SURGERY-PHYSICS

Germ-Proofing Your Operation

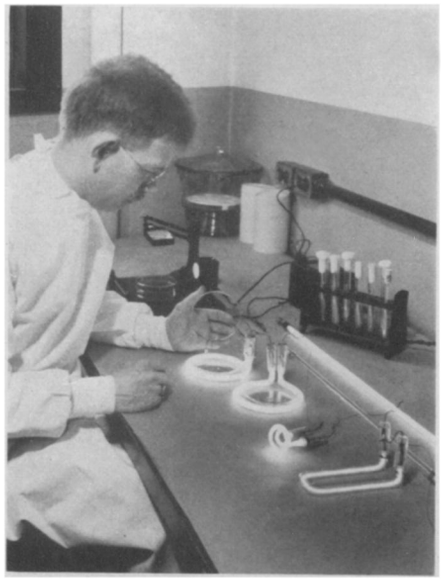
Barrage of Germ-Killing Rays Used To Destroy Any Bacteria That Might Lurk in Air of Operating Room

By JANE STAFFORD

NEXT TIME you have a surgical operation, it may be performed under a barrage of germ-killing rays that destroy the last possible chance of any infection setting in to threaten your life or even to delay your recovery.

The chances of such infection are mighty slim, anyway, with modern surgical technic: Everything which touches the wound and field of operation—instruments, sponges, surgeon's fingers—come germ-free, fresh from the sterilizers; in addition, the surgeon and all his assistants are gloved, robed and masked so that not even harmless organisms which may be present in nose and mouth and on the skin can get to the surgical wound.

Even with all these precautions, infections do occasionally occur after operations and Dr. Deryl Hart, surgeon-in-chief at Duke Hospital, Durham, N. C., believes these can be avoided and operations can be made safer by disinfecting the air above the operating table. His results since installation of the germ-killing ray machine at Duke Hospital seem to show that he is correct.



TO KILL GERMS

The germ-killing rays come from a tube developed by Dr. Robert F. James, research physician of the Westinghouse Lamp Company. The tube may be made in many different shapes, the one used by Dr. Hart being similar to the long slender one at the back of the table.

Ordinary air, as you know, contains countless numbers of bacteria or microorganisms—tiny one-celled creatures that cannot be seen without a microscope. The number and kinds of these organisms vary in different places. Some of them are comparatively harmless organisms, but the ones which can cause disease, familiarly known as "germs," are also present in the air to greater or less extent. Particularly common are the group known as staphylococci, commonly found in boils, abscesses and carbuncles. Generally speaking, these organisms do not harm a healthy person. All of us come in contact with thousands of them every day. Some varieties of staphylococci, however, can cause serious illness, and even the milder ones may be too much for a patient, weakened by the strain of a surgical operation, to stand.

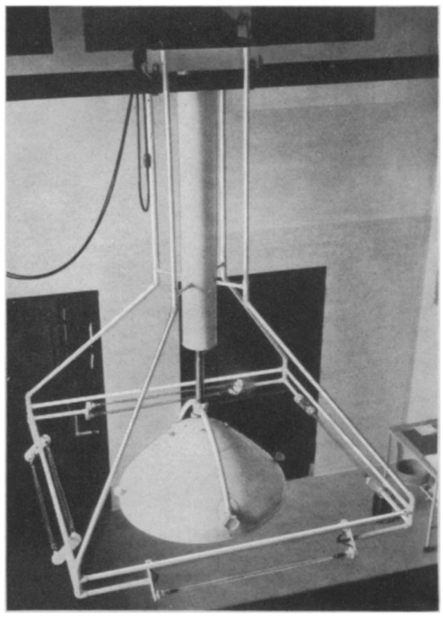
The air contains more of these germs —staphylococci and other varieties— when many people are together in a closed place such as a theater or church, breathing germs ever present in throats and noses into the atmosphere. That is why public health authorities advise avoiding crowds when an epidemic is loose in the community.

In Operating Room

Operating rooms, although they do not compare with a theater for crowds, do have a number of people in them in the course of a day. Dr. Hart points out that in large hospitals the operating rooms are in use the greater part of the day and a part of the night. With the modern trend for extensive surgical procedures, a larger operating personnel—internes, nurses, anesthetist and orderlies —is necessary. A number of visiting doctors may be present and also a class of medical students. When the room is occupied, there is considerable contamination of the air with disease-producing organisms, Dr. Hart says.

This problem of contamination of surgical wounds from germs in the air was first attacked by the great Lord Lister, the Father of Antiseptic Surgery which has become the aseptic surgery of today. When Lister started his career as surgeon in Scotland, in the middle of the nineteenth century, infected wounds were the rule rather than the exception. Pus was considered "laudable," the necessary first step in the healing of wounds. Erysipelas, septicemia (blood poisoning), hospital gangrene, and tetanus or lockjaw were rife in all the hospitals, and the maternity wards of hospitals were full of puerpural sepsis, the dreaded childbed fever.

The fatality for operations was terrific. According to one authority, half the patients operated on in hospitals died, even though the surgeons limited themselves to attempting to repair wounds, lancing boils, removing limbs and one or two minor operations. There was serious talk of burning all the hospitals, as this seemed the only way to get rid of the horrible gangrene, which caused such a stench in the wards that the windows had to be left open all the time.



HEALTHFUL BARRAGE

Specially designed tubes clustered around the lighting fixture in the operating room at Duke Hospital deliver a barrage of germ-killing ultraviolet rays into the air directly above the patient undergoing surgical operation. The operating table is not shown, but would stand beneath this light. (Picture from Modern Hospital.)

This was the period when Pasteur was at the beginning of his epoch-making discovery of the part played by bacteria in causing disease. Reading reports of Pasteur's early experiments on fermentation of wine gave Lister the idea for his first attack on hospital gangrene. Air came in contact with wounds, and if something in the air could cause fermentation of the grape juice, as Pasteur reported, perhaps it could also cause the putrefaction of human flesh which surgeons saw all around them.

Simple Fractures Heal

The idea was strengthened by the fact that simple fractures, in which the bone was broken but there was no flesh wound —and no contact of the bone with air— healed rapidly. The bone could be set and splinted and in time grew together again and the patient was as well as ever. If the broken ends of bone cut through the flesh, however, it was quite another story. In about half of these cases, inflammation set in, followed by pus, fever and death.

Lister determined to try to kill whatever it was in the air which caused inflammation and pus in wounds. When the next compound fracture case was brought to the operating room, he carefully painted the ends of the broken bone and the flesh surrounding it with carbolic acid. That was before the germ-killing properties of carbolic acid were known, but Lister had heard that carbolic acid was being successfully used in Carlisle to destroy the odor from the town's sewage system.

Tragic Disappointment

The first case was a tragic disappointment—the patient died in spite of the new treatment. Undaunted, Lister tried again, the second time with success. After a few such successes, Lister had carbolic acid sprayed into the air from what was called a "donkey engine" while he was operating. Dr. Hart's ray machine may be considered a scientific descendant of Lister's carbolic acid spray. The air above the operating table at Duke Hospital is, in manner of speaking, sprayed with rays that kill bacteria —harmful and otherwise.

The rays that do this job are ultraviolet rays, but not the ones that change ergosterol into rickets-preventing vitamin D. Unless you are a physicist, you probably never realized that there is a fairly large family of ultraviolet rays of varying wavelengths. The longest ones, the big brothers of the family, are particularly good for producing fluorescent effects and make possible the taking of photographs in the dark. Next come the group that can be used to cure or prevent rickets, and these are also the ones that give you your sun-tan.

The Germ-Killers

The babies of the family, rays from 2700 Angstrom units down, have the germ-killing effect but without sunburn blistering. These are the rays that sterilize the air for Dr. Hart's operations. The tube which delivers just these rays into the air was designed and constructed by the Westinghouse Lamp Company.

Eight such tubes, two on each side, are ranged about the lighting apparatus that hangs directly above the operating table. The effectiveness of the rays was first tested in the laboratory. A filtered suspension of staphylococci, the commonly found germs, was sprayed on a plate of culture medium and exposed to the rays at a distance of five feet. After sixty seconds, all the germs were dead. Plates sprayed with unfiltered suspensions, containing more of the germs, were exposed at the same distance and within five minutes all the germs had been destroyed.

Wounds in animals were next exposed to the rays for periods varying from half an hour to ninety minutes. No damage was apparent; in fact, healing seemed to be more rapid than in the control animals not exposed to the rays. This same favorable effect of producing more rapid healing of wounds was noted when Dr. Hart started operating on patients under the rays.

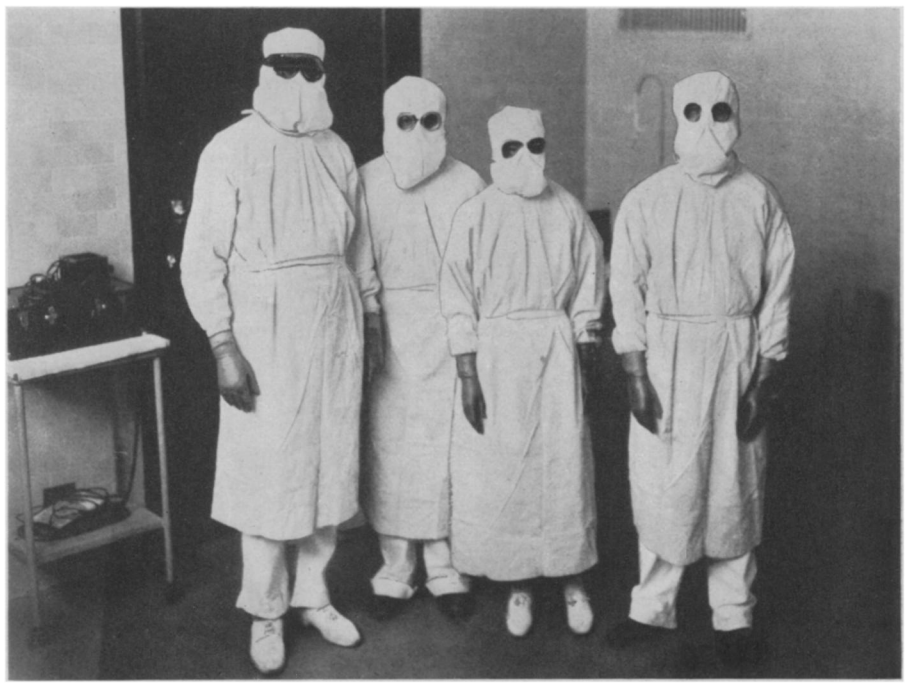
Plates of germ culture medium were exposed to the air during actual operations. When the tubes were not in use a goodly number of bacteria settled on the plates, showing that there were plenty in the air of the room. When the tubes were sending their barrage of germ-killing rays into the air, the plates showed that practically all the bacteria in the air about the operative wound, the supply and instrument tables were killed, although in the corners of the room, thirteen feet from the cluster of tubes, about 10 or 20 per cent of the bacteria escaped destruction.

Infections Disappear

"Operating room infections, which were fairly common before these tubes were installed, practically disappeared," he reported to Modern Hospital.

After the operation there was less rise in temperature, patients had less pain, their general condition improved rapidly, and their stay in the hospital was shortened.

While operating under the rays, Dr.



NOT KKK

Hoods of starched cloth and plain glass goggles are worn by Dr. Hart and assistants to protect themselves from the rays, which have some sunburning effect during long exposure. The rest of the regalia is part of the customary outfit worn by surgical "teams" as one of many measures to prevent germs getting into the patient's wound. (Picture from Modern Hospital.)

Hart and his assistants wear a get-up that looks not unlike the traditional costume of the Ku Klux Klan. This is because the rays do have some sunburning effect. Working within six to eighteen inches from the tubes for long periods of time, it is necessary to have some protection. This is afforded by a hood or helmet of starched cloth that covers head and neck completely and tucks under the operating gown. Their eyes are protected by goggles of plain glass which is impermeable to the radiation. All this is pretty warm and uncomfortable. Suction tubes placed beneath the goggles keep them clean, but a more comfortable and adequate form of protection is being developed.

The patient, of course, is not exposed to the rays for as long as the operating "team," members of which may work under the radiation all day, if there is a heavy schedule of operations. In addition, the patient is pretty well protected by the sheets which drape every part of him except the actual field of operation. This draping of the patient is an impressive part of the ritual of modern operations—a ritual developed and designed to prevent infection.

Boiled Towels

This, too, goes back to Lister and the days of the carbolic acid spray.

When Lister was trying to keep the germs of the air from getting into his patient's wound, he did not, at first, realize that he was introducing germs with his hands, instruments, sponges, and even the dressings applied at the end of the operation. He seems to have had a hunch about it, however. According to one account, at the second operation in which he used carbolic acid—the first from which the patient recovered—he demanded for the dressing of the wound the "cleanest towel in the house and told the Sister who helped him to *boil* it.

That boiling, which killed any germs on the towel, was a revolutionary step. It may have helped as much as the carbolic acid to keep the wound from infecting. Certainly it was the first step toward the aseptic surgical technic practiced today in every operating room in the world.

In the old days, hospital dressings were obtained from housewives who sent in their old linen. This was torn up and used without even washing before putting it on wounds. The sponges used inside the wound were ordinary sea sponges, used in one operation after another, with only an occasional washing with soap and water. The surgeon washed his hands after operating, never before. He wore his oldest coat, which gradually became coated with blood and pus. It was never cleaned, simply hung in the closet between operations. Needles and the wire or silk for sewing up the wounds were not sterilized. The very knives might have last been used in the dissecting room on a corpse and been plunged into the patient without even being washed in between.

Clean Hands

Lister changed all that. He and all his assistants washed their hands before an operation. They wore clean aprons. Instruments were washed and soaked in carbolic acid or boiled. Sponges were soaked in acid. A way to sterilize the silk for stitches was found.

Most surgeons thought he was crazy, laughed at his methods. As his success continued, and as the science of bacteriology grew and showed the soundness of his ideas, other surgeons began to adopt his methods, which were gradually improved and elaborated into the modern aseptic technic for operations.

This proceeds according to rigid rules. Before entering the operating room, the surgeon and all who assist him remove all outer garments and don clean, enveloping white gowns that have been sterilized. Head and hair are covered by caps or helmets, also sterilized, as are the masks that cover noses and mouths.

"Scrubbing"

The scrubbing of the hands is a ceremony in itself. Surgeon, internes and other doctors who assist him with the actual operation and the "clean" nurse who handles the sterilized instruments and threads needles all "scrub" for every operation. This means scrubbing the hands and arms up to the elbows with green soap and sterile brush for three minutes; cleaning the nails thoroughly with a sterile orange stick; and again scrubbing up to the elbows, with a second sterile brush and more green soap, for five minutes. The three- and five-minute periods are actually timed by a clock placed conveniently near the washbasin for the purpose. The faucets of this basin, incidentally, are operated by foot levers. The scrubbed hands must touch nothing that is not germ-free. After the scrubbing they are thrust into thin rubber gloves, plucked from the sterilizer and held out to the doctors and "clean" nurse by the "dirty" nurse, who never touches the gloves herself, handling them with forceps that stand with the business end in a solution of carbolic acid.

"Dirty"

The "dirty" nurse, of course, is not dirty in the usual sense, but she does not wear the gown, cap and mask and does not "scrub." Her job is to get extra supplies or instruments which may be needed.

There is a touch of romance behind the gloves. They were introduced into the ritual by that great American surgeon, Dr. William Stewart Halsted, first professor of surgery at the Johns Hopkins Medical School. The custom at that time was to operate with bare hands, immersing them after the scrubbing in a solution of carbolic acid. This strong acid was irritating to some skins, notably to the skin of Dr. Halsted's head operating room nurse, the lady who afterwards became Mrs. Halsted. The chief surgeon was much concerned over her hands. Because the carbolic acid was so irritating to them, the rubber gloves were introduced to take the place of the carbolic in cutting down danger of wound infection from the hands.

Draping

After he has scrubbed, the surgeon drapes the patient so that every part of his body is covered except the field of operation, which is shaved if necessary and scrubbed up with iodine and alcohol to kill any germs on the patient's skin. The draping is done first with towels and then with sheets, all of them sterilized and specially folded so that they can be draped with a minimum of handling. The "clean" nurse lifts them by the corners, held high above her head, so that the sheets fall open without touching anything. Then she turns and passes the corners to the surgeon.

As surgeons developed all these and many other precautions for keeping germs out of surgical wounds, they grew to ignore the danger of contamination from the air, Dr. Hart charges. Lister's carbolic acid spray was abandoned by its inventor, and no one since then has paid much attention to air-borne germs in operating rooms except to have the surgical "team" wear nose and mouth masks. Dr. Hart does not believe these are enough to keep dangerous germs out of the air. Surgeons elsewhere who have had few or no cases of operating room infections may, however, consider it unnecessary to install the ray tubes.

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