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# Brilliant Promotion for a Doubtful Invention: the Blood Transfusion Device of Doctor Joseph-Antoine Roussel (1837–1901) in European Medical Science and Practice in 1860–1880

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**Abstract**

In modern European historiography, the name of Dr. Joseph-Antoine Roussel and the device for blood transfusion he invented are commonly associated with the studies of the revival of transfusion in medicine in the 1870s. The discussion about the clinical application of transfusion methods, developed in the medical community during this period, was mostly confined to the technical issues: who should become a blood donor (animals or humans), which blood should be transfused (whole or defibrinated), and which method and device was better to use. Roussel was a proponent of transfusions of whole, unaltered venous human blood. The history of Roussel's device is presented in this article as an example of one of the first successful marketing campaigns, which was actively introduced into medical practice in the middle of the 19th century. Based on archival documents, articles, evaluations and reviews of the doctor's contemporaries, the authors have attempted to reconstruct the circumstances which determined the success of his "transfuser" among numerous competitors in the mid-1870s. Roussel's strategy was based on the needs of military field surgery, the development of means and methods of scientific communication, and the expansion of social interest in scientific and technical discoveries and inventions. The key elements of Roussel's advertising campaign were accessible and open demonstrations of the device for professionals, his reliance on the support of influential representatives from both the aristocracy and the professional community, and popularization of the device among ordinary people. As a result, in the 1870s Dr. Roussel managed not only to organize an international clinical trial of his device "in experiments on patients" with the involvement of the leading European and Russian doctors, but also to arrange the supply of his own device to the armies of Austria-Hungary, Russia, and Belgium.

**Keywords**: blood transfusion, Joseph-Antoine Roussel, Russia, military medicine, animal blood, St.-Petersburg, transfuser.

## 1. Introduction

Blood transfusion in the 1870s was one of the most controversial practices in both European and Russian medicine. It was a challenge of the time to existing scientific and medical knowledge, clinical experience, and ethical standards. The miraculous effect of blood transfusion in the treatment of severe social diseases (tuberculosis, typhoid, neurasthenia), as well as the sudden death of patients, reported by doctors who had the experience of using blood transfusion in practice, could not be scientifically justified. In the second half of the 19th century, the only available way to ensure the safety and effectiveness of this procedure for specialists was to find the ideal conditions for its implementation. However, as we know now, the lack of knowledge about the group compatibility of blood devalued any scientists' attempts to achieve the predicted result (Sergeeva, 2015: 422). What is more surprising is the story of the unprecedented commercial success of the blood transfusion device, invented in 1864 by the Swiss doctor Joseph-Antoine Roussel

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(1837–1901). In the 1870s, he managed not only to organize the international clinical trials of his device "in experiments on patients" and to attract leading European and Russian specialists for conducting it, but also to introduce the author's device into the military medical support of the armies of leading European states. The purpose of this article is to identify the factors that allowed Roussel's transfuser to surpass its numerous competitors and become the first blood transfusion device purchased in 1874–1876 by the military ministries of Austria-Hungary, Russia, and Belgium.

**2. Materials and methods**

Materials from the collections of the Russian State Military Historical Archive (RSMHA), the State Archive of the Republic of Buryatia (SARB), and works by Roussel and his contemporaries on blood transfusions were used.

2.1. The main sources were data from fund № 546 of the RSMHA, "Main Military Sanitary Department (1867–1918)" and № 12651, "Main Department of the Russian Red Cross Society (1867–1918)". The materials of case № 241, "On the proposal of a foreign doctor Roussel to acquaint Russian military doctors with the use of an instrument invented by him for blood transfusion from a healthy person to a sick person and on the Highest permission to present Roussel with 600 rubles to let him come from Vienna to St. Petersburg and back 29.12.1873–04.08.1874" (F. 546. Op. 3. D. 241) contain Dr. Roussel's letters to the Russian military leadership, interdepartmental correspondence, and reports about the stay and activities of the Geneva specialist in Russia, including the results of clinical trials of his device conducted in Russian hospitals. In case № 83, "On the order of Dr. Roussel 200 devices for blood transfusion operation 09.05.1874–04.02.1876" (F. 546. Op. 4. D. 83), the contract for the supply of 200 original devices to Russia, and the reports on the reception and distribution of devices among medical institutions of the military department are presented. Fund № 12651 contains data on the creation of an international medical commission to evaluate the "military-sanitary" exhibits presented at the world industrial exhibition in Vienna in 1873 (F. 12651. Op. 1. D. 1278). The files of the SARB Fund № 10, "Verkhneudinskaya city council 1874–1875" contain information about the attempt of the Ministry of Internal Affairs to introduce the Roussel apparatus into use in Zemstvo hospitals.

Works published in 1860–1880 characterize the views of the specialists of that time on the possibility of using blood transfusion for medical purposes in general, and Roussel's device in particular. Thus, the works of L. Landois, V.M. Rautenberg, and N. Tabure reflect the results of experimental studies aimed at finding the most effective methods of blood transfusion (Landois, 1875; Rautenberg, 1867; Tabure, 1873). The articles and monographs of J. Roussel, F. Gesellius, and O.F. Heufelder describe the experience of using various devices and methods of blood transfusion in clinical practice (Roussel, 1873; Roussel, 1877; Roussel, 1884; Gesellius, 1868; Gesellius, 1873; Gesellius, 1874; Heufelder, 1875a). The works of G.O. Dujardin-Beaumetz and Ch. Jennings allow us to assess the extent to which the blood transfusion procedure and the Roussel's apparatus were used in European medicine during the study period (Dujardin-Beaumetz, 1886; Jennings, 1883).

2.2. The research methodology is based on the principles of historicism and objectivity, in which Roussel's invention was considered as a revolutionary medical technique in the last quarter of the 19th century. The use of the comparative method allowed the evaluation of the advantages and shortcomings of Roussel's invention, and consideration of the physiological ideas about the functions and properties of blood, as well as methods and devices used for blood transfusion, which were widespread in the study period. The methods of analysis and synthesis used in this work enabled us to restore cause-and-effect relationships and identify the medical and socio-political aspects of Dr. Roussel's work that contributed to the implementation of the device he invented into the medical support system of the armies of Austria-Hungary, Russia, and Belgium. The combination of systematic and interdisciplinary approaches allowed us to assess the progress achieved by Roussel in terms of the commercial success of his apparatus.

**3. Discussion**

In modern European historiography, the name of Dr. Roussel is found in studies of the revival of the interest in blood transfusion in medicine in the 1870s. In the scientific work of the Swedish historian and sociologist B. Berner, Roussel is presented as one of the specialists whose activities played a crucial role in the spread of both intra- and interspecific blood transfusion in European medicine in the 1870s and 1880s. At the same time, the author gives the doctor an unflattering professional description, calling him "a cosmopolitan medical entrepreneur with irregular medical practice" (Berner, 2020: 40). A.L. Kibbie reveals Roussel's role in the development of blood transfusion in England in the 1870s, paying special attention to his utopian ideas about the benefits of "live blood" and an educational campaign aimed at both specialists and the general public (Kibbie, 2019). Roussel's contribution to the development of blood transfusion methods was examined by R. Van Hee, who mistakenly believed him to be the founder of arterial blood transfusion. At the same time, the author correctly noted the inventor's desire to replace the driving force of the heart with his device (Van Hee, 2015: 2). Thus, there are scattered studies that cover different aspects of Roussel's work in fragments in the existing European historiography. However, there are no such works in Russian historiography at all. The influence of Roussel and his device on the development of blood

transfusion practice in Russia in 1870–1880 has not yet been the subject of independent research. The scientific papers do not reflect Roussel's initiative in introducing blood transfusions into the military field medicine of this period. Moreover, in modern works, there is no comprehensive understanding of the marketing campaign conducted by Roussel to promote his own invention.

**4. Results**

The introduction of blood transfusion into clinical practice in the last quarter of the 19th century depended on the answering of key questions: Who should be a blood donor (animals or humans)? Which blood should be transfused (whole or defibrinated)? Which method and device should be used? (Sergeeva, Panova, 2020: 2) A key role in this process was played by the rivalry of Roussel, a proponent of transfusion of whole human venous blood, and F. Gesellius (1840–1900), who promoted the transfusion of the arterial blood of animals (Buess, 1953: 253).

In 1864, Roussel, a native of Geneva and graduate of the medical faculty of the University of Paris, designed his first blood transfusion device (Roussel, 1876a: 8). The German military surgeon O.F. Heufelder (1828–1890), who practiced in Russia, compared the device to the circulatory system: "the elastic pump ... corresponds to the heart; the constriction and expansion imitate the systole and diastole of the heart ... the valves ... prevent the return of blood ... like the valves in the veins" (Heufelder, 1875a: 200). The operating of the device was based on three main principles: the use of the classical method of bloodletting for drawing the donor's venous blood, mechanical pumping of the latter into the patient's vein, and filling the device with an aqueous solution of sodium bicarbonate (Roussel, 1877: 40). A sealed cup with bloodletting lancets fixed in it was fixed on the donor's hand (Figure 1).

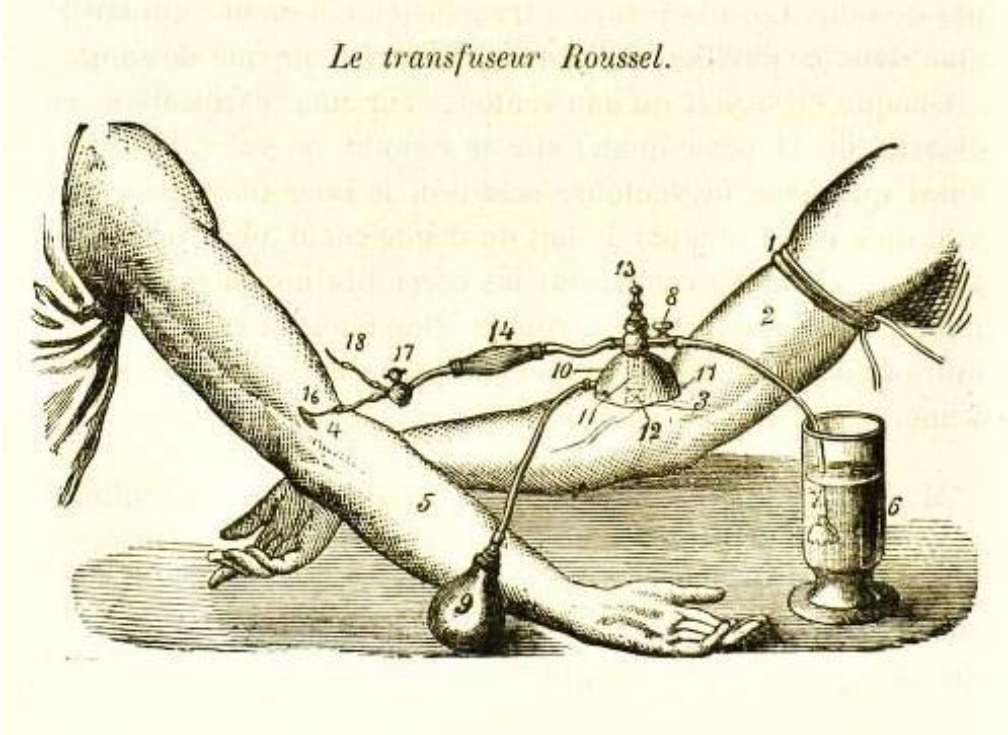


**Fig. 1.** A blood transfusion device of J. Roussel (Roussel, 1876a: 142)

When pressed, the lancets punctured a vein; blood flowed into the cup, forced water out of the system, and filled the "balloon pump". By mechanical compression of the balloon, the surgeon pushed a portion of blood into the patient's vein (RSMHA. F. 546. Op. 3. D. 241. L. 37). The procedure of bloodletting did not require a surgeon's invasion, and making only shallow incisions on the donor's arm meant phlebitis could be avoided. The surgeon could regulate the volume of blood and the process of transfusion. Water heated the device, preserved the rheological properties of the blood, cleaned the device from the inside, and prevented air from penetrating the patient's veins (Roussel, 1876b: 4). In addition, it allowed transfusion to be combined with the injecting of drugs or the stimulating effect of an electric current (Roussel, 1877: 40-41). In December 1865, Roussel first used the device in clinical practice (Roussel, 1877: 56). In 1867 he presented it at the Paris International Exposition and published the first report on its work in the French editions of "Gazetta des Hopitaux de Paris" and "Archives de l'anatomie et de Physiologie" (Roussel, 1873: 39).

A year later in St. Petersburg a brochure was published dedicated to a similar device for "capillary blood transfusion" (Figure 2), invented by Gesellius, a native of Mecklenburg, and a doctor of medicine and surgery.

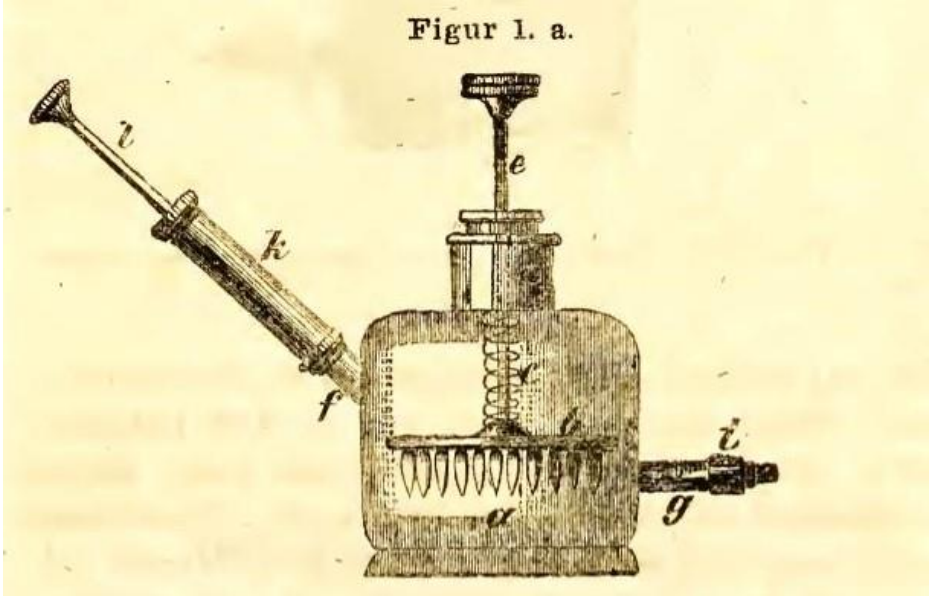


**Fig. 2.** F. Gesellius' capillary blood transfusion device (Gesellius, 1868: 29)

In the preface to this work, the author wrote: "I have a competitor... Roussel describes what seems to be a very complex instrument for direct arm to arm transfusion" (Gesellius, 1868: ii). In turn, Roussel criticized the Gesellius apparatus for "a false understanding of the role of the blood-sucking can in transfusion" (Roussel, 1873: 239). A more serious rivalry between them appeared in the mid-1870s and the cornerstone of the discussion was animal blood transfusions.

In 1873, at the Vienna World's Fair, Roussel presented the improved version of his transfuser. He simplified its design, standardized the capacity of the "balloon pump" and the materials used in the production of the device (RSMHA. F. 546. Op. 3. D. 241. L. 37; Roussel, 1876a: 9). The inventor was convinced that the key to successful transfusion was to keep all the blood parameters unchanged, so only whole venous human blood should be injected into the patient's veins, maintaining its natural temperature and preventing the formation of blood clots. "Any contact with metal, as well as with glass, ivory, etc. is harmful to the blood and provokes its clotting" – said Roussel. In this connection, all the details of his device were made of natural, pure, sulfur-free "black rubber", which "did not have the slightest effect on the blood" (Roussel, 1876b: 4; Roussel, 1873: 56; Roussel, 1877: 38).

In the same year, Gesellius published the treatise "Blood transfusion: Historical, critical, and physiological research" (Gesellius, 1873), where he stated: "The transfusion of lamb's blood will open a new era in medicine" (Gesellius, 1873: 159). This idea was supported by a wide range of private practitioners and military doctors, both in Europe and in Russia: O. Hasse (1837–1898), I.J. Neudorfer (1825–1898), V.M. Rautenberg (1840–1879), Heufelder, and others. Roussel criticized interspecific transfusions for the physiological discrepancy between animal and human blood. In the clinical state of the patient after this procedure (heavy sweat, rapid breathing, lower back pain, and the presence of red blood cells and protein in the urine), he saw evidence that the human body was trying to get rid of foreign blood "by all available physiological and pathological ways": through the skin, kidneys, and lungs (Roussel, 1873: 394). However, yielding to the growing popularity of this method, Roussel adapted his device for animal blood transfusions. In February 1874, Roussel and Gesellius arranged public demonstrations of their devices injecting patients with lambs' blood in the clinic of the St. Petersburg Medical and Surgical Academy (Roussel, 1873: 276).

The outcomes of blood transfusion at that time were evaluated by the visible changes in the patient's condition (skin color, sweating, conditions of the pupil and breathing, urine composition) and his subjective sensations (pain, hunger, emotional state). The patient of Gesellius experienced several crises (anxiety, suffocation, cyanosis, and severe pain in the chest, back of the head and lower back) during the operation, describing which the founder of obstetrics in Russia, Professor A.Ya. Krassovsky (1823–1898) noticed: "Although I saw terrible pictures during childbirth, I have never witnessed such a stunning sight" (Borchsenius, 1874: 66). The patient endured the transfusion performed by Roussel calmly, for which the performer, according to his own words, was rewarded with applause (Roussel, 1873: 278). Thus, the outcome of these operations not only demonstrated the competitive advantages of Roussel's transfuser, but also predetermined its commercial success in Russia.

Another controversial issue in the application of blood transfusion was the variety of methods, fluids, and devices used for this procedure in the 1870s. Whole blood was transfused into the veins or arteries. Defibrinated blood could also be administered subcutaneously and intraperitoneally. The alternative options

were infusion of milk or saline solution into the veins, or autotransfusion. According to the Austrian military doctor Neudorfer, by 1873 about 25 devices for blood transfusion (Roussel, 1876a: 159) had been developed. This diversity was due to the attempts of scientists and doctors to eliminate the factors that negatively affected the outcomes of the operation: cooling of donor blood, its contact with air or its entering the vessels, and inflammation of the veins (Rautenberg, 1867: 285).

Roussel considered the use of defibrinated blood dangerous, and other fluids insufficiently studied. "I would say to the supporters of defibrinated blood," he stated, "there is no parallel between two different things... Their artificial fluid is no longer blood ... they inject an intravenous medicinal fluid made from blood ... they raise the difficult question of which artificial fluid is better to inject into the veins: defibrinated blood or with salt added? Artificial whey, protein water, alcohol solution, or just milk? ... I confine myself to direct transfusion of live human blood, the single operation I trust" (Roussel, 1876b: 17). Roussel's opinion was based on the previously mentioned study of Gesellius (1873), in which the author proved that the mortality of patients with defibrinated blood transfusion was several times higher than with whole blood (Gesellius, 1873: 152, 155).

The "ideal" device for blood transfusion, according to the Russian medical scientist Rautenberg, who studied the implementation of this method in clinical medicine, should have had a simple design that allowed control of the presence of air, and the amount and temperature of the blood in the device (Rautenberg, 1867: 286). Roussel supplemented these requirements with the device's indifference to the blood composition, safety for the donor, and the ability to adjust the speed of movement and the force of blood pressure (Roussel, 1873: 48, 50, 51, 52). The single device that met all these requirements, as he considered, was his transfuser (RSMHA. F. 546. Op. 3. D. 241. L. 37). However, not all experts shared this point of view.

The design of the Roussel device was so complex that the German physiologist L. Landois (1837–1902) ironically noted that the inventor should think about creating an even more complex instrument with an electric heater, thermometer, timer, and "God knows what else" (Landois, 1875: 324-325). Heufelder testified that the doctor "had to make so many preparations, take so many precautions, and open and close so many taps that even Roussel himself did not always remember this" (Heufelder, 1875b: 219). A number of remarks were directed to the bloodletting lancet of the device. Belgian experts noted that its metal part could provoke the formation of blood clots (Roussel, 1876b: 27). Their English colleagues had serious concerns that the lancet would pierce the donor's vein and damage the underlying tissues (Jennings, 1883: 38). French professor L.-J. Behier (1813–1876) pointed out that the black rubber bowl hid the lancet, depriving the surgeon of the ability to control the process of bloodletting (Perelivanie krovi..., 1874: 167). Another source of doubt was the material used in the device. During long-term storage or at high temperatures, the rubber dried and broke (RSMHA. F. 546. Op. 3. D. 241. L. 52-53; Heufelder, 1875b: 219). In this regard, the storage of the device required special conditions, and its use the presence of special surgical skills, which could not be obtained without a proper practical training. Thus, the versatility of Roussel's transfuser allowed equally successful transfer of either human or animal blood, or alternative medicinal solutions. However, the possibility of its widespread use was limited by the complexity of the design. As a result, the inventor had to use additional measures to promote his device.

In 1867, at the Paris International Exposition, Roussel's transfuser did not attract wide attention from specialists. At the beginning of the Franco-Prussian war (1870–1871), there was no reaction from the French military administration, despite an article published in the newspaper "La Science pour tous" about the advantages of this device in the fight against blood loss. The inventor did not receive support from the International Committee of the Red Cross, to whom he sent the device in 1872 (Roussel, 1876a: 8; Roussel, 1876b: 3; Roussel, 1873: 40). He attributed the indifference to his invention to the lack of influential connections and patrons, and the interference of competitors (Berner, 2020: 38). It is also worth noting the conservatism of military administrations in matters of medical support for armies, based on the use of pre-approved treatment regimens and lists of medical products.

Military campaigns in the mid-1850s and 1870s were characterized by the transience of combat clashes and mass wound damages. In 1873 , a correspondent for the military newspaper "Militar-Zeitung" stated: "It is a fact that more than half of the wounded left on the battlefield do not die because of their own wounds, but due to bleeding" (RSMHA. F. 546. Op. 3. D. 241.L. 8). Neudorfer suggested that those who lost consciousness on a battlefield "can be brought back to life by a rush of living blood" (Roussel, 1876a: 159). Thus, Roussel realized that military medicine was the most promising field for the mass application of his invention.

In 1873, at the Vienna World's Fair, Roussel presented his transfuser as a new device necessary for military sanitary purposes and held the first public demonstrations of the device on patients. The International Medical Commission, then under the leadership of T. Billroth (1829–1894), which evaluated the merits of the presented exhibits, recognized the transfuser as "an ideal device for direct blood transfusion" and recommended it for use in military surgery (RSMHA. F. 12651. Op. 1. D. 1278. L. 2 Ob. 3; Sergeeva, Panova, 2020: 4-5). In 1873–1876 Roussel presented his instrument at the meetings of the societies of Viennese, Russian, and Belgian doctors; in clinics and hospitals of the Imperial Medical and Surgical Academy in St. Petersburg, the Royal Medical Academy in Brussels, and the University of Louvain; in military and civil hospitals of Vienna, St. Petersburg, Kronstadt, Brussels, Ghent, and other cities

(RSMHA. F. 546. Op. 3. D. 241. L. 22; Roussel, 1876b: 21; Roussel, 1873: 40; Kibbie, 2019: 18). Thus, the inventor actively toured European and Russian cities, organizing public demonstrations of blood transfusion, and promoting the device he invented among the medical community, government officials and the public in the mid-1870s. (RSMHA. F. 546. Op. 3. D. 241. L. 36; Roussel, 1876a: 5; Kibbie, 2019: 18). This allowed him to make the contacts necessary to promote his device.

Roussel's practice of sending copies of the device and his own monograph "La Transfusion" for review to the leading experts in Europe and Russia played an important role in the formation of personal contacts and scientific recognition of the transfuser. In 1873, the Roussel device was tested by surgeons L. von Dittel (1815–1898), Neudorfer, and Korzhenevsky; psychiatrist M. Leidesdorf (1818–1889); obstetrician Krassovsky, and others. A review of the French edition of Roussel's monograph (Roussel, 1876a: 166) was published in 1876 by the Belgian military surgeon and editor of the "Archives de la médecine belge", M. Titek (?–1885) (Roussel, 1876b: 21-28). In 1877, J. Paget (1814–1899), a member of the London Clinical Society, compiled the preface to its English translation (Roussel, 1877: 96). According to experts, Roussel's device took into account "all physical and physiological laws", which enabled the quick and safe injection of patients with human blood in large quantities, and in case of its deficiency, animal blood (Roussel, 1876b: 27). Thus, the reviewers not only unanimously recognized the transfuser as "the best among the currently known [devices]", but also recommended providing it to the military medical institutions of their states (RSMHA. F. 546. Op. 3. D. 241. L. 37 Ob.; Roussel, 1873: 42).

Roussel immediately tried to bring his achievements to the attention of the world community. To this end, he published official reports, reviews, letters from ministries and departments, and summary tables with data on the number and results of operations performed by his apparatus in leading national and international professional journals: "Le progrès médical" and "Archives générales de médicine" (France), "Berliner klinische Wochenschrift" (German Empire), "Archives de la médecine belge" (Belgium), "Voenno-medicinskij zhurnal" ("Military medical journal") and "Protokoly zasedanij obshchestva Russkih Vrachej v Sankt-Peterburge" ("Protocols of meetings of the society of Russian doctors in St. Petersburg") (Russia) (Roussel, 1873: 39; Roussel, 1882: 24-25; Roussel, 1876a: 21). His scientific papers did not include original content, being a compilation of various translations of previously published works. The author's journalistic style made them accessible to the general medical community. It was supposed that laudatory reviews and testimonials should have increased trust in the transfuser due to the community's respect for the reputations of the experts who gave them. However, the obvious simplification and tendency towards utopian ideas and self-glorification caused reproaches from the scientific medical community and editorial boards. Thus, the editor of the "Voenno-medicinskij zhurnal" ("Military medical journal") (St. Petersburg) wrote in the preface to Roussel's article: "Due to the attention that was given to the operations performed with the use of the device invented by the author, the editorial board considered itself obliged to publish his article, although in the details of the evaluation of the projectile, in some views, and, finally, in the very method of presentation, it cannot agree with him" (Roussel, 1873: 39).

The notes published by Roussel in non-scientific literature were clearly advertising in nature. One of the examples is the picture of an ideal blood transfusion on the battlefield (Figure 3), placed by him on the pages of the military newspaper "Militar-Zeitung" (1873) (RSMHA. F. 546. Op. 3. D. 241. L. 120b.) and the secular magazine "Daheim" (1874) (Gesellius, 1874: 13). The purpose of these notes was to form a romantic idea in the minds of readers about the benefits of blood transfusion and the possibility that everyone could become a donor (Kibbie, 2019: 6), although experts objectively noted the impossibility of performing this procedure in the military field (Berner, 2020: 52; Gesellius, 1874: 15).


**Fig. 3.** Blood transfusion on the battlefield (RSMHA. F. 546. Op. 3. D. 241. L. 120b.)

It should be noted that there were no official data on the use of the Roussel's apparatus in military medicine, especially on the battlefield (Berner, 2020: 45). The tests of the transfuser performed by Neudorfer in Austria-Hungary (10 cases) and public demonstrations performed by Roussel in Russia (25 cases) were carried out on patients who did not have a direct indication for transfusion – acute blood loss (Sergeeva, Panova, 2020: 6). Most of them had anemia as a secondary characteristic, being a consequence of other conditions (consumption, burns, inflammation, scurvy, gangrene, etc.). Moreover, Neudorfer "deliberately" selected for patients this procedure "who were already hopeless, and whose life had to stop, even despite the transfusion" (Roussel, 1873: 42). Operations on patients who died in agony were used in Russia to demonstrate the technique of performing the procedure and the features of the device (RSMHA. F. 546. Op. 3. D. 241. L. 67–67ob.). According to Roussel, only 11 of the 34 operations carried out with his apparatus in 1867–1874 were performed "for the sake of healing". All other cases were of an experimental nature: "palliative blood transfusions to incurable patients", "attempts to cure in hopeless cases", and "demonstrations and experiments", and had either no result or the improvement was short-lived (Roussel, 1873: 398). These data, on the one hand, indicate that blood transfusion in medicine in the 1870s had the character of a clinical experiment. At the same time, the use of dying patients as living manuals for educational and research purposes was a common practice at that time. On the other hand, there were no direct indications for blood transfusion in civilian medicine, except for uterine bleeding, and the advantages of using the transfuser in military field conditions were not proven. However, in 1874 the military ministries of Austria-Hungary and Russia concluded contracts with Roussel for the supply of his devices to their armies. The inventor was awarded the orders of Franz Joseph and Saint Prince Vladimir of the fourth degree for his scientific merits (RSMHA. F. 546. Op. 3. D. 241. L. 111; Roussel, 1877: 95). Moreover, the Russian Ministry of Internal Affairs recommended to the local authorities to purchase these devices in order to equip regional hospitals with them (SARB. F. 10. Op. 1. D. 1. L. 36). In 1875, 200 of Dr. Roussel's transfusers were distributed to all Russian military hospitals (RSMHA. F. 546. Op. 4. D. 83. L. 123–124). In 1876, the Belgian army purchased his devices, and the inventor received of the Order of Leopold (Roussel, 1876b: 30). According to Roussel, in 1877, British army ambulances and Marine Corps introduced his apparatus (Berner, 2020: 155). However, Roussel's success was temporary. We could not find evidence of the use of this device in Russian military or civilian medical institutions, or of its repeated purchases. Russian military surgeon N.I. Pirogov (1810–1881) wrote that during the Russo-Turkish war (1877–1878), Russian doctors "did not resort to blood transfusions at dressing stations in Bulgaria" (Pirogov, 1879: 207). For Zemstvo administrations, the device turned out to be too expensive (SARB. F. 10. Op. 1. D. 1. L. 33). Ch. Jennings

(1859–1930), a member of the Royal College of Physicians of London, testified that in 1883 the Roussel device did not have commercial success and was not actually used in private practice (Jennings, 1883: 38). The French and German authorities did not purchase Roussel devices for either civilian hospitals or army health services (Berner, 2020: 155). In 1886, French Professor G.O. Dujardin-Bometz (1833–1895), addressing students, noted: "Today, despite the efforts made by Roussel ... blood transfusion is an exceptional procedure in practice, and there are certainly few people among you who were present at this operation" (Dujardin-Beaumetz, 1886: 347). German surgeons considered the transfusion of lamb blood questionable; it was impossible to find a suitable human blood donor in war conditions, and any injections or infusions on the battlefield were unacceptable. The autotransfusion method successfully solved the problem of acute blood loss, and aseptic and antiseptic methods reduced the amount of secondary bleeding (Berner, 2020: 156). Thus, in the late 1870s and early 1880s, blood transfusion as a complex surgical method that required special conditions did not guarantee a favorable outcome of the operation and, therefore, was not widely used in military medicine. Contracts for the purchase of transfusers concluded by Roussel with the military ministries of Austria-Hungary, Russia, and Belgium in 1874–1876 became the only major trade deals for the inventor, and for the governments of these countries – a diplomatic signal to allies and opponents about the implementation of the latest technologies not only in weapons, but also in the medical support of their armies.

## 5. Conclusion

Dr. Joseph-Antoine Roussel was a talented medical entrepreneur who managed to conduct one of the first successful international marketing campaigns in practical medicine during the second half of the 19th century. In the 1870s, he became the first and only official supplier of blood transfusion devices to the governments of Austria-Hungary, Russia, and Belgium. This success was possible, on the one hand, due to the original approach to the design of the author's device, and on the other, to the skillful use of the social and political conditions prevailing at that time. Roussel was able to correctly identify the main cause of the high mortality rate of a modern war and offer the authorities an original piece of apparatus (technology) to combat it. The main competitive advantage of Roussel's invention was its versatility, which allowed human-to-human and animal-to-human blood transfusions to be carried out equally effectively, as well as enabling the transfusion of other medicinal solutions. Roussel's advertising campaign, based on public demonstration of the device's operation, support of influential people, and popularization of the blood transfusion procedure among ordinary people played the key role in the promotion of the transfuser. He used various means available at that time: exhibitions, conferences, professional and public press, and personal connections. However, despite all of Roussel's efforts, his device did not find mass use in practical medicine in 1870–1880 (by 1883 only 62 blood transfusions had been performed using his apparatus) (Dujardin-Beaumetz, 1886: 354). This can be explained not only by the design features of the device, national priorities, and high competition from existing methods of blood transfusion, but also by the lack of knowledge about blood physiology in 1870–1880 and the widespread introduction of the principles of asepsis and antiseptics into medical practice.

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