NEW INSTRUMENTS AND EQUIPMENT FOR CHEST SURGERY

V/O „MEDEXPORT"

SSSR MOSKVA

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By Prof. A. M. Geselewich and N. S. Gorkin

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INTRODUCTION

Operative chest surgery has of late been advancing at a high pace, acquiring ever new techniques and venturing on ever new indications. As a result, ever more stringent requirements have had to be met by surgical instruments and equipment.

This is particularly true of the past decade, when truly sweeping changes have taken place in the chest surgeon's armoury — it has expanded to include a large number of electrical units, the heart-lungs machine, and many other perfect pieces of surgical instrumentation.

A salient feature of the instrument-making industry in the Soviet Union is that new instruments, developed on a solid scientific and technological foundation, are tested in a series of surgical experiments before they are handed over for use at clinics.

For this purpose the Research Institute of Experimental Surgical Equipment and Instruments * has a special department. This is among the country's largest departments engaged in experimental surgery, investigating the topographical anatomy of the operational wound in the anatomic theatre and defining the specifications of the desired equipment and instruments for design engineers in the course of experiments or in a clinic. The department also carries out experiments on animals with a view of testing the quality of prototypes. The objectives of such experiments are to see that a new instrument operates faultlessly, that the organism responds properly to the action of the instrument on the tissues, and there are no complications, either immediate or remote.

The experimental facilities of the NIIEHAI include two operating rooms, a vivarium with 150 enclosures for animals, and four laboratories: clinical-diagnostical (incorporating an important hematology group), biochemical, physiological, and pathomorphological. The Institute also has a surgical clinic of its own.

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* Further referred to as NIIEHAI (the Russian abbreviation).

staffed by highly qualified surgeons. Their opinion of the new instruments being tested is supplemented by the opinion of the leading authorities in the science of surgery, who test the new instruments at many other surgical clinics throughout the Soviet Union.

New instruments are tested for functional compatibility, convenient handling, clinical efficiency, and the nature of the regenerative processes they stimulate in the wound area.

For example, the sutures applied to bronchial stumps should be hermetical, as should those applied to the arterial duct. A poorly sealed suture in the former case may give rise to primary bronchial fistulas (i. e. those developing immediately after an operation) or secondary fistulas (appearing some time later). In the latter case, hemorrhage may follow if the duct was dissected after the application of two sutures, or the duct may be re-channelled if the surgeon used a technique avoiding dissection.

New instruments are handed over for production and use only after pathomorphologists have proved that the edges of the sutured wound heal quickly as well, there are no thrombi forming in the blood vessels operated upon, the area around the operational wound is free from commissurae.

For control of the quality of instruments test experiments depend upon both hystological and other methods, especially roentgenography, with X-ray pictures taken both immediately after an operation and in the post-operation period.

Pathomorphological, physiological and biochemical methods of control are indispensable in testing instruments for the application of epineural sutures on the trunks of peripheral nerves, "electric sleep" apparatus, equipment for the preservation of isolated organs prior to transplantation, heart-lungs machines, artificial kidneys, appliances for the establishment of anastomosis between the vena cava and the pulmonary artery resorted to in the case of congenital defects of the heart, suture forceps for alloplastic, homoplastic, and transplastic grafting on blood vessels, etc.

The quality of the design of an instrument is usually put to test in acute and chronic cases. In experiments involving chronic cases, operated dogs have been kept in that condition for a year or longer.

The last stage in the sequence of tests for new instruments and apparatus is **the actual use in clinics** and the opinion of practising surgeons, supplemented by **clinical data** based on the analysis of post-operational observations carried out on large groups of patients for a long time after an operation has been performed with a new instrument (for example, after operations for aneurysms by the aid of mechanical sutures).

Simple instruments, such as forceps, needleholders, etc., are tested on isolated dead organs in the anatomic theatre and in operations on animals. This procedure is followed in, say, the case of forceps used in pneumonectomy, haemostatic forceps, and lung-

stump forceps, when it is essential to know whether these instruments may cause injury to the tissues and whether they are strong enough to stand rough handling. In the case of operations on the lungs, macromorphological control, has, of necessity, to be supplemented by histological investigations. The latter are very helpful in choosing the adequate thickness of metal, deflection, etc., sometimes leading to appreciable changes in the original design of an instrument.

The instruments and equipment covered by this publication have been tested by the NIIEHAI and leading surgeons at some other clinics in the Soviet Union and have shown good performance. Currently they are manufactured by Soviet medical instrument-making enterprises.

It should be noted that between 1957 and 1960 the instruments developed by the NIIEHAI were awarded honorary diplomas by the Soviet Economic Exhibition, and a large number of the designers — both engineers and physicians — received the Exhibition's medals.

At the World Fair in Brussels in 1958, Soviet suture appliances won an honorary diploma.

The apparatus for lung surgery are covered by French patents No. 1237035 of October 6, 1959 and No. 1239153 of October 27, 1959.

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All existing instruments and apparatus for chest surgery may be classed into the following groups:

1. Original equipment, which did not exist before, such as the suture appliances developed by the NIIEHAI, heart-lungs machines, infundibulectomes, etc.

2. Some new models based on the principles already used in old instruments, such as valvulotomes with extendable blades, designed along the lines of old instruments for internal urethrotomy or oesophagotomy.

3. Instruments common to other branches of surgery, such as scalpels, modified long raspatories, instruments providing access to the organs to be operated upon, such as guillotine rib-cutting forceps.

Sets of instruments for operations on the organs of the posterior mediastinum include those for operations on the aorta. In operations on the thoracic portion of the oesophagus use is usually made of the sets employed in abdominal surgery and chest-surgery sets which are essential in transthoractomy.

The instruments which may be recommended for operations on the oesophagus through the abdomen include the Savinykh set, a set of instruments forming passages for the small intestine in

oesophagoplasty by the Yudin method, and forceps for the oesophagus. *

Instruments and apparatus for chest surgery have been devised and developed by a large number of people both in the Soviet Union and abroad.

This Publication only deals with Soviet-made instruments specifically designed for chest surgery, and entirely omits any other **apparatus**, except for suture appliances which are classed, according to Soviet usage, under the heading of instruments.

For the most part instruments for chest surgery have been developed by the NIIEHAI. For this reason, the Catalogue is mainly based on the Institute's instruments handed over for production between 1954 and 1960 inclusive.

Besides, it includes some other instruments developed at different times by other medical establishments in the Soviet Union and used at clinics.

This edition describes but briefly the design of an instrument or apparatus and illustrates some component parts, suggests techniques and procedures for their use, and lists some of their technical data.

In some cases it has been impossible to identify the inventor of an instrument. Therefore, such instruments are named by the function they perform (for example, 'Forceps for Auricle', 'Valvulotome with Two Parallel Blades', etc.).

* This Catalogue does not include diagnostic apparatus for intrathoracic operations, such as thoracoscopes, oesophagoscopes, electrocardiographs, oxyhemometers, etc., and special-purpose instruments and suture appliances for vascular surgery.

Chapter 1. GENERAL REVIEW OF INSTRUMENTS AND SETS FOR CHEST SURGERY

INSTRUMENTS

The term 'chest surgery' covers operations on the lungs, the pleura, the anterior mediastinum (the heart and the cardiac blood vessels) and the posterior mediastinum (the thoracic portion of the oesophagus and the thoracic aorta).

Surgical operations on the surface tissues of the chest, the lacteal gland and the skeleton of the chest are outside the competence of major chest surgery, as they call for no special instruments.

To sum up, this Publication only presents special-purpose instruments for major surgery on the organs in the pleural cavities and in the mediastina (excepting the oesophagus).

The instruments, both simple and complex, for major chest surgery are designed for:

1) general and local anaesthesia;
2) artificial blood circulation and hypothermia;
3) prevention and control of shocks, blood losses and terminal conditions; *
4) separation of soft tissues and cutting bones;
5) clamping of tissues and retraction of wound edges;
6) prevention and control of hemorrhage;
7) blood aspiration and fluid injection;
8) suturing;
9) special applications.

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* Instruments for general and local anaesthesia, artificial blood circulation, hypothermy, prevention and control of shocks, blood losses and terminal conditions (Groups 1, 2 and 3 of our list) are omitted in the book.

Tissue and Bone Cutting Instruments

This category of instruments include bellied and pointed scalpels; pointed straight scissors; blunt scissors curved on flat, 250 *mm* long; Faraboeuf straight rib raspatories; Antelava double-bent first-rib raspatories (left- and right-handed); first-rib guillotine forceps, universal curved-blade; osteotomes and sternotomes; Gigli saws; combination knife-raspatories for the removal of bronchial cartilage, etc.

Many of the instruments under this heading are conventional types employed in general surgery.

Clamping and Retracting Instruments

This vast group of instruments embraces relatively simple devices, such as retractors, elevators, forceps, clamps, dissectors, specula and hooks. They are described but briefly.

Among the organ- and tissue-holding forceps included in the sets covered by the Catalogue are fenestrated forceps for the lung, for the auricle, and for the pleura. Besides, this group includes a large number of various bronchial clamps, hemostatic forceps, etc.

Many of the operations carried out by the chest surgeon are on blood vessels: on the open arterial duct, vascular anastomosis accompanying congenital defects of the heart, temporal closure of the blood vessels when an operation on the "drained" heart has to be made, etc. Therefore, a whole set of instruments for vascular surgery are also included here, such as dissectors, vascular scissors, hemostatic clamps, etc.

The category of tissue- and organ-holding and retracting instruments mainly covers novel models developed both in the Soviet Union and abroad in recent years to meet the needs of the chest surgeon.

Hemostatic Instruments

This category includes tourniquets and various hemostatic forceps and clamps.

Soviet surgeons mostly rely on Belmont—Rummel flexible tourniquets, 270-*mm* hemostatic forceps, double-curved forceps, twin forceps for the partial side compression of blood vessels (including left- and right-handed with three branches, Dogliotti—Vishnevsky types), similar forceps featuring twin branches. Less common are Blalock screw-type hemostatic forceps and Potts fenestrated vascular forceps in sets of six.

Instruments for the side closure of the aorta include a large fenestrated forceps, a bulldog forceps with blades 70 *mm* long, and some other.

Major blood vessels are usually separated by means of dissectors, and are held by means of fenestrated forceps. Besides, the sets include soft serrated clamps (of the 'dog' and 'bulldog' types).

To stop hemmorhage in a deep operational wound, use is made of straight and curved hemostatic forceps 220 *mm* long for ligations. They are convenient in that the ligature can easily slip off the tip of the forceps. With any type of ligating forceps, ligatures are applied by the aid of straight and curved ligature forks on wire probe forks.

Further progress in operations for the aneurysms of the heart and aorta has necessitated the inclusion in the chest surgeon's set of special instruments for compression of ampullary aneurysms and for ligating the neck of an aneurysm. To this end, the sets include three sizes of Bakulev frame forceps and Price—Thomas, Rummel—Morse needle clamps.

Aspirating and Injecting Instruments

This category includes electric aspirators complete with assorted tubings, trocars with three-way cocks, an obturator and assorted needles, and some other.

The instruments in this category have made a good showing in practical surgery.

They are included in the equipment of both surgical and therapeutical departments of clinics and hospitals.

Suturing Instruments

This category covers novel and original types developed for the first time in the USSR and widely tested in operations on the lungs, the heart and major vessels. Currently, a large number of suturing appliances are being used. They will be described in detail in Chapter 3 (Suture Applicators).

Special-Purpose Instruments

The special-purpose instruments employed in lung and heart surgery widely vary from technique to technique.

Instruments for lung surgery are not very numerous and include extractors for pleuroectomy, while those for heart surgery are numerous and include commissurotomes, valvulotomes, infundibulectomes, dilators, scarificators, etc.

Sets

In the Soviet Union instruments for chest surgery are available both in separate pieces and in complete sets devised to meet the needs of the practising surgeon and on consulting him.

Two lines of sets are available for chest surgery:

1. Instruments for lung surgery (operations on the lungs and the pleura), as shown in Figs. 1 and 2. *

2. Instruments for heart surgery (operations on the heart, major blood vessels, the pericardium, the cardiac cavities), as shown in Figs. 3 and 4. *

These sets only include special-purpose instruments for chest surgery and must be supplemented by instruments for general surgery.

The sets do not include the following items which must be ordered separately:

Suturing appliances for bronchial stumps, lung root, the auricle, the arterial (Botallo's) duct the sternum and ribs, thoracoscopes, electric cautery appliances, instruments for suturing blood vessels, and for operations on the oesophagus.

The instruments included in the sets are listed in Tables 1 and 2.

Table 1

SETS OF INSTRUMENTS FOR LUNG SURGERY

Cat. No.	Ord. No.	Item	Quantity per set
—	1	Retractor, ratchet-action, large, for chest wounds	1
—	2	Same, medium	1
05—177	3	Raspatory, first-rib	1
05—313	4	Retractor, shoulder-blade	1
05—216	5	Forceps, cutting, first-rib	1
05—215	6	Forceps, rib-cutting, universal, curved-blade	1
05—21	7	Scissors, blunt-pointed, curved, 25 *cm*	1
05—157	8	Fork, curved, for bringing ligature down onto blood vessels	1
05—158	9	Fork, probing, for bringing ligature down onto blood vessels	1
05—289	10	Retractor, heart, large	1
05—291	11	Retractor, heart, wire-type	1
—	12	Forceps, bronchial, three sizes	3
—	13	Dissector-forceps, curved, for blood vessels, four sizes (25, 16, 15, 13)	1 each
05—41	14	Dissector and spatula	1
05—334	15	Forceps for wedge-type pneumonectomy, straight and curved	2 each

* Figs. 1, 2, 3, 4 are applied at the end of the book.

Continued

Cat. No.	Ord. No.	Item	Quantity per set
	16	Cock, three-way, for pleuroaspirator	2
	17	Needles, for pleuroaspirator, in two sets of five	10
—	18	Needle for bronchial biopsy	1
04–18	19	Needle, Bogush's, for intrathoracic anaesthesia	1
—	20	Curette, for bronchial biopsy, straight and curved	1 each
05–10	21	Knife, with raspatory, for removal of bronchial cartilage	1
05–262	22	Forceps, operating, 25 *cm*	2
05–270	23	Forceps, dissecting, 25 *cm*	2
05–335	24	Forceps, lung, straight	3
05–335	25	Forceps, lung, curved	1
—	26	Forceps, pleura-holding	1
05–42	27	Forceps, tissue, straight	1
05–43	28	Forceps, tissue, curved	1
—	29	Clamp for kidney leg	2
—	30	Needle, hypodermic, curved	10
05–11	31	Spatula, tissue	1
05–159	32	Tourniquet, flexible	1
—	33	Tubing, rubber, soft	2 metres

Table 2

SET OF INSTRUMENTS FOR OPERATIONS ON THE HEART AND MAJOR BLOOD VESSELS

Cat. No.	Ord. No.	Item	Quantity per set
—	1	Retractor, chest-wound ratchet-action, large	1
—	2	Same, medium	1
05–190	3	Osteotome for the sternum	1
05–191	4	Sternotome	1
05–21	5	Scissors, blunt-pointed, curved, 25 *cm*	1
05–35	6	Valvulotome, with two rhomboid blades	1
—	7	Valvulotome, with two bicupsid blades	1
05–36	8	Valvulotome, with two parallel blades *	1
—	9	Nibbler, semi-circular, two sizes	1 each

* Currently these instruments are made with improved handles.

Continued

Cat. No.	Ord. No.	Item	Quantity per set
—	10	Nibbler, circular, two sizes	1 each
—	11	Cord, rubber, 1 *mm* square	2 metres
05—149	12	Forceps, for auricular appendage, set of three: large, straight; medium, curved; small, curved	1 each
—	13	Clamp, needle, for wounds and aneurysms of the heart	1
05—139	14	Forceps, for partial side compression of blood vessels, right and left	1 each
—	15	Forceps, frame-type, for aneurysms of the aorta and heart, set of three	1 each
05—289	16	Retractor, heart, large	1
05—290	17	Same, small	1
—	18	Dissector, forceps, curved, for blood vessels, four sizes (25, 16, 15, 13)	1 each
—	19	Dissector, forceps, straight, with handle, for blood vessels	1
—	20	Needle for heart puncture	1
04—5	21	Needle, hypodermic, bulb-guard	1
05—34	22	Commissurotome, finger-nail, three sizes	1 each
—	23	Commissurotome, guillotine, small, narrow, left and right	1 each
—	24	Needle, hypodermic, curved	10
05—31 05—32	25	Commissurotome, guillotine, large, broad, left and right	1 each
05 - 309	26	Retractor, heart, flexible, double-ended	2
05—11	27	Spatula, tissue	1
05—24 05—26 05—27 05—28	28	Scissors, for blood vessels, straight, curved on edge, curved on flat, curved on radius	1 each
05—262	29	Forceps, operating, 25 *cm*	2
05—270	30	Forceps, dissecting, 25 *cm*	2
05—30	31	Scarificator, heart	1
—	32	Tubing, rubber, soft	2 metres
05 - 159	33	Tourniquet, flexible	2
05 - 237	34	Spatula, bayonet and curved	1 each

Continued

Cat. No.	Ord. No.	Item	Quantity per set
—	35	Forceps, for auricle	1
—	36	Retractor, heart, wire-type	1
05–37	37	Dilator, for heart strictures, two-bladed	1
—	38	Adapter, probing, for measurement of pressure in the heart	2
05–158	39	Fork, probe, for placing ligature	1
05–157	40	Fork, ligature, curved	1

As can be seen from the above lists, both sets only include special-purpose instruments. The sets are regularly revised, the obsolete models are excluded, as are those which have gained usage in other branches of surgery, and new models, approved by practising surgeons, are added.

Note:

The ordinal numbers in the second column, Tables 1 and 2, correspond to the numerals in Figs. 1, 2, 3 and 4 (sets of instruments).

Chapter 2. INSTRUMENTS FOR THORACOSTOMY

As instruments for thoracostomy are, more or less, identical in both operations on the lungs and the heart, it seems advisable to briefly describe instruments for lung and heart surgery, leaving out well-known general-surgery instruments, such as bone-cutting forceps, rib shears, etc.

STERNO-OSTEOTOME

The sterno-osteotome serves to cut through the breast-bone to provide access to the organs in the anterior mediastinum (such as in operations for adhesive pericarditis). Some surgeons resort to Gigli or Olivercrona saws in such cases. The sterno-osteotome seems more convenient and less injurious. Still, it is a good policy to protect the adjacent tissues by means of a protecting spatula (see Fig. 6).

The sterno-osteotome (Fig. 5 a) resembles the Loeb knife. It is an all-forged instrument terminating in a blunt hooked beak changing into a sharp blade at a right angle to the body. It measures 165 *mm* long and tips the scales at about 75 grams.

The beak protects the adjacent tissues from damage when the instrument is led in and during the operation.

The back of the instrument has a longitudinal flat projection at which the surgeon strikes with a surgical mallet in cutting through the sternum.

To cut through the sternum, insert the beak of the sterno-osteotome into the hollow above the sternal notch, pull at the grip of the instrument, and keep striking at it with a mallet, while following the centre line, as low as the manubrium.

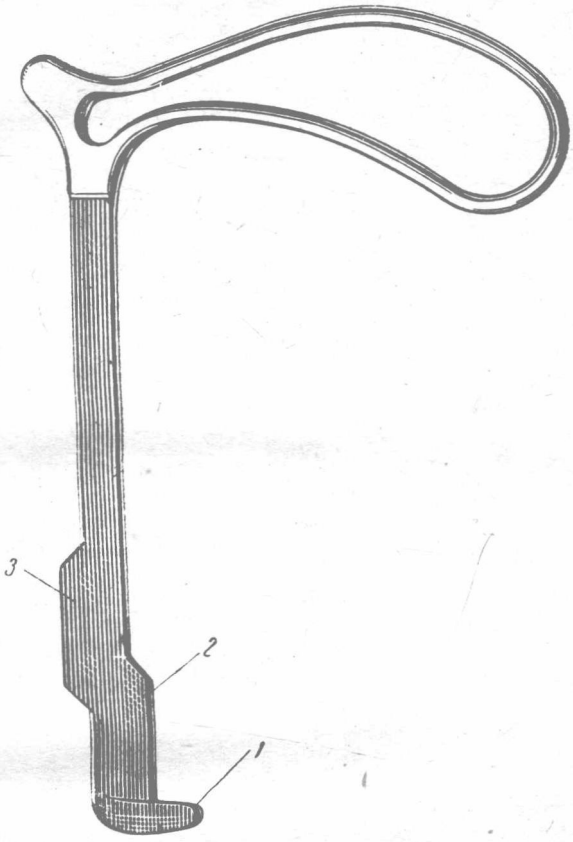

Fig. 5 a. Sterno-Osteotome
1 — beak; *2* — blade; *3* — flat

STERNOTOME

This is a Liston — Key — Schumaher sternotome employed to cut through the sternum both transversally and longitudinally so as to obtain free access to the organs in the mediastinum and the pleural cavities. The instrument is essentially a bone forceps (Fig. 5 b) with a blade moving along the body and with a stationary support having a narrow slit to receive the moving blade at the end of a cutting stroke. The grips are brought together with two hands, which provides for the instantaneous incision of the bone.

Apart from the body, the moving blade and two grips, the sternotome consists of two flat springs, a lever action, an insert and a screw.