

ANAESTHESIA

Painless amputation: history of a discovery that wasn't made

Sam Shuster ponders on why his retrospective discovery of tourniquet anaesthesia wasn't made earlier, when it would have mattered

My realisation that using tourniquet ischaemia in the pre-anaesthetic era could have made amputation painless led to the idle thought of why it hadn't been discovered, and then, to the even more idle thought of whether looking at why discoveries aren't made would help us understand how they can be made. Because this could be answered only by a study of the history of amputation that looked for the ambience of ideas and practices rather than their chronology, that is where my idleness ended—with a new reading of the original documents on amputation procedures from the 16th century onwards, written by surgeons who had used or developed them, in addition to historical reviews.

The pain of pre-anaesthetic amputation

The horror of amputation without anaesthetic is revealed by contemporary accounts, of which this by James Cooke in 1685 is typical¹: “Dismembering is a dreadful Operation; yet necessary, that the dead part may not injure the living, nor procure death. . . let one man be at the Patients back holding him, and another before him, holding the upper part of the limb; and a Third holding that Part that must be taken off. . . you are to make strong Ligature with broad Tape. . . about three inches above the Place you intend to incise. . . and let him that has the Gripe haul up the Muscles tort. . . This done (and the Man having had a Spoonful of Cordial to cherish him), you must with your dis-membring Knife, take two large Slashes round the part in the form of half rounds, and let one meet the other as evenly as possible, and let them be deep enough. Then with your Catling divide the Flesh and Vessels about and

between the Bones, and with the back of your Catling, remove the Periostium that it may not hinder the Saw, nor cause greater Torment in the Operation. So Saw off the Bone at as few stokes as possible, and let him that holds the lower Part have a Care to hold steady lest he break the Bone before the Saw is quite through. . . see that your Instrument maker hath set the Teeth of your Saw wide enough, so it may not stick [have]. . . two saws, lest one should break” and several knives, because “after an operation or two [they] lose their keenness.”² We should stop there, before the pain of cautery and sutures.

Many fainted during amputation, more remained agonisingly conscious, and a few suffered in silence (despite the more often quoted than referenced story of a sailor who sang *Rule Britannia* as his arm was removed³). The brutality of amputation left a profound scar even on men as brave as Nelson: “The sufferings of the operation. . . strongly impressed on his mind. . . so painfully and deeply was the recollection engrafted on his feelings.”⁴ He controlled his fear of further amputation by insisting that the pain had been from “coldness of the knife,”^{4,5} not its cut, and this allowed the comforting belief that the pain of the “next time” would be overcome by the warmed knives he demanded were always ready.⁴ Fortunately, Nelson's concealment of his deep fear was never exposed.

The agony and sequelae of amputation were accepted because it was thought to be life saving and without alternative, “when part of a Limb is carried away, or the Bones so shattered. . . if that be left on, it will Gangreen, and Death will issue”⁶; few people who refused surgery survived. The perceived necessity of amputation explains why so lit-

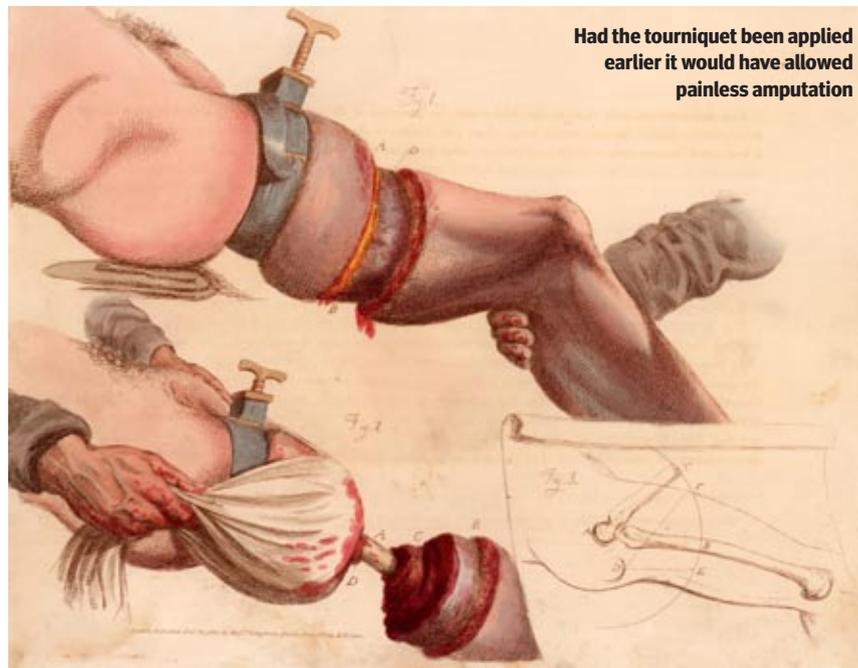
Many fainted during amputation, more remained agonisingly conscious



tle was thought about its pain—some texts ignore it,⁷ others offer sympathy,⁸ but all early writings proposed speed as the only way to minimise pain.⁹ Yet, however fast the amputation, the devastating intensity of the agony remained.^{1,2,6-9}

So what else could have been offered? Volatile anaesthetics were not available before 1846, but alcohol and opium were; yet, amazingly, they were used postoperatively, if at all. In face of the “violent and inexpressible Pain. . . the Operator is to encourage the Patient, and having given him half a Glass of Wine to enable him the better to endure his Pain;”¹⁰ the preoperative gulp of alcohol was given for fortitude not anaesthesia.^{1,6,11} But was this what was commonly practised? One way of assessing best practice is to examine what was given to the best, as in Eshelby's bald summary of his treatment of Lord Nelson: “The arm was immediately amputated and opium afterwards given.”¹²

The reason that alcohol and opium “anaesthesia” was rarely used is not clear. Kirkup lists variable efficacy, dose, and nausea,¹³ but my reading of the original texts suggests another reason—surgeons believed patients had to be conscious and alert to withstand amputation: “proceed as soon as possible. . . otherwise the patient may. . . be so exhausted to make it very hazardous, and his recovery doubtful.”¹⁴ This belief probably explains the extraordinary sitting posture used. The notion that its purpose was to achieve pain relief by inducing syncope is unlikely,¹³ because fainting was considered an undesirable response.¹ Although the association of “alertness” with response was correct, cause and effect were confused, and this led to the unfortunate exclusion of alcohol and opium preoperatively.



Had the tourniquet been applied earlier it would have allowed painless amputation

IMAGES FROM CHARLES BELL: ILLUSTRATIONS OF THE GREAT OPERATIONS OF SURGERY

Finally, physicians were licensed to use drugs but surgeons just operated—this may have contributed to the poor appreciation of the use of drugs and non-surgical methods, and may partly explain why use of the tourniquet wasn't extended beyond haemostasis.

Tourniquet anaesthesia and painless amputation

The tourniquet evolved from the bandage, thread, and screw device¹⁵; it allowed vessel ligation and banished painful cautery. It was applied immediately before surgery; had it been applied earlier, anaesthesia would have allowed pain-free amputation. Impaired neural function from ischaemia—as when a leg “goes to sleep”—is so familiar that it tends not to be noticed. I was reminded of it when using a sphygmomanometer just above arterial pressure to stop the circulation and fix vasoactive agents in the forearm,¹⁶ as with histamine.¹⁷ Limb ischaemia induced a proximally spreading anaesthesia with motor paralysis, complete in 30 minutes, that recovered rapidly on release. But a narrow cuff and higher pressures cause local pain and nerve damage from compression.¹⁸⁻²¹ Thus, application of a broad low pressure tourniquet 30 minutes before surgery would have allowed painless amputation in the pre-anaesthetic past. Tourniquet anaesthesia could still be used in extreme circumstances; it probably has been used unknowingly in the self amputation of trapped limbs, with the entrapment acting as a tourniquet.

Why wasn't tourniquet anaesthesia discovered earlier?

I made my anachronistic discovery when studies of naval health²² revived my earlier tourniquet

observations,¹⁶ and its ease of discovery made me question why it had not been made before anaesthesia made it irrelevant. Absence of the idea of improving pain control and, therefore, methods for its achievement, and the isolation of surgeons as technical practitioners are obvious, but re-examination of the historical accounts revealed a more interesting explanation.

When any procedure is used, all possible variants will occur, most of which inevitably follow the law of Murphy's cynical partner; thus although the tourniquet was applied immediately before amputation, there will have been exceptions; indeed the gangrenous consequence of leaving a tourniquet too long were well known,²³ as with tight splinting.²⁴ Although the opportunity to see the progressive course of tourniquet anaesthesia must have occurred, I found no records of such observations in the original texts or recent reviews.^{13 25- 29}

In addition to this tantalising closeness of the observational opportunity, I also found ideas that could have led to tourniquet anaesthesia. In 1637, William Clowes notes, “the pain of the [haemostatic] binding doth greatly obscure the knife and feeling of the incision.”¹¹ James Yonge's 1679 account says, “nor shall the pain of that operation be comparable to what it would be, were not the member nummed by the Compress.”²³ Of course, this was distraction by tourniquet pain—the onset was too rapid for tourniquet anaesthesia. Nevertheless, the idea of “numbing” wasn't that far off, and it got closer when the anaesthetic effect of screw pressure on a nerve was found.³⁰ So the ideas and techniques were there, waiting for the link; why didn't it happen?

Although accidental tourniquet anaesthesia must have occurred, either it wasn't noticed or its application wasn't realised. Failure to notice is a consequence of the need for reflex action rather than thought, when quick responses are essential. If it had been noticed, even in part as some accounts suggest, surgeons of the time were essentially operative technicians, working at great speed and stress at times of battle, with no time to consider, analyse, and classify the “interesting” neural consequences of tourniquet ischaemia, let alone develop its possible uses, as would a clinical researcher whose main life stress is finding a grant.

Thus, the failure of busy surgeons to extend their use of the tourniquet to anaesthesia is an almost inevitable consequence of the constraints of practice at the time. Having reached the limits of speed for reducing pain, further improvement needed awareness of the problem and a search for its solution; and that could only come with independence from clinical constraints. Time for reflection and experiment is essential to clinical advance and underlines the differences in the methods and traditions of clinical practice and clinical research.³¹ The gap between the two has closed, but, sadly, it is still obvious—otherwise, the retrospective discovery of tourniquet anaesthesia would have been made sooner, when it mattered.

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Autoappendectomy in the Antarctic

The Russian surgeon Leonid Rogozov's self operation, undertaken without any other medical professional around, was a testament to determination and the will to life, explain

Vladislav Rogozov and **Neil Bermel**

The ship *Ob*, with the sixth Soviet Antarctic expedition on board, sailed from Leningrad on 5 November 1960. After 36 days at sea she decanted part of the expedition onto the ice shelf on the Princess Astrid Coast. Their task was to build a new Antarctic polar base inland at Schirmacher Oasis and overwinter there. After nine weeks, on 18 February 1961, the new base, called Novolazarevskaya, was opened.

They finished just in time. The polar winter was already descending, bringing months of darkness, snowstorms, and extreme frosts. The sea had frozen over. The ship had sailed and would not be back for a year. Contact with the outside world was no longer possible. Through the long winter the 12 residents of Novolazarevskaya would have only themselves to rely on.

One of the expedition's members was the 27 year old Leningrad surgeon Leonid Ivanovich Rogozov. He had interrupted a promising scholarly career and left on the expedition shortly before he was due to defend his dissertation on new methods of operating on cancer of the oesophagus. In the Antarctic he was first and foremost the team's doctor, although he also served as the meteorologist and the driver of their terrain vehicle.

29 April 1961

After several weeks Rogozov fell ill. He noticed symptoms of weakness, malaise, nausea, and, later, pain in the upper part of his abdomen,



"A job like any other, a life like any other"—Leonid Rogozov

which shifted to the right lower quadrant. His body temperature rose to 37.5°C.^{1,2} Rogozov wrote in his diary:

"It seems that I have appendicitis. I am keeping quiet about it, even smiling. Why frighten my friends? Who could be of help? A polar explorer's only encounter with medicine is likely to have been in a dentist's chair."

As a surgeon Rogozov had no difficulty diagnosing acute appendicitis.

In this situation, however, it was a cruel trick of fate. He knew that if he was to survive he had to undergo an operation. But he was in the frontier conditions of a newly founded Antarctic colony on the brink of the polar night. Transportation was impossible. Flying was out of the question, because of the snowstorms. And there was one further problem: he was the only physician on the base.

30 April

All the available conservative treatment was applied (antibiotics, local cooling), but the patient's general condition was getting worse: his body temperature rose, vomiting became more frequent.^{1,2}

"I did not sleep at all last night. It hurts like the devil! A snowstorm whipping through my soul, wailing like a hundred jackals. Still no obvious symptoms that perforation is imminent, but an oppressive feeling of foreboding hangs over me . . . This is it . . . I have to think through the only possible way out: to operate on myself . . . It's almost impossible . . . but I can't just fold my arms and give up.



"18.30. I've never felt so awful in my entire life. The building is shaking like a small toy in the storm. The guys have found out. They keep coming by to calm me down. And I'm upset with myself—I've spoiled everyone's holiday. Tomorrow is May Day. And now everyone's running around, preparing the autoclave. We have to sterilise the bedding, because we're going to operate.

"20.30. I'm getting worse. I've told the guys. Now they'll start taking everything we don't need out of the room."

Preparation for the operation

Following Rogozov's instructions, the team members assembled an improvised operating theatre. They moved everything out of Rogozov's room, leaving only his bed, two tables, and a table lamp. The aerologists Fedor Kabot and Robert Pyzhov flooded the room thoroughly with ultraviolet lighting and sterilised the bed linen and instruments.

As well as Rogozov, the meteorologist Alexander Artemev, the mechanic Zinoviy Teplinsky, and the station director, Vladislav Gerbovich, were selected to undergo a sterile wash. Rogozov explained how the operation would proceed



Rogozov worked mostly by feel. Anticipating this he had decided to work without gloves

and assigned them tasks: Artemev would hand him instruments; Teplinsky would hold the mirror and adjust the lighting with the table lamp; Gerbovich was there in reserve, in case nausea overcame either of the assistants. In the event that Rogozov lost consciousness, he instructed his team how to inject him with drugs using the syringes he had prepared and how to provide artificial ventilation. Then he gave Artemev and Teplinsky a surgical wash himself, disinfected their hands, and put on their rubber gloves for them.

When the preparations were complete Rogozov scrubbed and positioned himself. He chose a semi-reclining position, with his right hip slightly elevated and the lower half of the body elevated at an angle of 30°. Then he disinfected and dressed the operating area. He anticipated needing to use his sense of touch to guide him and thus decided to work without gloves.

The operation

The operation began at 2 am local time. Rogozov first infiltrated the layers of abdominal wall with 20 ml of 0.5% procaine, using several injections. After 15 minutes he made a 10-12 cm incision. The visibility in the depth of the wound was

not ideal; sometimes he had to raise his head to obtain a better view or to use the mirror, but for the most part he worked by feel. After 30-40 minutes Rogozov started to take short breaks because of general weakness and vertigo. Finally he removed the severely affected appendix. He applied antibiotics in the peritoneal cavity and closed the wound. The operation itself lasted an hour and 45 minutes.^{1 2} Partway through, Gerbovich called in Yuri Vereshchagin to take photographs of the operation. Gerbovich wrote in his diary that night³:

“When Rogozov had made the incision and was manipulating his own innards as he removed the appendix, his intestine gurgled, which was highly unpleasant for us; it made one want to turn away, flee, not look—but I kept my head and stayed. Artemev and Teplinsky also held their places, although it later turned out they had both gone quite dizzy and were close to fainting . . . Rogozov himself was calm and focused on his work, but sweat was running down his face and he frequently asked Teplinsky to wipe his forehead . . . The operation ended at 4 am local time. By the end, Rogozov was very pale and obviously tired, but he finished everything off.”

After the operation

Afterwards Rogozov showed his assistants how to wash and put away the instruments and other materials. Once everything was complete, he took sleeping tablets and lay down for a rest. The next day his temperature was 38.1°C; he described his condition as “moderately poor” but overall he felt better. He continued taking antibiotics. After four days his excretory function came back to normal and signs of localised peritonitis disappeared. After five days his temperature was normal; after a week he removed the stitches.^{1 2} Within two weeks he was able to return to his normal duties and to his diary.

8 May 1961

“I didn’t permit myself to think about anything other than the task at hand. It was necessary to steel myself, steel myself firmly and grit my teeth. In the event that I lost consciousness, I’d given Sasha Artemev a syringe and shown him how to give me an injection. I chose a position half sitting. I explained to Zinovy Teplinsky how to hold the mirror. My poor assistants! At the last minute I looked over at them: they stood there in their surgical whites, whiter than white themselves. I was scared too. But when I picked up the needle with the novocaine and gave myself the first injection, somehow I automatically switched into operating mode, and from that point on I didn’t notice anything else.

“I worked without gloves. It was hard to see. The mirror helps, but it also hinders—after all, it’s showing things backwards. I work mainly by touch. The bleeding is quite heavy, but I take my time—I try to work surely. Opening the peritoneum, I injured the blind gut and had to sew it up. Suddenly it flashed through my mind: there are more injuries here and I didn’t notice

them . . . I grow weaker and weaker, my head starts to spin. Every 4-5 minutes I rest for 20-25 seconds. Finally, here it is, the cursed appendage! With horror I notice the dark stain at its base. That means just a day longer and it would have burst and . . .

"At the worst moment of removing the appendix I flagged: my heart seized up and noticeably slowed; my hands felt like rubber. Well, I thought, it's going to end badly. And all that was left was removing the appendix . . .

"And then I realised that, basically, I was already saved."

Leaving Antarctica

More than a year later the Novolazarevskaya team left Antarctica, and on 29 May 1962 their ship docked at Leningrad harbour. The next day Rogozov returned to his work at the clinic. Shortly thereafter he successfully defended his dissertation. He worked and taught in the Department of General Surgery of the First Leningrad Medical Institute. He never returned to the Antarctic and died in St Petersburg, as

Leningrad had by then become, on 21 September 2000.

The boundary of the humanly possible

There are some references to autoappendicectomies in the literature. The earliest one was possibly that performed by Dr Kane in 1921 (although the operation was completed by his assistants).^{4,5} We know that Rogozov had not heard about it before he performed his operation.

Rogozov's self operation was probably the first such successful act undertaken in the wilderness, out of hospital settings, with no possibility of outside help, and without any other medical professional around. It remains an example of determination and the human will for life. In later years Rogozov himself rejected all glorification of his deed. When thoughts like these were put to him, he usually answered with a smile and the words: "A job



like any other, a life like any other."⁶

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Prescriber's narcophobia syndrome: physicians' disease and patients' misfortune

Prescriber's narcophobia syndrome (PNS) is a professionally disabling neuropsychiatric malady. It strikes physicians who, as medical students, wished to alleviate suffering and improve patients' wellbeing.

Once afflicted, physicians become frustrated by patients in pain and treat them without compassion.

Physicians succumb to PNS early in practice and often for decades. However, brief remissions occur when treating a malpractice attorney, hospital administrator, or someone who reminds the physician of himself or herself. PNS is highly infectious, passed at the bedside from teachers to students.

Usually the victim of a physician with PNS projects obvious verbal and behavioural cues of severe pain. Hence PNS may reveal sadistic sociopathy of a physician wishing for the patient to suffer.

This explains forced discharge of patients with persistent pain and prescribing ineffective non-narcotic agents with poor side effect profiles. Alternatively, PNS may uncover a variant of autism in a doctor who is unable to perceive the patient's emotions or read behavioural cues.

Such doctors avoid eye contact with patients in pain and are hyperfocused on their diseases instead of how they feel. Alternatively, paranoid schizophrenia may explain physicians' bizarre thinking that every patient requesting effective pain relief is a

"drug seeker trying to get high." Supporting evidence includes physicians' delusional belief that not treating pain will cure the "addiction" caused by desire for pain relief.

The "modified" CAGE questionnaire¹

- Do you ask a colleague to Cut down on their narcotic prescribing?
- Do you become Angry when patients claim that narcotics work for their pain?
- Do you feel Guilt after writing a narcotic prescription?
- Do you avoid Eye contact with your patients in pain?

Answering Yes to ≥2 makes PNS more likely

Initiating prompt therapy for PNS stops the vicious cycle of oligoanalgesia and professional frustration. Educational literature shows the inadequacy of non-narcotic agents for treating severe pain and highlights the safety and efficacy of judicious narcotic use. Behavioural counsellors literally "hold your hand" while you write a prescription for oxycodone and point out increased patient satisfaction.

However, the traumatic approach works best. Begin by kicking the narcophobic physician in the shins to create a non-disabling, continuously painful disruption to daily function and enjoyment of life (the doctor's recent patients will gladly do this



How a kick in the shins could change a doctor's life....

part). Then, the physician is given his or her choice of non-narcotic analgesia to show its relative impotence. Finally, narcotics are administered, offering rapid relief. Consequent is a life altering realisation of how much good the physician may do for patients by a change of behaviour.

Remember the ethic of reciprocity, or "golden rule." One day, every physician will find himself or herself in enough pain to seek out another physician. How would you like that physician to approach your pain?

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