3. Blood on the battlefield

An unconscious and dishevelled soldier lies on the ground in the arms of another man. A tourniquet is fastened around his left leg. A short tubing with a rubber pump and a dome-like contraption connects the arms of the two men. A uniformed doctor kneels to administer what seems to be a transfusion. There is a satchel on the ground with a Red Cross emblem, and a flask, perhaps containing something to strengthen the men. In the background, two shadowy figures carry a stretcher away from the scene.

The impression is one of a classical Pietà, with the tree behind the men resembling a cross and the wounded man seemingly dead with his hands open towards the sky. The donor holds him in his protective arms; his gaze is one of compassion and care.[1] The doctor's professional gaze, on the other hand, is focused on the arms and the transfusion apparatus. 'God willing will soon new blood and new life flow into the [soldier's] veins', exclaims the author of the article in which this image appeared. [2]

The instrument described in the article about how 'a wounded man is saved by transfusion on the battlefield' was designed by Joseph-Antoine Roussel. He also supplied the image. It appeared in the German family journal *Daheim* (Home) in September 1874. In a later text, Roussel would give detailed instructions for how a transfusion on the battlefield should be carried out, a description that closely resembles the arrangement in the image. He also claimed that his instrument had been used for transfusions at Pontarlier in Eastern France during the Franco-Prussian War.[3] This was not a battlefield but a small town where the retreating French army turned eastwards to enter Switzerland at Verrières. There, in January 1871, more than 89,000 wounded, exhausted and freezing soldiers laid down their weapons and finally got medical attention.[4]

There are, however, no official records of any transfusions with Roussel's apparatus during the Franco-Prussian War. Perhaps we should interpret the

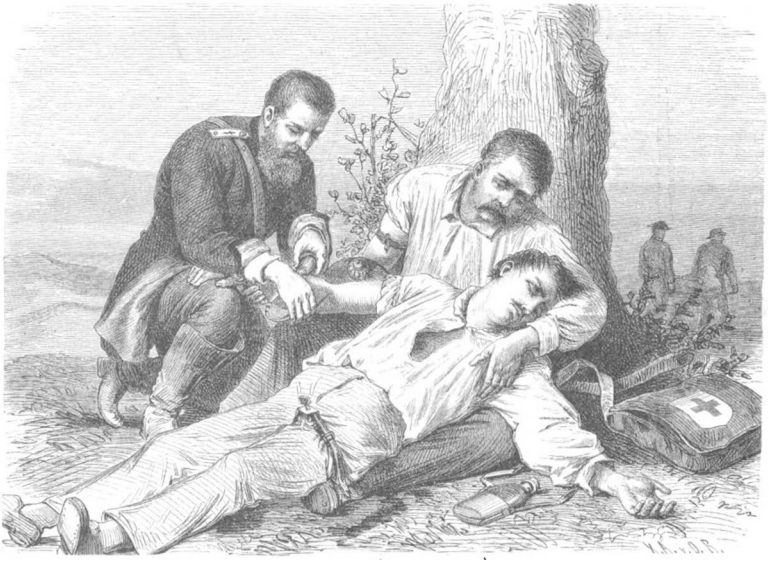

Figure 10. Blood transfusion to save a wounded man on the battlefield (Niemeyer 1874, 60).

enthusiastic *Daheim* article, published some three years after the war, not as a statement of fact but as one of anticipation. It was an advertisement for blood transfusion in general and for Roussel's method in particular, praising its life-saving potential on the battlefield. Roussel himself often argued that if it had been acquired in time by the French (and other) military authorities, much death and agony could have been avoided.

Wars, wars, wars

By any standards, the 1860s was a decade of blood, and the carnage continued into the 1870s.

The list of wars includes the American Civil War, a war in Mexico, the Taiping rebellion in China, and a prolonged war between Paraguay and its neighbours. Europe went through four short but very bloody wars between

1859 and 1871. The Second Italian War of Independence in 1859, also called the Franco-Austrian War, was fought by France and Sardinia against the Austro-Hungarian Empire. Politically, the campaign led to the unification of Italy. Militarily, it was the first war in which both sides used the new technologies of railways, the telegraph and rifled weapons. Medically, it was a disaster with a total lack of trained medical personnel, surgical instruments and ambulances. Wounded soldiers were left lying for days on the battlefield without water, food or medical care. It was after having witnessed the horrors of the battle of Solferino in June 1859 that Henri Dunant began the work that would lead to the International Red Cross.[5]

The Schleswig campaign of 1864, involving Prussia and Austria against Denmark, was short but violent. The next war, the Austro-Prussian War of 1866 with Austria fighting against Prussia and Italy, saw horrendous bloodshed. On the fields of Custoza in Italy, for example, 9,000 Austrian and Italian battle casualties lay unattended for hours. They were difficult to evacuate and no surgeons or ambulances arrived to attend to them.[6] Somewhat earlier, during the American Civil War (1861-65), 620,000 American soldiers died from battlefield injuries and diseases ranging from diarrhoea and measles to typhoid.[7] For every soldier who died of combat-related causes, at least two died of disease.[8]

These wars were waged using the new technologies of capitalism: heavy armour-piercing artillery, machine guns, precision-produced rifles and modern explosives.[9] Such weapons – 'conical bullets animated at a terrible speed by sophisticated rifles, sharp fragments of shrapnel, shells', Roussel observed, 'produce haemorrhage much more often than in the days of old round bullets and massive [cannon] balls'.[10] When limbs were wounded, amputation was not merely the preferred treatment but the necessary one. Soldiers would be removed 'to have their wounds scoured with petroleum and creosote, and their injured limbs sawn off', a later historian notes.[11] Before the widespread use of anaesthesia, the best surgeons could do to improve survival chance was to perform the operation as quickly as possible, thereby minimizing further shock to the victim's system. And surgeons got deft at performing amputations in a matter of minutes. Head wounds, stomach trauma, and infections of the trunk were usually inoperative.[12]

What about blood transfusion? It was discussed as a possible life-saving manoeuvre during the mid-19th century wars, but it was difficult to put into practice. Some military surgeons tried it out while others were more sceptical.

A first attempt was made in 1859 during the Italian War of Independence against Austria.[13] The Austrian surgeon, Ignaz Josef Neudörfer (later a supporter both of lamb blood transfusion and of Roussel's apparatus), was then at the St. Spirito Hospital in Verona attending to injured soldiers with never-ending suppurations caused by wounds from rifle fire. The possible dangers of a transfusion – then considered to be an experimental therapy – first held him back. Seeing the patients' desperate condition nevertheless made him dare the attempt. A simple apparatus was improvised, and six wounded soldiers were transfused with defibrinated blood. None of them survived for more than a few weeks. Neudörfer blamed the negative result on the character of the donated blood. It had been taken from a person who was about to have an attack of gout. Therefore, Neudörfer surmised, the blood was full of uric acid and would act as a poison. Still, transfusion had a future, he thought. A French medical journal, commenting on his report, was less enthusiastic: 'A treatment with wine or broth, and stimulating massage […] are emergency measures that are more effective and less dangerous', it claimed.[14] A not uncommon recommendation, as we shall see.

During the American Civil War, blood transfusion was practiced twice, once with success, once not.[15] The American surgeon J. A. Lidell later regretted that it had not been used more. It could have saved those suffering from a state of anaemia and general debility due to great losses of blood, 'from which they could not be raised by even the most nutritious food, alcoholic stimulants, the chloride of iron, or the citrate of iron and quinine'.[16]

In the European wars of the 1860s, some transfusions were made, mostly far away from the battlefield and with no lasting positive effects.[17] How many they were is not clear since most attempts were not published.[18] Among these were the nearly 100 transfusions that Neudörfer allegedly performed during the battle of Sadowa (Königgrätz) in 1866, as it seems with little success.[19] Accordingly, many surgeons were sceptical about the method's feasibility. Making an indirect transfusion with defibrinated blood – the then favoured technique – was considered far too time-consuming in field conditions. And who should supply the blood? Other soldiers were not suitable since their strength was needed for combat. Nor could slightly wounded soldiers be used as a blood reserve. Bloodletting had until recently been a common intervention. Thus, doctors could, in principle, use blood from wounded soldiers' head and breast wounds for transfusion. But by the late 1860s, the norm was to avoid bloodletting entirely or wait until there was an urgent need for it; this method was therefore no longer possible.[20]

War-time modernization

We have now come to the Franco-Prussian war of 1870–71.

This was a short, five-month, war that nevertheless led to terrible bloodshed and death. Still, it was the first war in which fewer soldiers died from disease than from enemy fire, that is, on the Prussian side.[21] The German military authorities had learnt from the abysmal conditions of earlier wars and had adopted new ideas about antiseptic techniques, inoculation and anaesthesia. Each soldier was provided with a first-aid kit, including bandaging material and sterile lint as an absorbent.[22] In addition, most German soldiers had been vaccinated and there were only a few cases of smallpox. This should be compared to the 2,000 deaths among the French forces, which were only partially vaccinated.[23]

German military thinking also took inspiration from the changes made to medical organization during the American Civil War. The principle became to evacuate seriously ill and wounded as soon as possible back to Germany, using a coordinated system of railways and hospitals of different capacity, each provided with a different set of expertise – doctors, nurses and medically trained stretcher-bearers.[24]

Did this medical modernization include the use of blood transfusion?

One physician who might have tried transfusions during the 1870/71 war was Oscar Hasse. He had experience both with war conditions and with performing transfusions in civil life. In the 1860s, he had on several occasions left his private practice in Nordhausen to take part, first, in the 1864 war against Denmark, then, a couple of years later, in the Austro–Prussian War, and then again in 1870 in the Franco–Prussian War. By then, the Prussian sanitary corps had an efficient organization and high status. It recruited some of the country's best physicians and surgeons. This was in sharp contrast to other armies, whose medical services in war, as in peace, depended on whoever they could lure into uniform.[25] For ambitious young doctors like Hasse, the war experience meant a chance to learn advanced surgery, something that he got, for example, in the very bloody battle of Königgrätz in 1866. He would there, to use his own words, find an 'overwhelming surgical material'. On the other hand, he later remarked, he had never in the wars of the 1860s felt the need for a transfusion.[26]

It was different in the Franco-Prussian War where he for five months was in charge of a typhus station during the siege of Paris. He had to deal with substantial intestinal bleedings often leading to the patient's death.[27] 'Here,

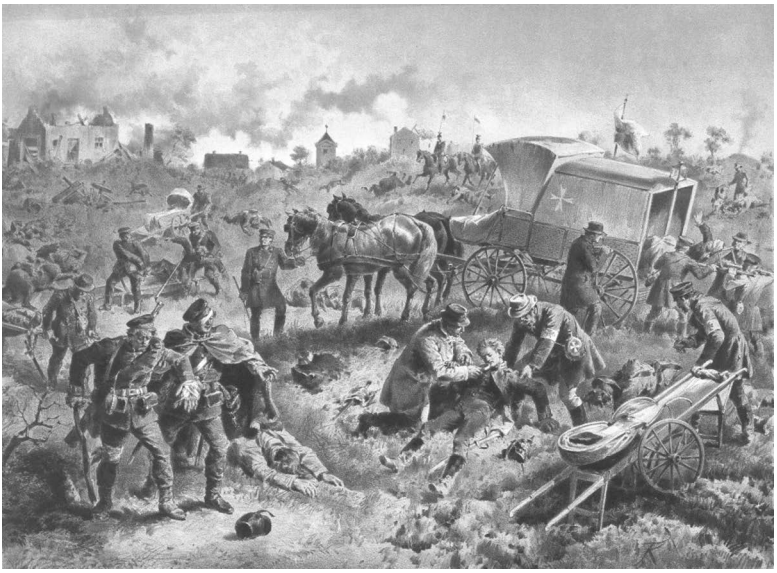

Figure 11. A battlefield scene with the wounded being tended to and carried away. Lithograph, c.1870 (Wellcome Collection. CC BY, https://wellcomecollection.org/works/fbesqjn8).

the thought of and the desire to make a transfusion gave me many sleepless nights', he remembered. However, the lack of healthy donors was a problem, as was the safety of the transfusion instruments. Those recommended for use in the field were far from ideal. Hasse had, at an early stage, procured a Hüter transfusion box. However, he complained:

> The leather head in the therein included Uterhardt syringe was dripping wet from oil, which also coated the inner side of the syringe's glass point with thick, pearly drops. The smell from the oil was revolting. When I put the syringe in hot water to clean it from the rancid oil that surely would not have had a wholesome effect on the blood to be transfused, the varnish that attached the rubber cap to the glass tube dissolved. The syringe was unusable. Given this situation and the possibly complete dissolution of the closing cap, how easily could particles of varnish or putty have become mixed with the blood and cause the most substantial embolism.[28]

Hence, no transfusions by Hasse during the Franco-Prussian War and very few by other military surgeons. Overall, the German side transfused 19 wounded and 14 sick persons, including some French prisoners. One transfusion took place in a casualty clearing centre, three in field hospitals, one in a permanent war hospital, and the rest in reserve hospitals in Germany. Of the 33 transfused soldiers, 13 were healed, 19 died, and the fate of one patient is unknown.[29]

On the French side, transfusion was performed twice according to official sources. A first transfusion was made in December 1870 on a soldier wounded at Champigny, leaving the soldier dead.[30] A second transfusion, on another soldier wounded at Champigny, took place five years later, in 1875, at a Paris hospital. Here, too, the patient died and, what is more, the donor, a young student 'of delicate constitution' got violently ill and died. This sad experience would inspire, a later article claimed, 'a deep loathing of transfusion' among French military physicians.[31]

Using Roussel's apparatus – or not?

Thus, there were very few transfusions during the Franco-Prussian War. Military surgeons had little training in the procedure; it was seen as uncertain and cumbersome. But many were interested and anticipated its regular use in wars that were certain to come. Here is Dr Bruberger talking to the *Berliner Militärärztlischen Gesellschaft* in 1874 about the need for transfusion apparatuses in war:

> [Imagine] standing at the bed of a soldier wounded for the fatherland, who struggles with death after exhaustive bleeding, and saying to yourself, I could save this man, I could surely have saved him – only this miserable little apparatus is missing. Believe me, I do not pronounce these words carelessly but out of a deep, innermost conviction, when I say: The introduction of transfusion apparatuses for the field hospitals of the army is urgently required.[32]

Bruberger himself favoured an instrument by Schliep, but there was a growing interest in Roussel's apparatus, which the inventor himself considered eminently suitable for war conditions.

This leads us to a rather entertaining polemic. As it turns out, not all doctors were as enthusiastic about Roussel's instrument as he was himself. It

demanded much practice to be handled properly. A real indictment against it was delivered by Franz Gesellius. In his 1873 book, he had opposed the use of defibrinated blood, claiming it was 'dead blood'. He also dismissed Roussel's instrument despite its use of direct transfusion with 'living' blood because it was 'very complicated'.[33] A year later, and after having read the *Daheim* article, he was outright caustic about this 'wonderful Rousselian apparatus'. 'What an interesting picture', he said of the battlefield image, and continued:

> Still, I miss in this famous sketch by Roussel a field fire with a kettle filled with water hanging over it. Since where would otherwise the representative of the Red Cross get the absolutely necessary warm water for the Roussel apparatus? Wouldn't a spirit or kerosene fire to boil water be impractical in the open field because of potential wind or rain? Moreover, must not the operator be of an unprecedented dexterity to be able to properly push the apparatus subcutaneously into a bloodless, and therefore invisible, vein?[34]

Gesellius thought it virtually impossible to drag hot water along in war circumstances where often not even cold water was to be found (Roussel, not surprisingly, did not agree). The same objection held for asking soldiers or paramedics to sacrifice their blood:

> [Someone] who does not generously want to give his blood and life in an open and honest struggle for his Kaiser and Fatherland is a scoundrel but he is certainly no scoundrel if he refuses to cut open his veins for friend or foe and, thus, perhaps succumb in phlebitis or get a paralysed arm or, in the best case, become weak and unable to work for days. Just to ask for such an undertaking is, I feel, […] an inhuman attack on the health and life of one's fellow beings.'[35]

So, if Roussel's apparatus was too cumbersome to use and the prospect of bleeding soldiers for direct or indirect transfusion was not realistic, what was there to do? Gesellius had the answer in his 1873 book and, even more explicitly, in his 1874 leaflet: lamb blood transfusion! 'Transfusion with human blood will and must – thanks to animal blood transfusion – in no time belong to the history of medical aberrations!' he exclaimed.[36]

The animal blood alternative

Gesellius was not the first to suggest using animal blood in war. In 1860, the German military surgeon, Friedrich Esmarch, transfused 420 grams of defibrinated calf's blood into a dying soldier. The solider died during the operation despite attempts at artificial respiration.[37] The procedure may also have been tried during the Italian War of Independence (part of the Austro-Prussian War). The Italian doctor, Giuseppe Albini, later reported how he, in 1866, when in Milan and about to leave for the battlefield, decided to bring with him a living lamb in the ambulance. The purpose was to make a transfusion using his 'haemodromometron' instrument. There is no information about whether this actually occurred.[38]

By the early 1870s, however, and as we saw in chapter 1, the question of the usefulness of animal blood for civil or military purposes seemed, once and for all, to have been settled in the negative – a verdict Gesellius was bent on reversing, and so he did. His 1873 book and 1874 pamphlet, together with Hasse's publications and practical experience, changed the debate and inaugurated a period of lamb blood transfusion at sickbeds across the continent. But could it be used on the battlefield? Now ensued a vivid exchange of opinions with many ideas but few empirical examples.

Some military surgeons found the prospect enticing. Several now regretted that they had not thought of using animal blood to revive wounded soldiers during the Franco–Prussian War. Hasse ruefully remembered how 'large herds of sheep grazed unchallenged and unnoticed in the park outside the hospital' where he attended to sick soldiers.[39] Paul Schliep of the Augusta hospital in Berlin recalled how there had been 'columns of sheep accompanying our troops and whose blood would only benefit the enemy's earth'.[40] And Oscar Heyfelder mused in 1875:

> If I, in 1870 and 1871, had known of the curative value and the ease of execution of the direct transfusion of lamb blood, I would have infused new blood into most of the starving and weakened sick from [the battle of] Metz, something that would have made it possible for me to proceed to large operations.[41]

As to what animal to use, suggestions were not limited to sheep. Other animals, too, were present in 19th century battalions: calves, dogs, cows and oxen. The Austrian military surgeon Joseph Friedrich Eckert argued for the convenience of using dog's blood:

> With every troupe and medical service, vertebrates are brought along who have smaller blood corpuscles than humans and who therefore are completely suitable for transfusion. Normally, there is no lack of lamb or calves in an army but if that should be the case, there are always stray dogs around. Certainly, dog blood has the same effect as lamb blood – its blood cells are smaller than human ones. Dogs eat mixed food just as humans do, so would not its blood be more favourable than that of the lamb? Even if there are arguments against it, I am completely convinced that in moments of lethal danger, nobody will be against it and I find arterial transfusions with dog blood on the battlefield to be very appropriate.[42]

Both Eckert and Gesellius advised the operator to cover the donating dog's eyes to prevent its almost human, pitiful and helpless gaze making too deep an impression on the patient. Also the nose should be tied up so that the dog's miserable wailing would not distract those around.[43] Given these complications, a lamb seemed to be a more practical alternative: 'Why not a lamb that, when all is over and done with, may be consumed?'[44]

The task then became how to best organize a lamb blood transfusion under war conditions. For Gesellius it was simple:

> A military medical orderly can accompany each doctor and very comfortably in a leather rucksack carry one or two not-too-heavy lamb, which have already been completely prepared for immediate transfusion.[45]

This suggestion was greeted with some enthusiasm. Eckert, for one, thought it 'a very ingenious idea'.[46] Gesellius gave explicit advice on how the lamb should be prepared, instructions that Eckert embraced and further developed. The animal should be prepared on a board but if none was available, he noted, a rolled coat would do as a support.[47]

The Austrian military surgeon Neudörfer, who had made transfusions with human blood in the 1859 and 1866 wars, also seized upon this new alternative. He constructed a special cannula to be inserted into the carotid of the sheep. This manoeuvre could be made away from the battlefield and hours before it was needed. Once out in the field, the doctor or his assistants could then swiftly and safely transfuse blood from the animal to the wounded soldier. Neudörfer thought that one fully-grown sheep could provide blood for at least four persons. Hence, ten sheep with attached cannulas could be used to transfuse forty haemorrhaging soldiers in a couple of hours. This operation

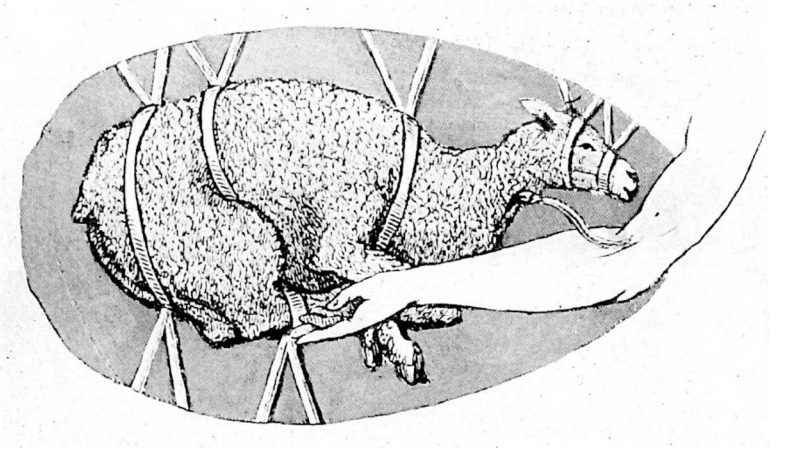

Figure 12. Eckert's suggestion for how the lamb should be positioned for a transfusion in the field (Eckert 1876, 169).

could be performed in a field hospital, but also at a dressing station nearer to the battleground.[48]

Saving the apparently dead

Here, we enter another heated discussion about transfusion in war. *Where* could and should it be done?

Roussel had – with his 'pretty picture' – argued for performing transfusions already on the battlefield, although 'in a sheltered place'.[49] The reason for doing this, he and others argued, was the terrible danger of *Scheintot*, apparent death. Soldiers were declared dead even if they were not. They had lost much blood, were cold, unconscious, had no apparent breathing or heartbeat. But they were alive![50]

The German surgeon von Nussbaum remembered how he, on a cold, dark night after the battle of Orléans in October 1870, struggled to bring soldiers, declared dead, back to life:

> We returned several times, with four or five stretcher carriers, to the wounded who had been left for dead despite that their hearts could still be felt beating and, after having collected, warmed and refreshed them, we brought them back to life.
>
> Loss of blood, exhaustion, hunger, cold and fright were, it seems, the causes of their lethargy. And even if one could not, on the battlefield, use long needles to prick the tip of their hearts, which is the best way to determine death, one could at least […] put one's ear against their chest, which is very easy to teach any stretcher carrier to do.
>
> For it is too dreadful to think that these poor and brave people would spend an entire night dying in the ditches along the roads while the carriers come and go around them without noticing them. There is no doubt that their stupor will turn into real death if several hours go by without any relief or warmth.[51]

Others were more hesitant. Neudörfer, in 1872, did not think it possible to find and save the apparent dead in the chaos of the battlefield:

> Unfortunately, it is still impossible to distinguish the apparent from the real dead when searching through the battlefield and that will not soon be any better. In battles where there are 2–3,000 dead and 6–10,000 wounded, one human life more or less is hardly relevant. It is not possible […] to find and carefully determine who is an apparently dead among the thousands of really dead.

Performing a transfusion in such circumstances, he added, was impossible. If, by chance, one would discover such a seemingly dead soldier on the battlefield, he should instead be placed in a horizontal position, made warm and given some drops of rum or wine. 'Of blood transfusion, which would be the most suitable remedy, there is no question in the field.'[52]

To this, Eckert responded: Should we just give up? Should we idly put our hands in our laps and not even try a transfusion because the operation is so arduous to perform and does not always succeed? His answer was: 'Absolutely not – death threatens and there is nothing left to lose', and recommended the use of animal blood in the field.[53] Roussel, too, was in favour of transfusion to the seemingly dead (if not necessarily with animal blood): 'Very often death is only apparent, and even after many hours, it is not to the pit but to the ambulance that one should carry a body that a transfusion might return to life', he argued in 1876.[54]

By then, Neudörfer had changed his mind. In his 1874 recommendations to the Austrian war ministry about what transfusion instrument to acquire (he opted as we have seen in chapter 2 for the one by Roussel), he now thought that a transfusion would do great service during the evacuation of the battlefield. Experience from the war in America, he argued, had shown that not all bodies abandoned immobile on the battlefield were *really* dead. A good part of them were only unconscious due to haemorrhage and in a state of apparent death. They could be called back to life with a transfusion of human or, if necessary, animal, blood.[55]

Again, not everyone was convinced. Even Hasse thought it a bad idea. For the wounded in the dressing station, 'a roast lamb with a good bottle of red wine would be far more appropriate than a living lamb with prepared carotid', he argued.[56] The military surgeon Hermann Fischer, professor of surgery in Breslau, argued that warm, refreshing beverages or champagne, milk, egg, hot water bottles, then repeated ether injections, meat, beer and wine were better therapies in cases of severe losses of blood. And the lamb that Gesellius proposed should be carried on the shoulders of a soldier in every battalion, 'had better stay at home, or should be put in a soup pot in the encampment'.[57] The military surgeon Bruberger agreed: 'Only a total ignorance of the battlefield' could make Gesellius enounce the naive idea that every battalion upon going into action could have a transfusion-ready sheep on the shoulders of a soldier. Instead, one should get the wounded transported away without thinking about introducing foreign blood.[58] And a German reviewer of Gesellius' text had much fun imagining what would happen if the enemy did not show up as predicted and there was no battle – should one then have a new lamb delivered and prepared for the next day? In the future, one could perhaps instead use condensed blood?[59]

Thus, the Gesellius-Eckert-Neudörfer proposal met with both incomprehension and ridicule by other physicians. It was a suggestion made at the writing table, far from the realities of war, and based on an illusion that 'the direct transfusion of lamb blood [could] be the salvation of many human lives'.[60] As it turned out, only one or two of the transfusions performed during the 1870/71 War were made near the battlefield, and they did not use animal blood. The only lamb blood transfusion on a wounded from this war took place far away from the battlefield. It occurred three years after the war and only after Hasse and Gesellius had re-opened the idea of animal blood transfusion. In early 1874, Bruberger and Schliep at the Augusta hospital in

Berlin transfused a severely wounded soldier four times with blood from a lamb but the soldier did not survive.[61]

War and medical innovation

We now leave the wartime world of amputations and apparent death, thundering cannons and the cries of wounded soldiers for the quiet rooms of city hospitals, clinics and spas. Here, lamb blood transfusion was, in the early and mid-1870s, practiced on quite a number of patients. It was sometimes done to counter a disturbing loss of blood but more often as a kind of medicine against such 'civil' conditions as consumption and insanity.

Still, an interesting question remains: how important were the many mid-19th century wars for the development of transfusion, be it with human or animal blood?

The relationship between war and medicine is a paradoxical one. Wars imply horror and suffering, but – some argue – nevertheless bring lasting medical benefit to mankind. Wars provide unique learning experiences for the medical corps. They include opportunities to develop urgently needed new techniques and therapies, they give access to a huge number of wounded soldiers to operate upon and corpses for dissection.[62]

This was partly true in the 19th century, as Hasse noted with respect to his wartime surgical experience. Still, as medical historian Roger Cooter argues, the lessons of war are not necessarily of direct civilian relevance since wartime conditions in many ways are radically different from those in peace.[63] Most 19th century wartime type of injuries, such as large wounds from mortar and shells, were unusual or irrelevant in peacetime. In the chaos of the battlefield, there was often a need for urgency in wound treatment and amputation – but this was much less essential in a well-organized civil hospital with anaesthetized patients, or was impossible to perform in a local doctor's clinic or a patient's home.

As we have seen, transfusions were hardly attempted during the 1860s and 70s wars, for reasons indicated above. Thus, no relevant civilian lessons could be drawn. The impact was rather the other way around: the mid-1870s *civil* experiences of transfusion, including those with animal blood, influenced military thinking. They seemed to promise simple and efficient ways to save lives, even on the battlefield.

Still, one could argue that there was a give-and-take of visions and technical alternatives between the civil and the military spheres. Military surgeons were active in civilian life and promoted new surgical techniques and interventions. And the wars of the 1860s and early 70s had encouraged new medical arrangements and techniques. 'Never before has the military-medical domain gained so much attention, nor has it had such a rich material to take account of', a Swedish surgeon summarized the impact of the Franco-Prussian War. He mainly referred to the improved status and organization of the military medical corps.[64] But much military attention was also, as we have seen above, given to debating and devising transfusion techniques for use in future wars, and in civil life. Military competitions were set up between different methods of transfusion, large military and technical exhibitions were organized and instruments acquired by various military authorities – and the alternative of using the blood of lamb was endorsed by highly placed military surgeons in both Austria, Russia and Germany.

This leads us to the civil experiences of lamb blood transfusion. The intervention was tried out for a variety of indications, most remarkably, for cases of tuberculosis and pellagra. These were terrible diseases that above all affected the poor in society and often led to an early death. How did doctors reason about the need for a transfusion to such patients, how were the transfusions performed? And how did the patients react? Did they get any better?

These questions will be dealt with in the next two chapters.