssmann’s experiments and was convinced that he faced a bright future.

Only a small number of scientists took note of Forssmann’s discovery or even integrated parts of his technique into their own research studies. One of these was Otto Klein, assistant professor at a Prague hospital, who referred to Forssmann and his catheterization in a publication on the identification of the minute volume by the Fick principle half a year after Forssmann’s publication. In his paper, Klein reported on 18 probes; in 11 cases, he was able to reach the heart. In addition, Forssmann himself referred to a letter he received from the famous Prague chemist Karl Thomas, who informed Forssmann that the procedure had been successful in his animal experiments on glucose metabolism. Altogether however, feedback from the scientific community remained very limited. After the Nobel Prize ceremony, Thomas wrote in the notifications of the Max-Planck-Society: “That way a research character was lost for Germany and theoretical-medical research” [2].

Immediately after publication of his self-experiment, Forssmann was optimistic for further research in this field (Fig. 2). Felix supported Forssmann’s animal experiments, which were first carried out on rabbits. However, all the rabbits died of cardiac arrest, prompting Forssmann to change to dogs. He introduced catheters into the jugular vein of a total of 6 or 7 dogs and used X-rays to document the injection of the contrast medium. Although Forssmann had asked a scientific society (Notgesellschaft für Wissenschaften) for support, he never received an answer. In order to prove that the procedure was safe for humans, he repeated his cardiac catheter examinations 9 times, twice with the contrast medium, and thus demonstrated that the injection of the contrast medium was tolerated by the human heart. He published his experimental results in the “Münchener Medizinische Wochenschrift.” To avoid a longer waiting time for publication, Forssmann gave a speech about his experiments at a doctor’s meeting in Eberswalde on November 30, 1930. With the help of his doctoral supervisor Professor Georg Klemperer, Forssmann once again tried to obtain a position in a department of internal medicine to extend his experiments. Once again, he was rejected. Klemperer did not seem to have understood the meaning of Forssmann’s discoveries. At that time, Klemperer was publishing studies on the retention of the radioactive Thorotrast in the liver and spleen.

The second lecture on Forssmann’s cardiac catheter examinations of dogs and his self-experiments took place at the German Surgery Congress in April 1931. Forssmann’s speech was delivered at the end of the congress and the audience seemed “exhausted” and bored. Later

on, Forssmann described the response to his thesis as a mixture of “disgusted muttering, scratching, and even light laughter” [2].

According to Forssmann’s autobiography, his uncle, the doctor, told him that he should not be annoyed by the public’s lack of understanding. One day he would win the Nobel Prize for his discovery. It seems that just a few people, among them Willi Felix and Forssmann’s uncle, understood the importance of his heart catheterization at this early stage. The majority of the scientific community denigrated or ignored his work.

What Happened in the Years after the Self-Experiment with Regard to Publications and Scientific Orientation?

After meeting Sauerbruch at a surgery conference, Forssmann returned to work at the Charité, subsequently finishing his surgical training in Mainz, where he met his future wife Elsbeth. It is remarkable that Forssmann does not refer to any further scientific experiments in his autobiography. After Mainz, Forssmann changed to urology and worked at the Rudolf Virchow Hospital in Berlin under Karl Heusch [3]. In 1934, he published an article in “Der Chirurg” on “Appendicitis and Deep Ureteral Stones”, a subject far removed from the cardiological self-experimentation of 5 years before. The article was about the likelihood of mistaking suffering a urethral stone from appendicitis with many unnecessary subsequent therapeutic methods including surgical procedures following. In a way, the article bridged the gap between Forssmann’s surgical work and his new discipline of urology. In the following year, 4 articles were published on urological topics, 2 on anesthesia in urology and the other 2 on therapy options and resection of the prostate. Three of these articles were published in the “Zeitschrift für Urologie”, which became the periodical in which Forssmann published most of his articles. Two years later, he wrote a paper on “Clinic and Technique of Electrorsection”, and after another 3 years, he published an article on “Sectio alta lateralis”, a surgical technique for opening the bladder, both appearing in the same journal. In 1939, shortly before he was drafted into military service, Forssmann wrote an article about the prostate in a journal for advanced medical training.

During the war, Forssmann served as a medical officer in Prussia, Norway, and on the eastern front, spending some time in an American prisoner-of-war camp after being captured by American troops in 1945. After reuni-

fication with his family in the Black Forest, he underwent denazification and was banned from working for 3 years [4]. During this time, Forssmann helped his wife Elsbeth, who worked as a general practitioner in a village in the Black Forest. Describing their fields of practice in his autobiography, Forssmann casually brings up the subject of infections of the breasts during lactation. The operational treatment of precisely this disease was the subject of his first publication after WWII and his only one in the gynecological field. After the end of his professional ban, Forssmann worked as a urologist at the Deaconry Hospital in Bad Kreuznach (1950–1957). In 1951, he wrote 5 articles for the “Zeitschrift für Urologie,” mainly on topics related to the ureter, 4 of them being case reports. In 1952, Forssmann commented in an account of proceedings of the German Society of Urology on cystectomies. In this comment, he argued for a restricted performance of cystectomies in papillomatosis. One year later, his contribution to the same event was about the best available technique for transurethral surgeries. After WWII, the name Forssmann only appears in connection with urological topics (Table 1).

The Years after 1950: Remembering Werner Forssmann

However, Forssmann once again became involved in cardiology in 1951. By then, it was slowly becoming clear where his self-experiments had led. John McMichael, a British cardiologist, invited Forssmann to London to participate in a film about cardiac catheterization. Immediately after his return, the next invitation arrived, this time to the Congress of the German Society of Circulation Research in Nauheim, and Forssmann gave a lecture on “21 years of heart catheterization – Retrospection and Outlook.” From the early 1950s onwards, Forssmann became increasingly involved in the scientific community – this time as a welcome member rather than being a figure of derision. In his autobiography, Forssmann described how he learnt from a surgeon from Jena, Professor Nikolaus Guleke, that he had been nominated for the Nobel Prize. Recent historical research has reconstructed the road leading Forssmann to the Nobel Prize. Between 1952 and 1956, Forssmann was nominated by 7 scientists (among others John McMichael), so that his name became increasingly prominent within the scientific community [5, 6]. His newly acquired significance was reflected by a lecture he gave at the annual conference of the German Society for Surgery (1954) on the historical de-

Table 1. Publications of Forssmann in the urological field

1	Forssmann W: Appendizitis und tiefsitzender Ureterstein. <i>Der Chirurg</i> 1934;6:807–812
2	Forssmann W: Die Schmerzbetäubung bei Eingriffen an den Harnorganen. <i>Z Urol</i> 1935;24:316–328
3	Forssmann W: Zwischenfälle der Rückenmarksbetäubung und ihre Verhütung. <i>Z Urol</i> 1935;24:151–162
4	Forssmann W: Die heutigen Behandlungsmöglichkeiten der Prostatahypertrophie. <i>Med Welt</i> 1935;9:1034–1038
5	Forssmann W: Zur Technik der Prostataresektion. <i>Z Urol</i> 1935;24:73–75
6	Forssmann W: Klinik und Technik der Elektroresektion. <i>Z Urol</i> 1937;26:153–170
7	Forssmann W: Sectio alta lateralis. <i>Z Urol</i> 1938;27:57–59
8	Forssmann W: Zur Prostatafrage. <i>Z Aerztl Fortbild</i> 1939;36:107–110
9	Forssmann W: Fibromatöser Ureterpolyp. <i>Z Urol</i> 1951;44:708–710
10	Forssmann W: Spätergebnis nach totaler Resektion des Nierenbeckens. <i>Z Urol</i> 1951;44:618–6247
11	Forssmann W: Strahlendurchlässiger tiefsitzender Ureterstein. <i>Z Urol</i> 1951;44:424–425
12	Forssmann W: Pelottensyndrom durch solitäre Leberzyste. <i>Z Urol</i> 1951;44:840–841
13	Forssmann W: Angeborene Erweiterung des linken unteren Harnleiters. <i>Z Urol</i> 1951;44:412–413
14	Forssmann W: Aussprache zum Thema Cystektomie. <i>Verhandlungsbericht der Deutschen Gesellschaft für Urologie</i> 1952;14:335–336
15	Forssmann W: Der heutige Stand der transurethralen Technik. <i>Verhandlungsbericht der Deutschen Gesellschaft für Urologie</i> 1953;14:52–68
16	Forssmann W: Zur operativen Behandlung blasennaher Harnleiterengen. <i>Zentralbl Chir</i> 1956;47:2412–2421

Fig. 3. Newspaper clipping from New York Herald Tribune October 19, 1956 (kindly supported by Prof. Dr. Wolf-Georg Forssmann, private archive of the Forssmann family).

velopment and methodology of cardiac catheterization and its applications. In the same year, he was awarded the Leibniz Medal of the German Academy of Sciences in Berlin. His career – although marked by different directions and mostly without rigorous research – was crowned

with the Nobel Prize in 1956 alongside André Frédéric Cournand and Dickinson Woodruff Richards (Fig. 3). The Nobel Prize brought another title in its wake: Forssmann became Honorary Professor of Surgery at the Johannes Gutenberg University in Mainz.

After receiving the Nobel Prize, Forssmann published an article on the surgical treatment of ureteral constriction in a surgical journal. In 1957, he wrote an article on William Harvey, a British physician and dissector, which dealt with anatomical studies of blood circulation and was published in the “*Medizinische Wochenschrift*.” There was no relevant discontinuity or caesura regarding the articles Forssmann wrote after and before the Nobel Prize. Yet, in 1958, he once again changed his focus to surgery, succeeding Alfred Beck as head physician of the Protestant Hospital in Düsseldorf. Shortly after he had taken up his position, he came into conflict with the board of trustees, which led to a public argument, which was the subject of much media attention. In the following years, Forssmann was occupied with a large number of new and challenging tasks, with the result that he was not in evidence as an author of journal articles for 4 years. In 1962 and the 2 years thereafter, 3 articles on the treatment of bone fractures were published in the surgical field. In

1968 and 1969, Forssmann published another 3 articles on surgical topics as head physician in surgery before retiring in 1970.

In the 1960s, Forssmann gained even more international recognition, being awarded an honorary professorship of Cordoba (Spain), becoming an appointed member of the American College of Chest Physicians and an honorary member of the Swedish Society of Cardiology. The recognition for his self-experiment came quite late – but it came.

After receiving the Nobel Prize, Forssmann repeatedly expressed his views on various ethical issues. He opposed the death penalty, and his strongest argument being that a single mistake can result in the irreversible death of an innocent man. He commented on euthanasia by giving interviews, writing articles, and holding a speech at the 16th Annual Meeting of Nobel Laureates at Lake Constance in 1966. According to Forssmann, the duty of a physician was to heal and preserve human life, not to take it away. Moreover, he argued against (hasty) organ transplantation, especially when Christiaan Barnard made headlines by transplanting a heart. Forssmann strictly rejected the idea of transplanting individual organs, warning against the manipulation and cannibalization of corpses.

Conclusion

After his death, Werner Forssmann aroused the interests of many researchers, and many articles have been published in different international journals [7–22]. Most of the articles deal with the heroic self-experimentation in 1929, but there are also several articles, especially recently published, that focus on other aspects of his life, for example, the awarding of the Nobel Prize, his

political attitude before and after 1945 and his position in the scientific community. Following up on the last mentioned aspect, it can be said that Forssmann published only a few papers dealing with cardiological topics. A quarter of a century elapsed between his publication of his self-experiment – which was astonishing for the time – and his publication of further articles and statements based on his self-experiment and the topic of cardiac catheterization. Most of the articles he wrote between 1934 and 1956 were, in fact, published in the field of urology. After becoming senior physician of a surgical department, a few articles on surgical topics were added to Forssmann's publication list. Thus, it is not surprising that he is often looked upon as one of the 2 urologist Nobel Prize winners (next to Charles B. Huggins). But none of his articles on urological topics equaled his achievement as a 25-year old assistant doctor. Karl Thomas' line of thought leads us to the question as to what might have happened if the scientific community had supported Forssmann and his research after his self-experiment of 1929. It is one of those questions that will always remain unanswered.

Disclosure Statement

The authors declare that they have no conflicts of interest. This article does not contain any studies with human participants or animals performed by any of the authors. Therefore, informed consent was not needed to be obtained.

Authors' Contribution

L.-M.P.: project development, data collection, data analysis, manuscript writing. D.G.: project development, manuscript editing.

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