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# GUIDE FOR PRACTICAL SKILLS IN GENERAL SURGERY

Chișinău, 2022

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Department of General Surgery and Semiology no.3

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# **GUIDE FOR PRACTICAL SKILLS IN GENERAL SURGERY**

for the 3rd-year students, Faculty of Medicine no.2

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## FOREWORD

It is known that the name of medical specialty “surgery” comes from two Greek words: “hand” and “work”. From the moment of its inception to the present day, surgery has been and remains to a large extent a “handicraft”, which fundamentally distinguishes it from other fields of medicine. Undoubtedly, a modern surgeon is not only a “master virtuoso”, but also a comprehensively developed specialist with deep theoretical knowledge in fundamental medicine, a broad clinical outlook, the ability to interpret the results of various imaging studies and laboratory tests, and optimally combine the possibilities of conservative and surgical treatment. Nevertheless, the manual skills of the surgeon, the quality of performing simple and complex procedures and manipulations necessary for the treatment of the patient, are still one of the main indicators of his professionalism.

Mastering surgery is a difficult and long-term task, starting from student years, continuing in residency, clinical residency, professional specializations, and fellowship and, perhaps, never ends. During all these years, the accumulation of new theoretical knowledge must necessarily be combined with the development and improvement of the necessary practical skills. Without this, it is impossible to imagine the work of any doctor, and even more so a specialist in a surgical profile.

For the first time, students of a medical University enter a surgical clinic in their third year, studying the basics of general surgery and the technique of clinical examination of surgical patients for a year. During this time, future doctors need not only to master a large amount of theoretical knowledge, but also to learn how to perform basic surgical procedures: bandaging various parts of the body, applying and removing sutures, performing injections, installing tubes, catheters and much more.

For the successful implementation of this task, we have compiled this guide, which briefly and step by step describes the technique of the appropriate manipulations. We have tried to accompany the description with a large number of illustrations designed to facilitate the assimilation of the presented material.

The manual is intended for use by third-year students of the Faculty of Medicine in practical classes in general surgery, and is also recommended for preparing for a practical exam in this discipline. It should be noted that the three sections of the manual: “Surgical Instruments, sutures and knots”, “Dressing and bandaging”, “Minor invasive surgical manipulations” correspond to the three stages of the practical skills exam. We also expect that this manual will be of great help to students during their summer nursing and medical practice.

**Authors**

# I. SURGICAL INSTRUMENTS, SUTURES AND KNOTS

## SURGICAL INSTRUMENTS

**Surgical instruments** are very varied and comprise numerous types of objects used directly for surgery. There is a common instrumentation, completed by a number of other special tools needed for surgical interventions in various fields of surgery (cardiac surgery, orthopedics, neurosurgery, etc). The advent of minimally invasive surgery, such as laparoscopic, thoracoscopic, arthroscopic, has led to the creation of special instruments handled outside the patient's body and reaching the working chamber through trocars.

Conventional surgical instruments are made of durable materials, usually stainless steel, which provides elasticity, resistance to prolonged use, making them easy to clean and sterilize. Instrumentation must be simple, easy to handle, and must provide safety in use. The size and shape of the instruments are specially designed for surgical approach, operated area or organ. Instruments for superficial tissue surgery or microsurgery are usually have a small length (about 10 cm), while instruments for use in deeper body cavities or in laparoscopic surgery are longer.

According to generally accepted classification, surgical instruments are **divided into the following groups:**

- (1) For dissection of tissues,
- (2) For hemostasis,
- (3) For grasping of tissues,
- (4) Retractors and dilators,
- (5) For suture of tissues,
- (6) For exploration,
- (7) Different and special instruments, and
- (8) Laparoscopic (thoracoscopic, arthroscopic, endovascular, etc.) instruments.



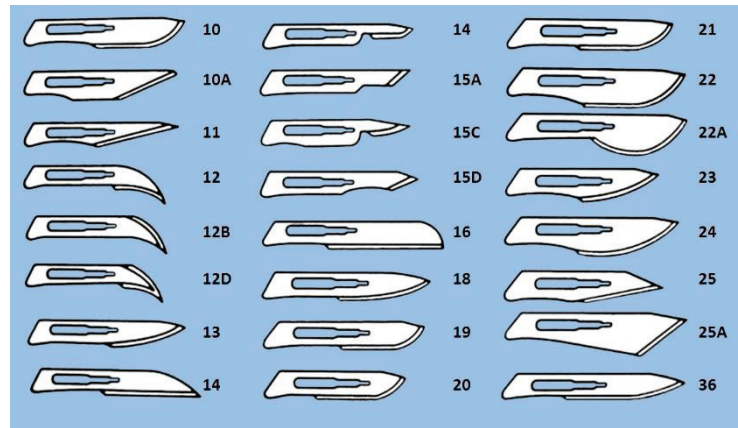
**Fig.1.** Surgical scalpels: A. Conventional scalpel, in which the handle and blade are unit in a common body; B.-C. Modern scalpels with a disposable and replaceable blade attached to a reusable handle; D. Completely disposable scalpel with plastic handle.

**Instruments for dissection of tissues** are represented by the scalpels and scissors. Scalpel is a small and extremely sharp instrument used for surgery and anatomical dissection. Scalpel consists of a handle and a blade, which in conventional scalpels are unit in a common body, or blade is a single use and disposable, and attached to the handle using special locking mechanisms (Fig.1).

Disposable blades for scalpels are produced and sterilized in factory, and released into the hospitals in sterile sealed envelopes (Fig.2). Various types of blades by shape and size are labeled with specific number. Commonly, semioval flat blades are used for skin incision, and for other tissues are used small pointed or bent blades (Fig.3).

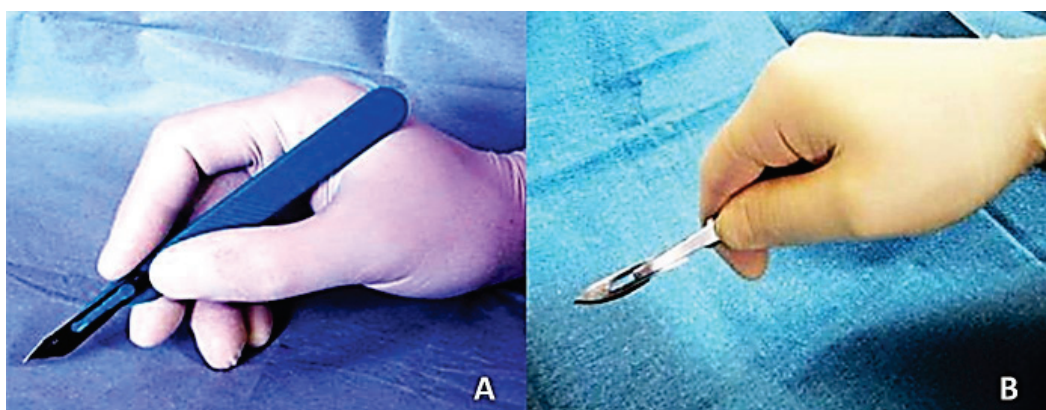


**Fig.2.** Envelopes with sterile disposable scalpel blades.



**Fig.3.** Classification of replacement blades, in which a specific number indicates the certain shape and size of the blade.

As a rule, when making a tissue incision the scalpel should be held as a pen for writing. In this case, the direction, length and depth of produced cut can be controlled in the best way. Sometimes should to press additional with index finger on the handle of scalpel in order to create a higher pressure on the blade during cutting in particularly firm tissues (Fig.4).



**Fig.4.** Holding the scalpel while performing incision: A. Correct; B. Wrong.

Surgical scissors may have different length and shape (Fig.5). Scissors length varies between 10 and 35 cm, scissors with shorter and thicker blades are used for tissue dissection, thick-walled organs or sutures. Fine curve scissors are used in deep tissue dissection. In vascular surgery fine scissors of different shapes are used.



**Fig.5.** Surgical scissors: A. Scissors vary in length, thickness and shape; B. Straight and curved scissor blades.

However, during some general surgical and, in particular, orthopedic operations, it becomes necessary to dissect bone structures and tissues. Currently, electric saws of various shapes and sizes are mainly applied for this purpose. But also hand tools are often used. For example, an amputation knife, Gigli wire saw and various osteotomes are used as cutting tools for amputations (Fig.6).



**Fig.6.** Gigli hand saw, consisting of a cutting wire and two handles.

**Instruments for hemostasis.** Various types of forceps (clamps) adapted to operated region, depth of surgical field and vessel size are used for intraoperative hemostasis (Fig.7). The general meaning of using hemostatic forceps during surgery is that they are applied to a bleeding vessel and stop the hemorrhage temporarily. At the same time, the clamp remains closed, which frees the hands of the surgeon and assistant for other manipulations.

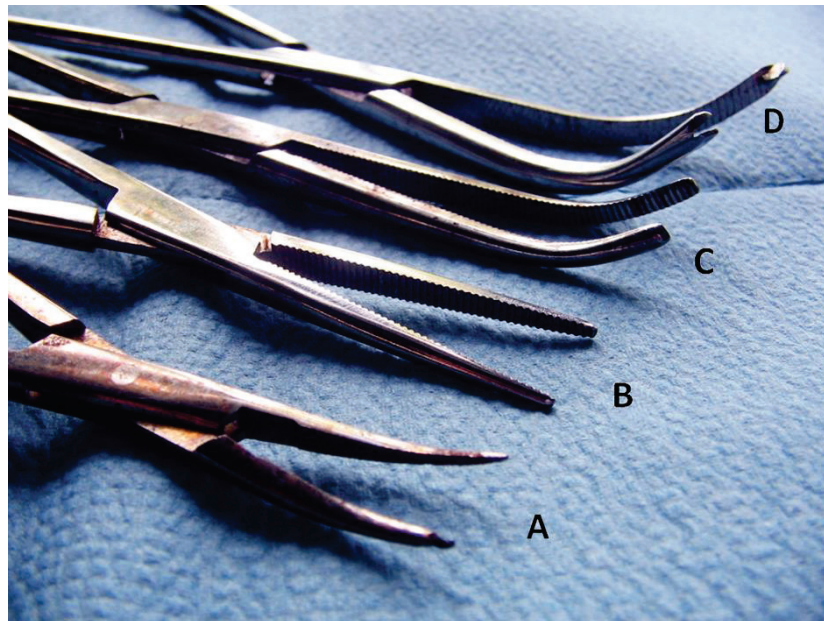




**Fig.7.** Hemostatic clamps of various lengths.

The main types of clamps used in general surgery are (Fig.8):

- Pean clamps – with the active arms curved or straight, have no teeth at the top,
- Kocher clamps – the same form, but with top teeth,
- “Mosquito” clamps – is a fine clamp, with thin jaws for use in vascular and endocrine surgery.



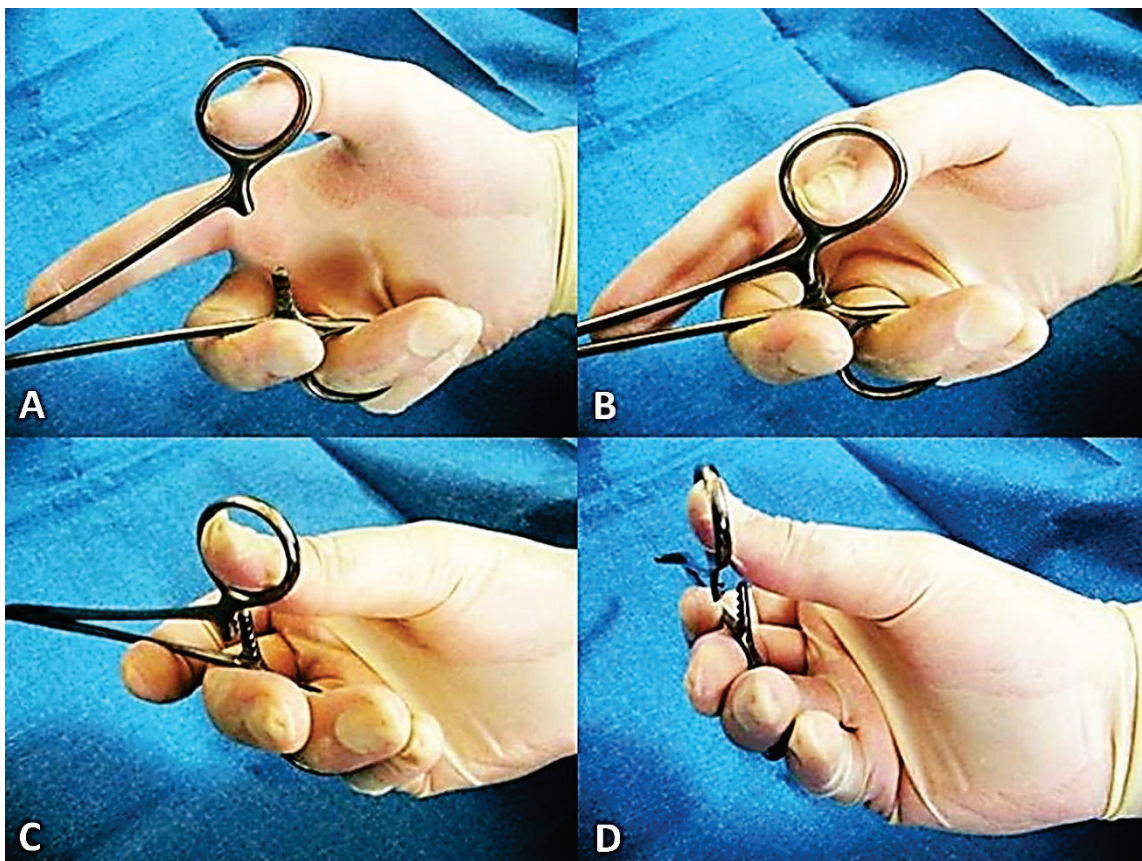
**Fig.8.** Differences of hemostatic clamps in shape and structure: A. Thin “mosquito” clamp; B. Direct Pean clamp; C. Pean clamp with curved jaws; D. Kocher forceps with curved jaws and teeth at the top.

From the inside of the arms is situated a locking system, rack type, composed of 2-7 teeth (Fig.9). The number of teeth depends on the requirements for clamping safety. For example, the forceps for fixing the surgical drape around the wound has only 2 teeth, while the aortic clamp for temporary closing of aorta has 7 teeth.



**Fig.9.** The rack type locking mechanism of surgical clamp, located from inside of the arms.

Forceps are locked automatically by simple pressure on both arms of instrument (Fig.10). In order to open forceps, the arms should be lightly shift outward one from another to unlock the teeth, and the clamp can be easily opened.



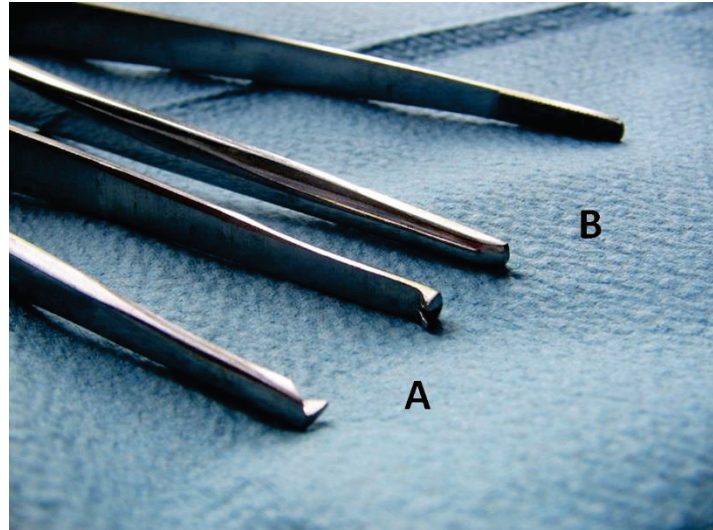
**Fig.10.** Closing and opening surgical forceps: A.-B. The clamp is closed by simply bringing the arms of instrument together; C.-D. The clamp opens with a slight outward displacement of one arm in relation to the other.

**Instruments for grasping of tissues.** For grasping of tissue using anatomy (soft) forceps (pincettes) of different length depending on the depth of operator field (Fig.11). The pincettes do not have a locking mechanism, which determine their exclusively manual handling during

the operation. Anatomical pincettes are used for clamping soft tissues: the walls of the stomach, intestines or blood vessels. Free ends of surgical forceps (pincettes) are terminated with teeth, providing a strong grasping, and used to capture and presentation of resistant tissues (skin, fascia) (Fig.12).

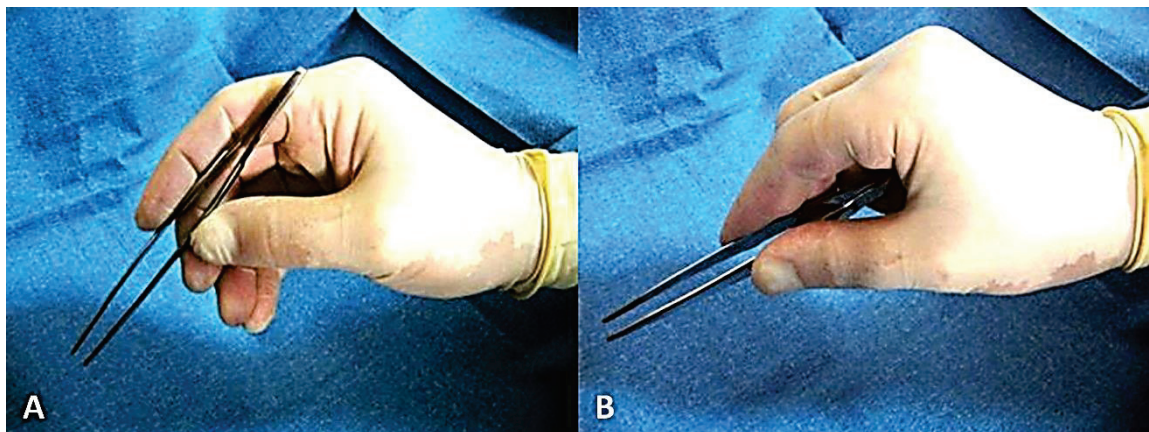


**Fig.11.** Pincettes are available in various lengths and shapes, and do not have locking mechanism.



**Fig.12.** The main types of forceps (pincettes) used in surgery: A. Surgical forceps, with teeth at the end of working jaws; B. Anatomical forceps.

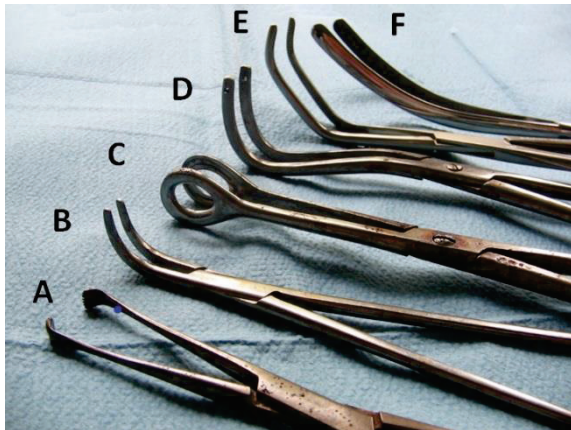
Forceps (pincettes) should also be held like a writing pen, varying degree of compression in function on the density and mobility of the tissue being held (Fig.13).



**Fig.13.** Handling the forceps (pincettes) during surgery: A. Correct; B. Wrong.

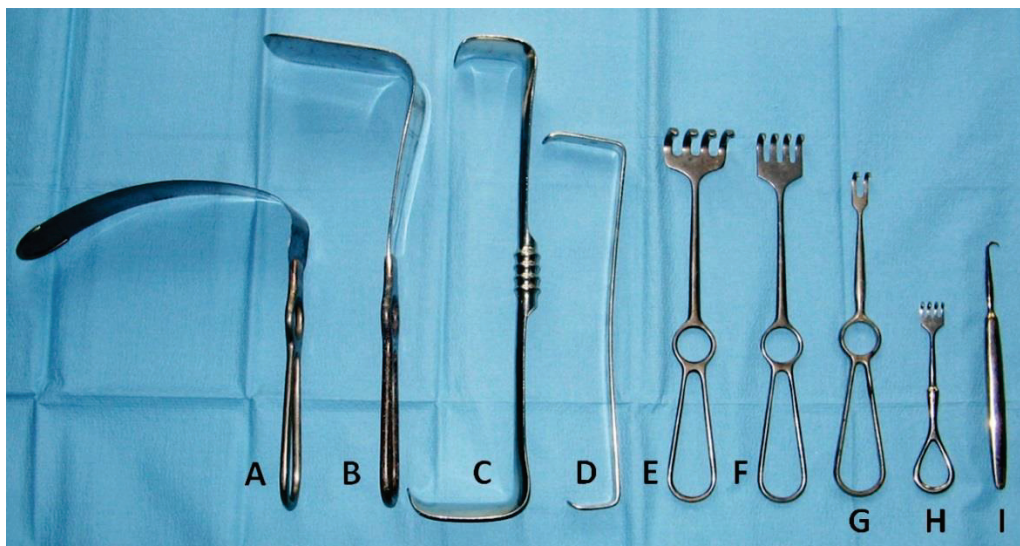
In addition, a number of clamps are used for holding, equipped with a ratchet and designed to grasp certain organs or tissues (Fig.14). So, intestinal Allis clamps have small fine teeth, which do not penetrate the bowel wall. Dissector with curved tips – for holding delicate, usually vascular structures deep in the wound. The Luer clamp or “fenestrated” clamp is designed to grip a hollow (stomach) or parenchymal (liver) organ, ensuring its tight compression, but without crushing the tissues. Satinsky’s atraumatic vascular forceps has long elastic, double curved jaws, and is used to hold and laterally clamp large vessels. Intestinal

clamp is used to hold the bowel loop during anastomosis performing, including to prevent leakage of intestinal contents.



**Fig.14.** Instruments for holding tissues of a certain type: A. Allis intestinal forceps; B. Vascular dissector; C. "fenestrated" Luer clamp; D. Fedorov forceps; E. Satinsky's aortic forceps; F. Intestinal clamp.

**Retractors and dilators** are required to remove the wound edges, tissues or organs from the surgical field. Retractors may have different size and shape depending on the region to be operated, are mobile, manned by an assistant or mechanical (Fig.15).



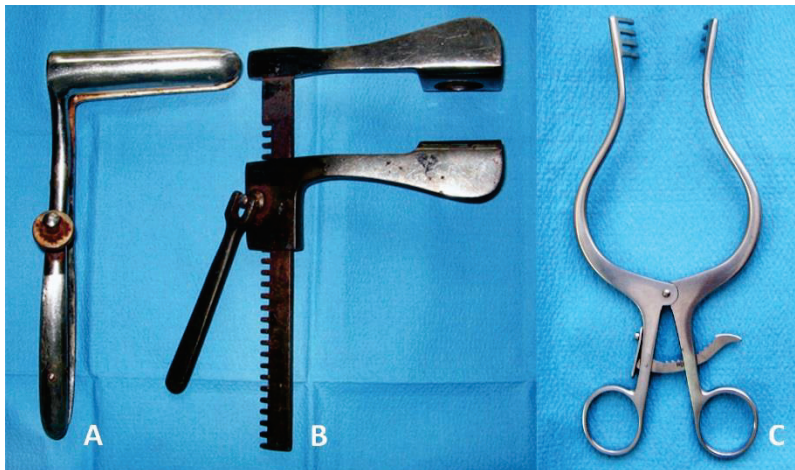
**Fig.15.** Manual retractors and dilators: A. Cardiac speculum; B. Abdominal (hepatic) speculum; C. Fritsch dilator; D. Farabeuf dilator; E.-I. Volkman retractors.

The cardiac and abdominal (hepatic) speculum consists of a straight or curved blade, which continues with a handle. Using this instruments, the corresponding organ is moved away from the area of the surgical maneuver.

Farabeuf retractor consists of a solid blade, bent at right angles at both ends, with one blade longer and wider and the other – shorter, which is convenient when used in persons with different thicknesses of the anterior abdominal wall. They are used in pairs, for example, during appendectomy.

Volkman retractor is similar in structure to abdominal speculum, but has 2-6 sharp teeth on the end, used to remove resistant tissues (muscles, skin, tendons).

Mechanical retractors have a system to lock the valves, and generally are used in abdominal and thoracic surgery (Fig.16). Mechanical dilators are very convenient, as they do not require constant physical effort on the part of assistant and allow him to free his hands for more active assistance to the operating surgeon. The Finochietto rib retractor consists of two blades, one of which is fixed on the ratchet, which allows to change the degree of wound expansion. The Dartigues dilator is formed of two handles with blades that widen the edges of the laparotomic or skin wound. The arms are crossed in the middle and fixed to the arch where the serrated mechanical fixation system is located. There are also systemic retractors of the Kirschner type, which are equipped with a frame and a large system of blades attached to it (Fig.17). This allows to expand the wound in various elected directions, and significantly improve the conditions for performing surgical intervention.



**Fig.16.** Mechanical retractors: A. Mechanical rectal speculum; B. Finochietto retractor; C. Dartigues retractor.



**Fig.17.** Mechanical retractor of Kirschner.

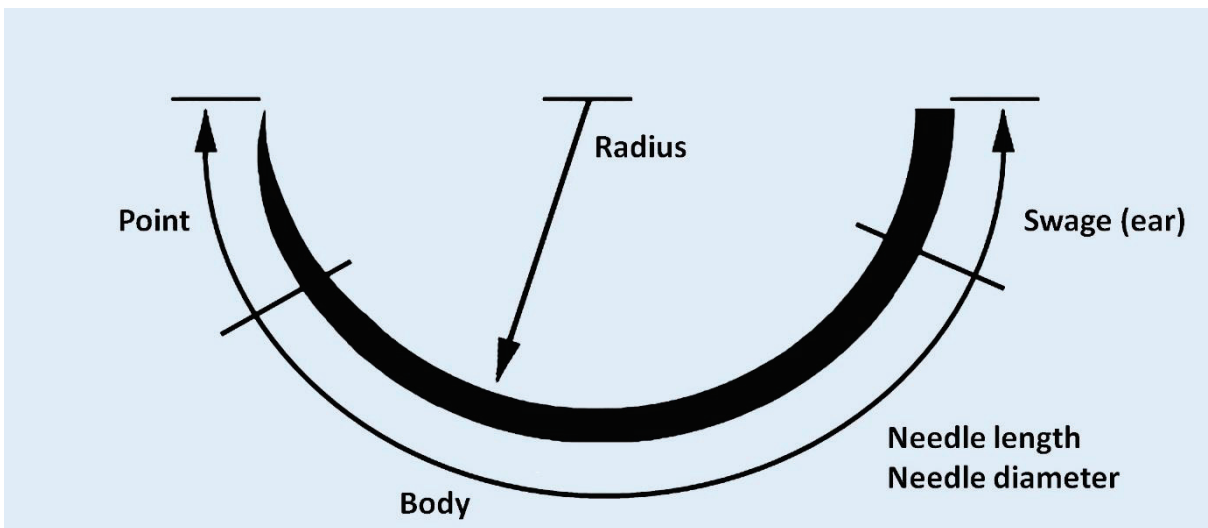
**Instruments for tissues suture.** It consists of surgical needle holders, needles and forceps (pincettes). Hegar needle holder is commonly used (Fig.18).



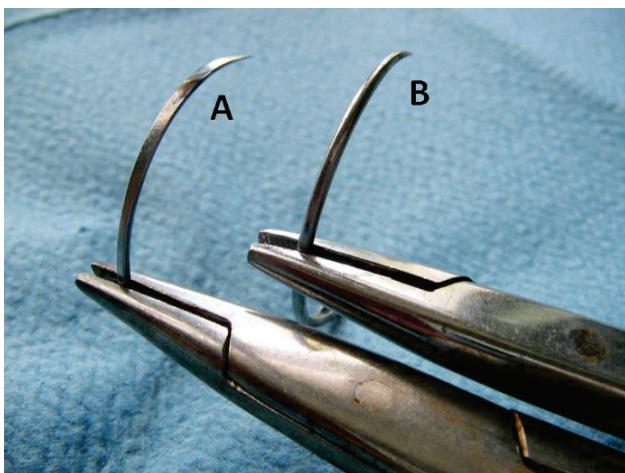
**Fig.18.** Hegar needle holders.

It has the shape of long forceps, with thicker arms and short tip, which ensures its security. Needle holders are provided in different lengths, depending on the area of use. Like hemostatic clamps, the Hegar needle holder is equipped with a ratchet-type locking mechanism. Mathieu needle holder has two arms articulated to the top, which is short and thick at the base and is provided with a lock system, consisting of three teeth on one arm and one tooth on the other.

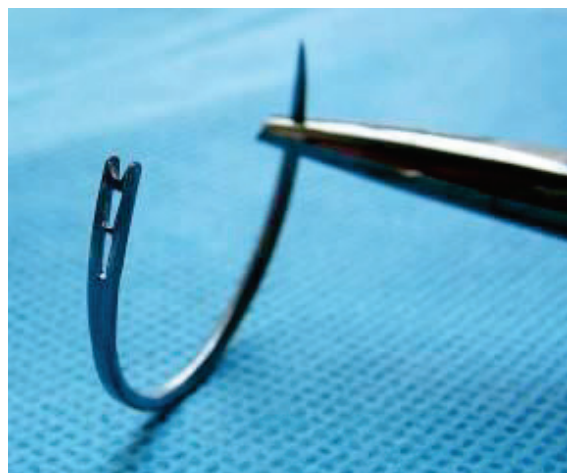
The needles are made of steel and are very diverse depending on their purpose. Surgical needles can be straight or semicurved, but the latter are used more often. The curved shape of surgical needle allows for better control of its movement, especially in deep wounds. Hagedorn needle has a swage, body and point (Fig.19). Other characteristics of a surgical needle include length, diameter, and curvature. Hagedorn needles have 14 dimensions adapted to virtually all organs and tissues which are sutured. The needles are produced with standard, but not random curvatures. So, their curvature could be on 1/4, 3/8, 4/8 (1/2) or 5/8 of circle.



**Fig.19.** Anatomy of the surgical needle.



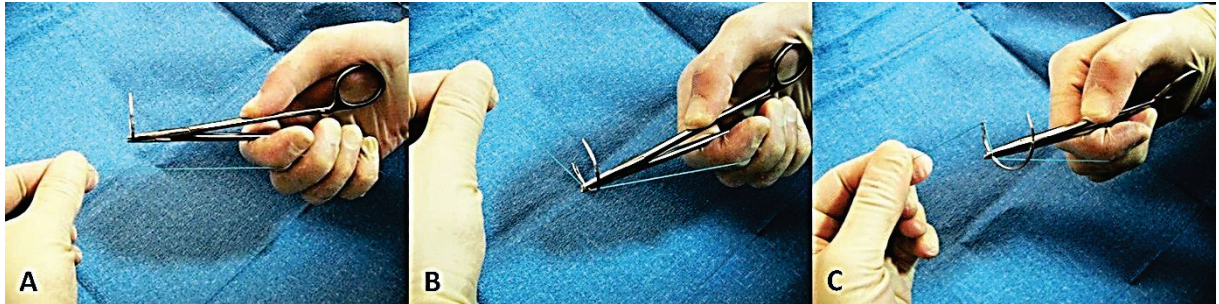
**Fig.20.** Surgical needle point: A. Triangular (cutting); B. Round (stabbing).



**Fig.21.** Hagedorn surgical needle swage (ear).

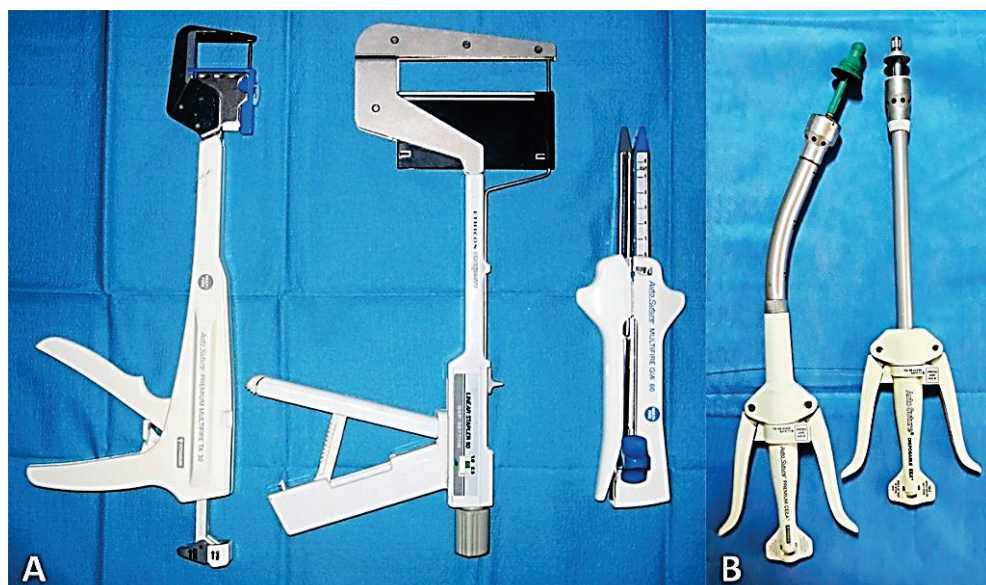
The tip of the needle can be triangular (cutting) or round (stabbing) (Fig.20). Those with triangular points are used for suturing the skin, fascia, tendons and muscles. Those with rounded point are used for suturing hollow organs, vessels or fine soft tissues.

The needle ear is fitted with two small side plates, with a narrow cleft in the “V”-shape between them (Fig.21). This system allows the loading of needle with the thread push under tension (Fig.22).



**Fig.22.** Technique for loading of Hagedorn surgical needle with the thread: A. Thread is pulled along to the axis of needle holder; B. The taut thread is fixed at the corner formed by the needle and needle holder; C. The taut thread is loaded into the needle by simply pressing between the side plates of the ear.

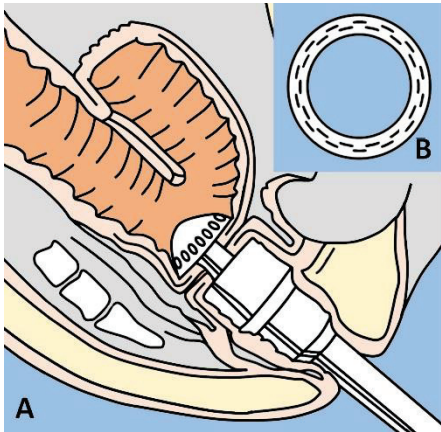
A great progress in surgery has been achieved with advent of mechanical staplers – devices for applying mechanical sutures. Instead of threads, such devices use titanium staples (clips), which in closed position connect and securely fix tissues. Numerous instruments, originally invented by Russian surgeons and then manufactured by the American company AutoSuture, can be divided into linear and circular staplers (Fig.23). Linear staplers of various lengths are designed to apply 2 or 3 lines of staples to close quickly and safely pulmonary tissue or bowel lumen. A circular stapler allows performing anastomosis between two cavitory organs: to connect colon, intestine or esophagus after their resection.



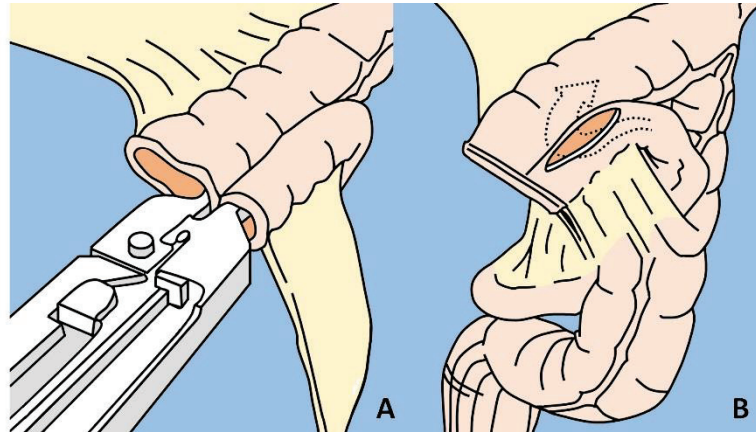
**Fig.23.** Staplers for mechanical sutures: A. Linear staplers of various lengths and designs, including the GIA stapler; B. Curved and straight circular staplers of various diameters.

Mechanical suture devices are especially useful when anastomoses are required in hard-to-reach areas of the body, for example, deep in the pelvic region or high at the level of the diaphragm, as well as during laparoscopic surgery (Fig.24).

There are also staplers for intestinal anastomoses, the so-called GIA (Gastro-Intestinal Anastomosis) staplers (Fig.25). Two branches of device are inserted into two different bowel loops required for anastomosis. Once closed, the stapler applies 4 staple lines while simultaneously making an incision between them. Thus, a reliable lateral intestinal anastomosis can be applied in just a few seconds. Due to the simplicity of anastomoses and the ease of use of staplers, their field of application is constantly expanding, and they themselves have become an integral component of modern surgery.

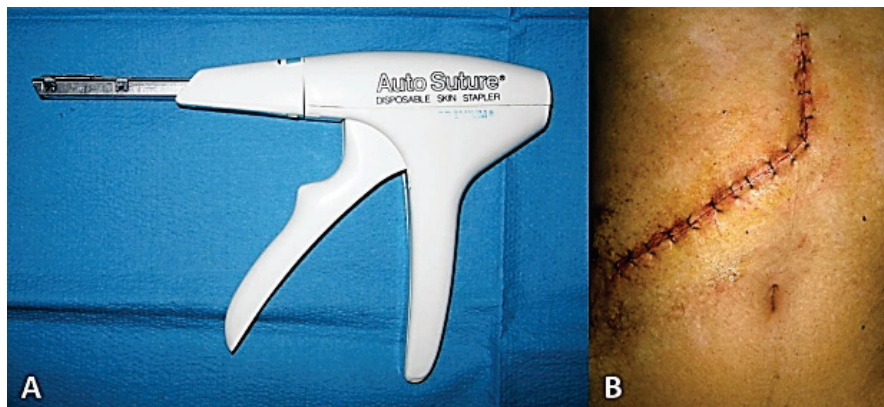


**Fig.24.** Performing a mechanical suture using a circular stapler: A. Applying a rectal mechanical anastomosis deep in the pelvis; B. Once closed, the stapler creates two rows of staples and is equipped with a circular scalpel to remove excessive tissue.



**Fig.25.** Intestinal anastomosis with a GIA stapler: A. The branches of stapler are inserted into the anastomosed bowel loops; B. The final view of the anastomosis. The open ends of intestinal loops were closed with a linear stapler.

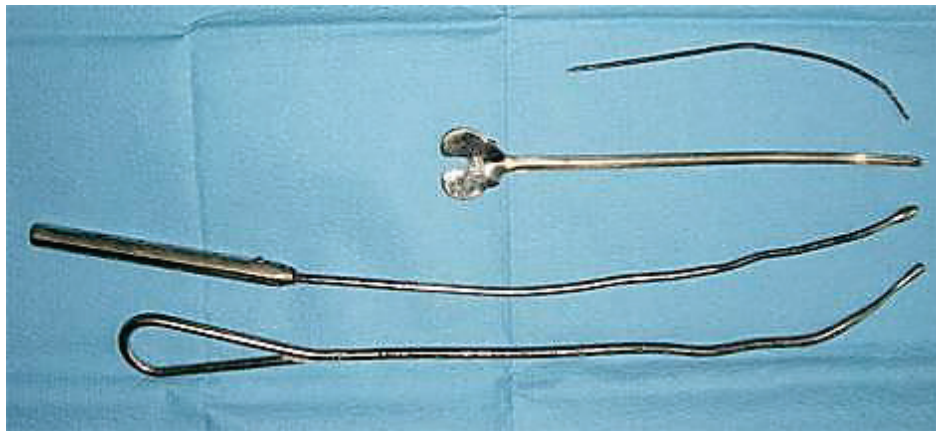
Skin staplers have been invented and widely utilized to close wounds with metal staples (Fig.26). The use of a stapler allows to close surgical wound quickly and reliably, which helps to reduce the length of surgical procedure. To remove skin staples, a specially designed device (extractor) is applied.



**Fig.26.** The stapler for skin wound and the results of its use: A. Skin stapler; B. Skin incision closed with metal staples.



The instruments for exploration are represented by stylets (probes) designed to examine trajectories of fistulas, wound canals or normal hollow anatomical structures (for example, bile or urinary ducts), without the risk of damaging surrounding tissues (Fig.27).



**Fig.27.** Probes of various types and purposes.

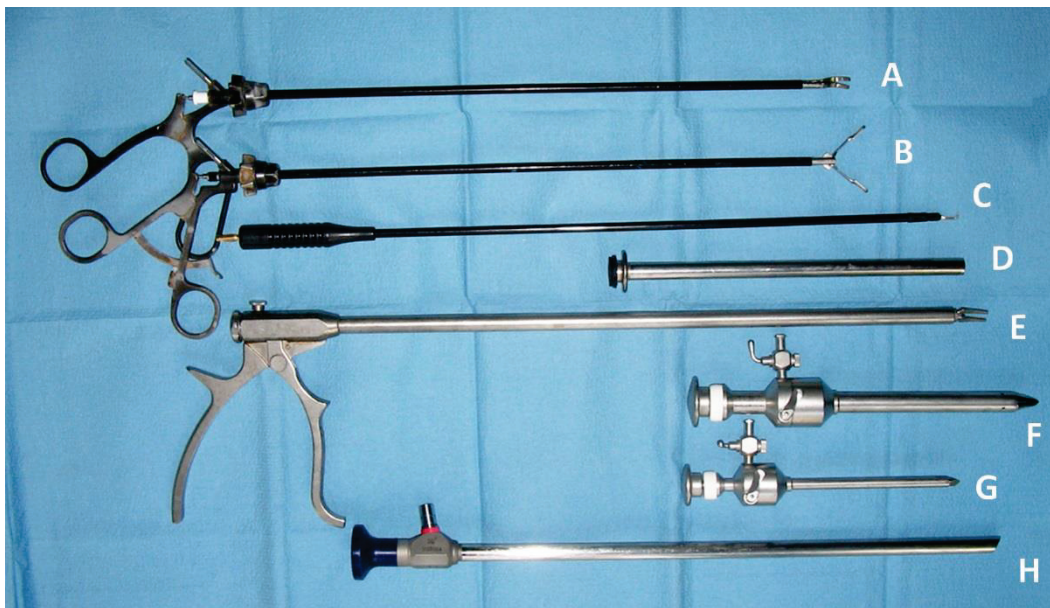
**Special and different instruments.** This group includes numerous types of objects used for one certain maneuver during surgical intervention (forceps for extraction of biliary and urinary stones, varicose vein stripper), or using in all operations (such as working part of aspirator, electrocautery, forceps for fixing the operating field around the surgical wound, etc.).

A modern operating room is unbelievable without the use of electrosurgical equipment, be it a traditional open or laparoscopic surgeries. The standard installation is a power supply unit that allows electrosurgical action in two modes: cutting and monopolar coagulation (Fig.28). Some devices also have a bipolar coagulation mode. The hemostatic effect of electrocautery consists in transforming the energy of electric current into heat and increasing the temperature of tissues at the point of exposure to 60-100°C, which leads to their thermal destruction and hemostasis. A disposable sterile plastic handle with two buttons is connected to the external electrosurgical unit by means of a wire. Surgeon selects the required mode of action (incision or coagulation) by pressing the corresponding button. The shape of attachable accessories can be different. The most commonly used tip in the form of a conventional scalpel, but there are also tips in the form of a needle, a sphere of various diameters, and loops of different sizes and shapes.



**Fig.28.** Electrosurgical equipment for diathermocautery during surgery: A. Electrosurgical power supply unit, which provides two modes of tissue exposure; B. Disposable plastic handle with attachable accessories of various shapes and lengths.

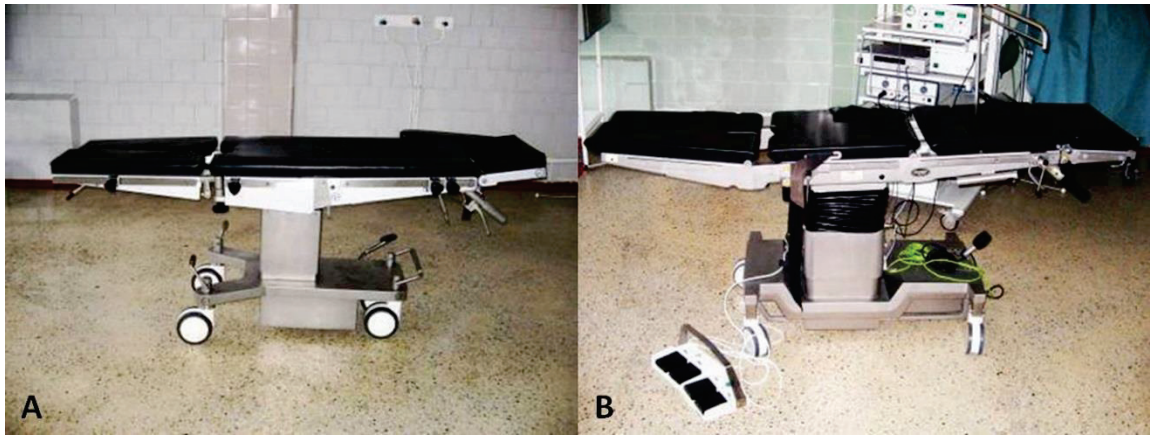
**Laparoscopic instruments** were developed and appeared relatively recently, in connection with the development and widespread use of minimally invasive laparoscopic surgery. Laparoscopic instruments are much longer than conventional ones, most of them are made not only of stainless steel, but also of plastics (Fig.29). This is due to the fact that most instruments designed to provide electrosurgical effects upon the tissues and, therefore, must be safely isolated. Laparoscopic instruments are handled outside the body and reaching the working chamber through trocars, installed in the anterior abdominal wall through small incisions. However, most laparoscopic instruments are similar in purpose and construction to conventional surgical instruments, and are represented by scissors, forceps and clamps of various shapes.



**Fig.29.** A set of laparoscopic instruments: A. Laparoscopic scissors; B. Laparoscopic forceps; C. Laparoscopic electrocautery hook. All three of these instruments have connectors for electrocautery; D. Reducer; E. Laparoscopic clip applicator; F. Trocar with a diameter of 10 mm; G. Trocar with a diameter of 5 mm; H. Telescope (optical device) connected to video camera.

### OPERATING ROOM TABLE AND LIGHT

**Operating room table.** Until the end of the 19th century, that is, before the discovery of bacteria and the introduction of aseptic method in surgery, operating tables were made of wood. Only in 1889 the company Maguet manufactured the first steel table for surgery, which made possible to reliably disinfect it before the subsequent procedure. Currently, there are two types of operating tables: mechanical and electromechanical (Fig.30). In mechanical tables, the position and shape of the table is changed manually using special handles. The electromechanical table is remotely controlled and can be reconfigured during surgery by simply pressing the foot pedal. The first electromechanical operating tables have been elaborated and produced in 1958.



**Fig.30.** Modern operating tables: A. Mechanical table; B. Electromechanical table.

There are the following requirements for operating table: stability and safety, functionality, easy cleaning and disinfection. Functionality means the ability to change the shape of the operating table to give patients the position necessary for various operations: lying on their back, lying on their side, with raised lower limbs (Trendelenburg position), with raised head (anti-Trendelenburg position), sitting or semi-sitting position (Fowler position), lying on your back with leg supports (for gynecological and urological procedures).

**A surgical light.** Operating lamp is an important component of surgical equipment designed to provide the required level of illumination of operating field and wound. Lamps produced for operating rooms must meet the basic requirements for surgical light: it must be bright and cold (so as not to heat the operating field), capable of illuminating deep cavities well, maintaining natural color rendering and minimizing shadows unintentionally created by the heads and hands of surgeons and his assistants. The latter condition is achieved by installing numerous lamps in a hemispherical shade. In addition, the surgical lamp should be easily disinfected, but surgeons should have the power to change a field and adjust the pattern of light using a replaceable sterile handle. Surgical lamps could be mounted (in a ceiling or wall) and portable, on wheels (Fig.31). In addition to this there are individual surgical light (named lighthouse) placed on the surgeon's head.



**Fig.31.** Operating lamps: A. Lamp mounted into the ceiling; B. Portable lamp.

## SUTURE MATERIALS

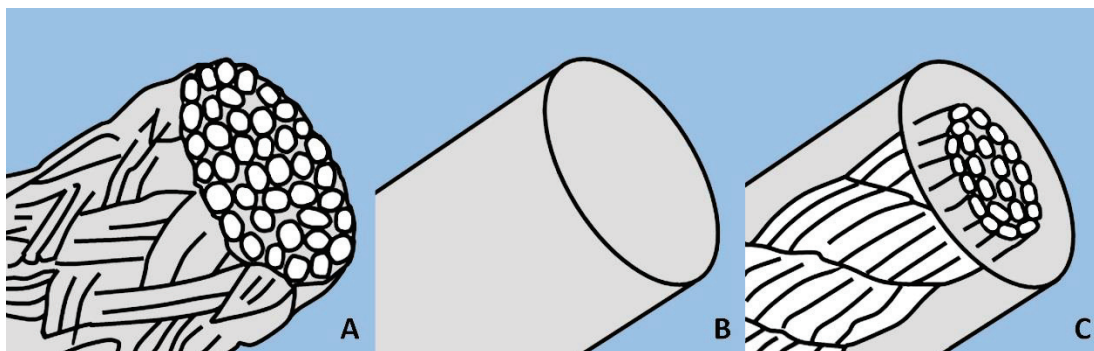
The oldest sutures are from Egypt and China where 4,000 years ago suturing of skin and bowel with plant fibers were used. In India, the Sushruta Samhita manual, dating back to the 6th century BC, recommends the use of hair, tendons or tree bark as surgical suture material. First absorbable suture material was catgut, invented by the ancient Roman surgeon Claudius Galen and made from cleaned submucosa of sheep's intestine. Then, much later, Joseph Lister in 1868 introduced slowly and more predictably absorbable material – chromic catgut. During the Middle Ages, numerous attempts were made to find an inert material of non-biological origin for surgical sutures. Even threads of gold or silver were used for this purpose. Natural silk came into use in the late XIX century, thanks to the two great surgeons Theodor Kocher and William Halsted. However, detailed studies of gut and silk properties have revealed multiple side effects of these materials: allergy, high reactivity, low resistance to infection, and long-term resorption.

Subsequent progress in surgical suture material was marked by synthetic threads appearance:

- In the 20-s of the XX century – nylon (Polyvinyl) – the first synthetic material,
- In the 30-s of the XX century – kapron (polyamide) and lavsan (polyester),
- In 1956 – polypropylene, in the 40-s of the XX century – “supramide extra” – complex suture (braided or twisted multifilament kapron, coated with polymer),
- In 1971 – the first synthetic absorbable suture – dextron (polyglycolic acid), and in 1974 – vicryl (copolymers glycolic and lactic acid derivatives, polyglactin 910).

The ideal suture material should have the following characteristics: simplicity of sterilization, safety of knot, resistance to infection, absorbability, resistance of wire has to exceed that of the tissue, easy handling, possibility of universal application in various operations, the absence of carcinogenic activity, absence of allergic properties, and low cost.

Suture materials are classified **by structure** into three categories: **multifilament** composed of many fine braided or twisted fibers (ethibond, mersilene, dextron II), **monofilament**, in which the synthetic thread is represented by a solitary fiber (prolene, PDS, dermalon, maxon, nylon), and **composites** – polymer-coated multifilament (vicryl, polysorbe, supramide) (Fig.32).



**Fig.32.** Classification of suture material by structure: A. Multifilament thread; B. Monofilament thread; C. Composite thread.

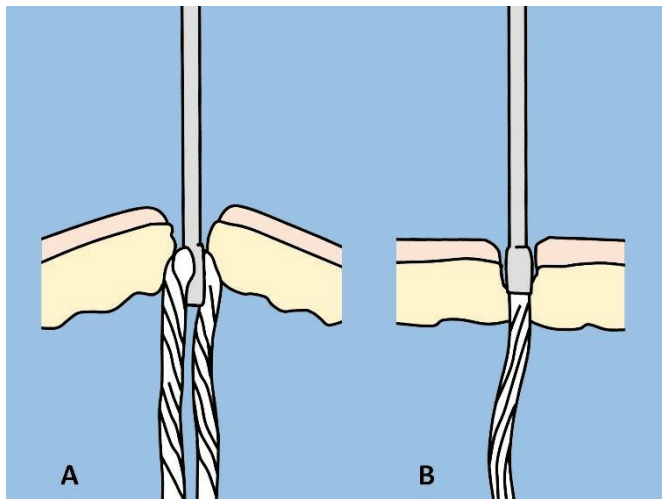
Another classification divides sutures materials by **source** from which they are produced:

- I. **Biological sutures:** catgut, silk.
- II. **Synthetic sutures:**
  - **Absorbable sutures** (dextron, vicryl, monocryl, maxon, PDS).

- **Nonabsorbable sutures** (lavan, kapron, mersilene, polyester, ethibond, prolene, polypropylene, gore-tex, novofil).

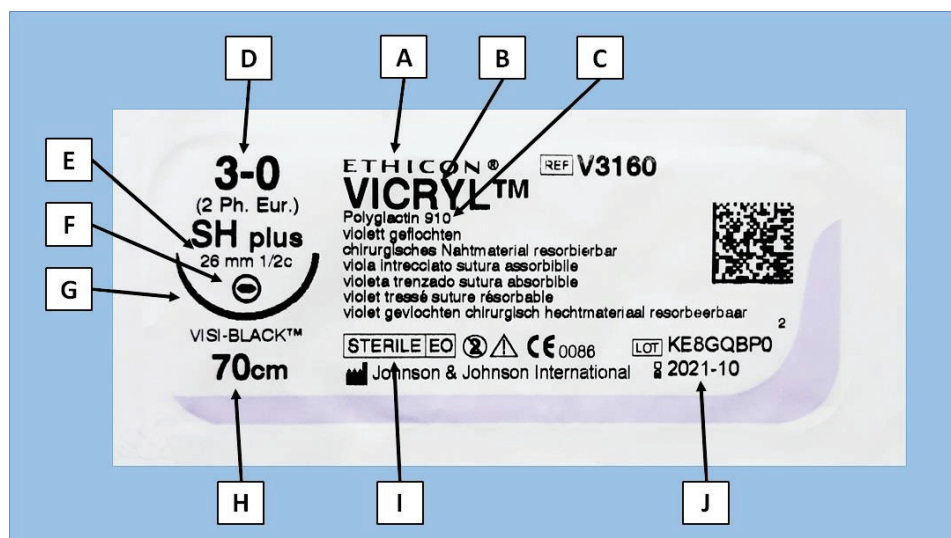
### III. Metallic suture.

Currently, in surgical practice are used atraumatic needles of various diameters and sizes, in which thread is mounted in continuing of needle. When passing through the tissues, such a needle with thread forms only a narrow point defect, and not a rupture with a double thread and an ear mechanism, as is the case with the Hagedorn needle (Fig.33). They are sterilized industrially and kept in sealed plastic envelopes. The thread can have one or two needles mounted at both ends.



**Fig.33.** Comparative characteristics of tissue defect created by different types of needles with a thread: A. Traditional Hagedorn needle with a loaded double thread; B. Atraumatic needle with a mounted thread.

Labeling of enveloped atraumatic needle with thread includes: name of manufacturer and suture material, wire thickness and length, needle properties (length, diameter, curvature, triangular or round point), the validity of sterilization period (Fig.34).

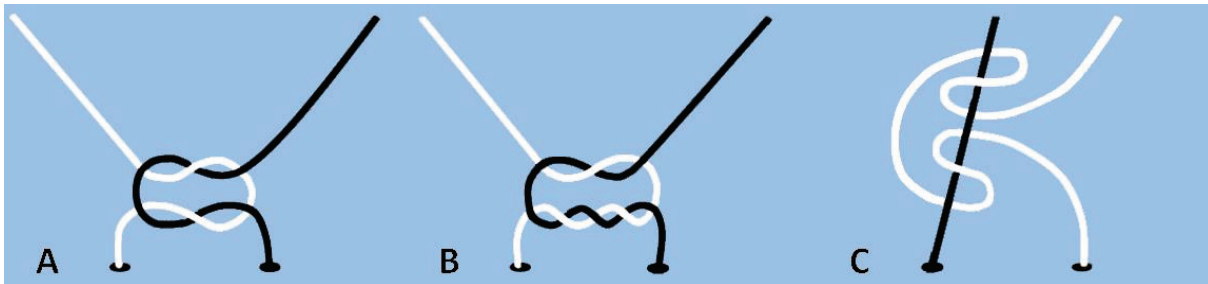


**Fig.34.** Labeling of enveloped atraumatic needle with thread: A. Manufacturing company; B. Commercial name of the suture material; C. Chemical name of the suture material; D. Thread thickness; E. Diameter and curvature of the needle; F. Type of needle point (triangular or round); G. Full size picture of the needle; H. Thread length; I. Confirmation of the sterility of envelop with the contents; J. Validity of sterilization period

## KNOTS AND SUTURES

**Knots.** The four nodes types are commonly used in surgery (Fig.35):

- (1) Simple knot (also called direct or square) - most often used;
- (2) Surgeon's knot, when tying threads are crossed twice – the safest;
- (3) Slip knot – tied with a single hand when one end of the thread is fixed;
- (4) Instrument knot – applied when one end of the thread is short.



**Fig.35.** The main types of knots used in surgery: A. Simple (square) knot; B. Surgeon's node; C. Slip knot.

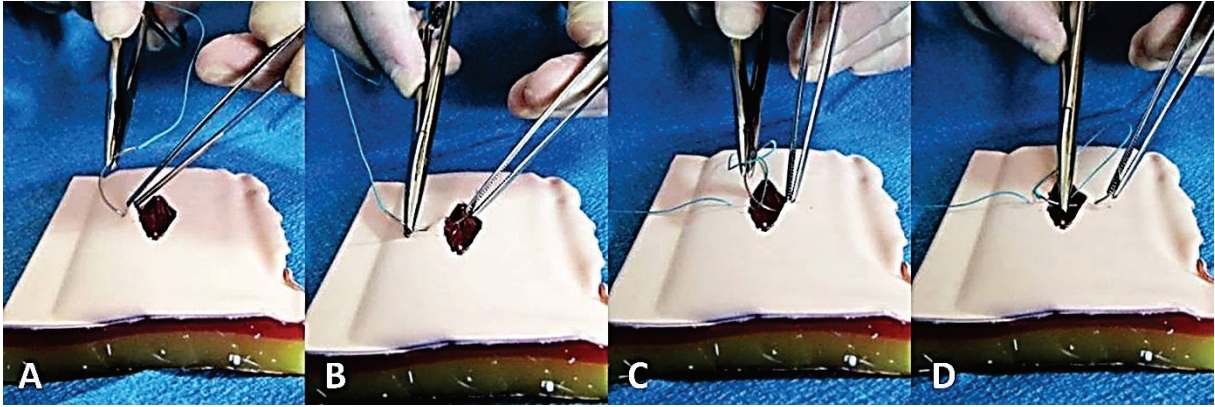
Only two knots are enough to tie securely the silk thread. Most threads are tied off with 3-4 knots (catgut, lavsan, kapron, mersilene, polyester, daxon, vicryl etc.) Monofilament synthetic threads (polypropylene, PDS, nylon, maxon, etc.) are ligated using 6-8 knots.

### There are general principles of suturing:

- Initially, it is necessary to achieve a thorough hemostasis in the wound.
- A good blood supply of tissues to be sutured should always be maintained.
- For deep wounds, it is advisable to perform layer-by-layer reconstruction so that no cavities remain in the depth of the wound.
- It is necessary to guarantee perfect adaptation of the sutured tissues, for example, the edges of a skin wound.
- Try to achieve tightness of suture line, in order to exclude areas of dehiscence between the neighboring knots.
- Care should be taken to adjust the thread tension (ie the force with which the knot is tied) to the type of tissue, in order to tie the knot safely but at the same time to avoid tearing the tissue edges with thread.

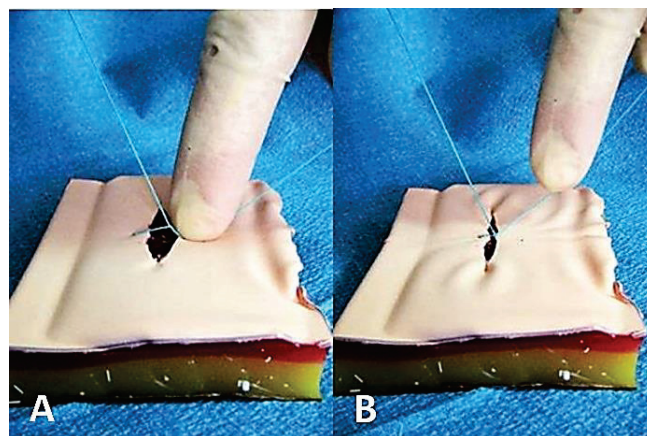
### Basic principles of skin wound closure:

- First, using surgical forceps (pincettes), grasp and hold the edge of the skin wound in the area where the needle is to be inserted.
- The needle should be inserted at a sufficient distance from the edge of the wound to avoid tearing the edge of the skin (Fig.36).



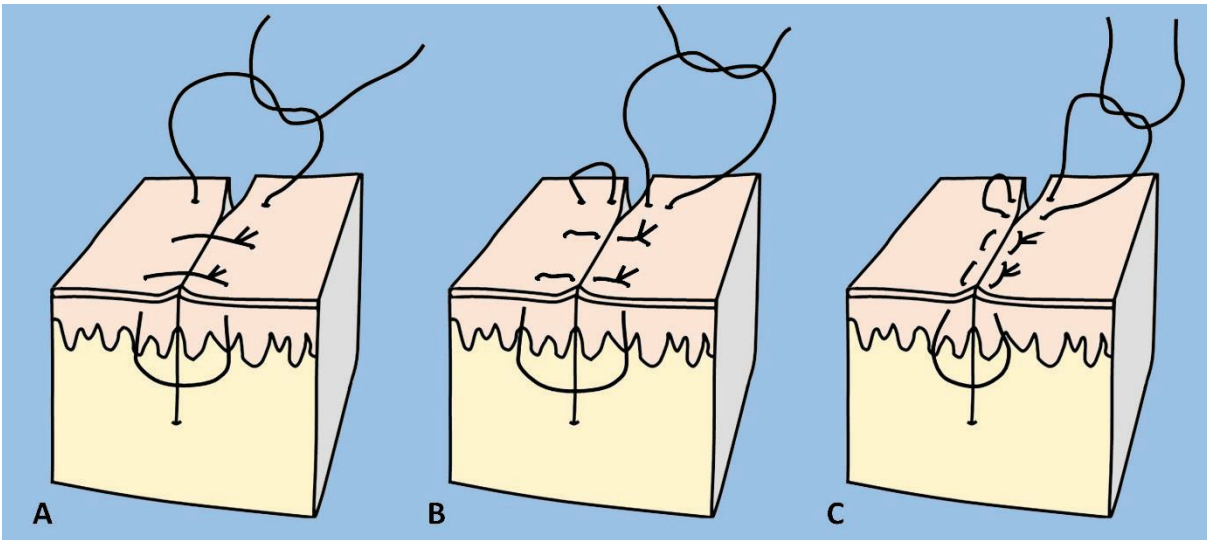
**Fig.36.** Applying of a single suture on the skin wound: A. Insertion of the needle perpendicular to skin surface; B. The needle must not be left uncontrolled; C. Adequate distance from the wound edge to avoid skin tearing; D. The equal distance between the site of entry and exit of the needle from the wound edges.

- The needle must penetrate the skin perpendicularly, and the force must always be applied along the direction of needle curvature.
- The needle is not left without control of any instrument, alternately using the needle holder and surgical forceps for this purpose.
- It is necessary to maintain an equal distance between the site of entry and exit of the needle from the wound edges, and an equal distance between the sutures.
- When tying a correctly applied suture, the edges of the wound gradually come closer and perfectly approximate one to each other. The knot is then tightened completely (Fig.37).

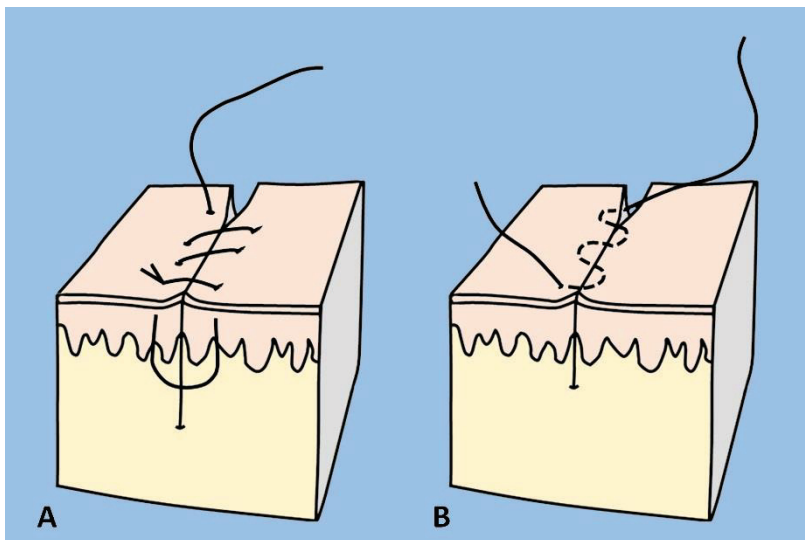


**Fig.37.** Tying a suture applied to the skin: A. Approximation of the wound edges; B. Tightening the first knot.

**Skin sutures** are divided into single (interrupted) sutures (simple suture, Blair-Donati suture and “U”-shaped suture, and continuous suture (simple running suture and intracutaneous or intradermal suture). Schematic representation of sutures is shown in Fig.38 and Fig.39.



**Fig.38.** Types of single skin sutures: A. Simple suture; B. Blair-Donati suture; C. "U"-shaped suture.



**Fig.39.** Types of continuous skin sutures: A. Running suture; B. Intradermal (intracutaneous) suture.



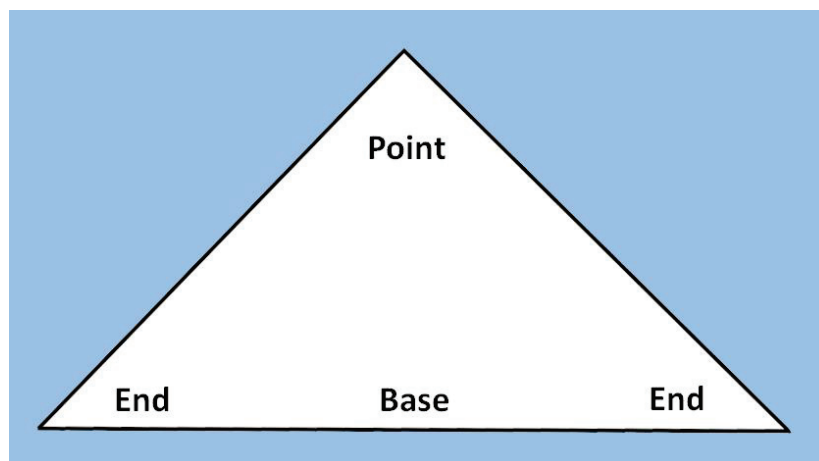
## II. DRESSINGS AND BANDAGES

**Desmurgy** is a set of rules about dressings, their practical use and correct application. Dressing is a pad that is placed in direct contact with the wound. It should be large enough to cover the entire area of the wound and to extend at least 2-3 cm in every direction beyond the edges. If the dressing is not large enough, the edges of the wound are almost certain to become contaminated. The dressing material which covers wound should always be sterile. However, emergencies will sometimes arise when they are not available. In such a case, use the cleanest cloth available. A freshly laundered handkerchief, towel, or shirt may be used. Unfold these materials carefully so that you do not touch the part that goes next to the skin. Always be ready to improvise, but never put materials directly in contact with wounds that are likely to stick to the wound, leave lint, or be difficult to remove.

Bandages are strips or rolls of gauze or other materials that are used for wrapping or binding any part of the body and to hold compresses in place. **The types** of most commonly used bandages are (1) the triangular bandage, (2) the cravat bandage, (3) the roller bandage, and (4) elastic net retention bandage.

### TRIANGULAR BANDAGES

Triangular bandages are usually made of cotton. They are made by cutting a 90 to 100 cm square of a piece of cloth and then cutting the square diagonally, thus making two triangular bandages. A smaller bandage may be made by folding a large handkerchief diagonally. The longest side of the triangular bandage is called the base; the corner directly opposite the middle of the base is called the point; and the other two corners are called ends (Fig.40).

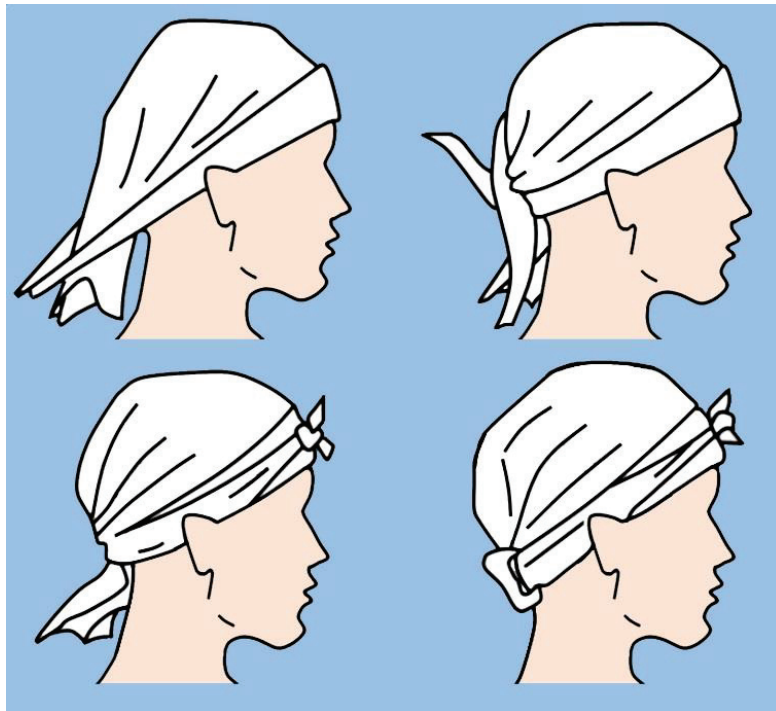


**Fig.40.** Triangular bandage.

The triangular bandage is useful because it can be folded in a variety of ways to fit almost any part of the body. Padding may be added to areas that may become uncomfortable.

**Triangular bandage for head.** This bandage is used to retain compresses on the forehead or scalp. Fold back the base about 5 cm to make a border. Place the middle of the base on the forehead, just above the eyebrows, with the border on the outside (Fig.41). Let the point fall over the head and down over the back of the head. Bring the ends of the triangle around the

back of the head above the ears, cross them over the point, carry them around the forehead and tie in a knot.



**Fig.41.** Triangular bandage for the head. Explanation in the text.

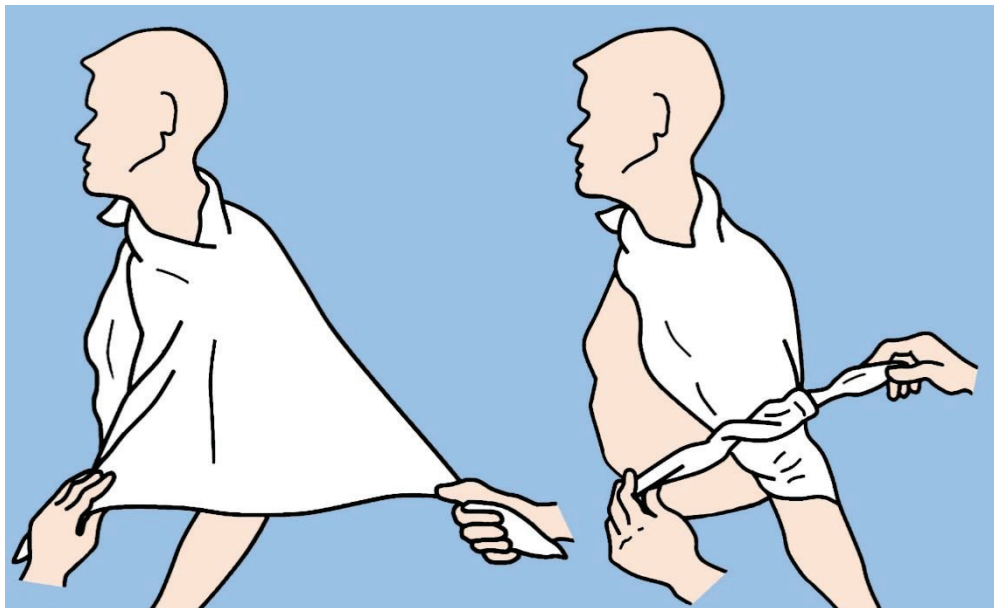
Hold the compress firmly with one hand and, with the other, gently pull down the point until the compress is comfortable; then bring the point up and fold it over the bandage where it crosses the back part of the head.

**Triangular bandage for shoulder.** Cut or tear the point about 25 cm, perpendicular to the base. Tie the two points loosely around the patient's neck, allowing the base to drape down over the compress on the injured side (Fig.42A).



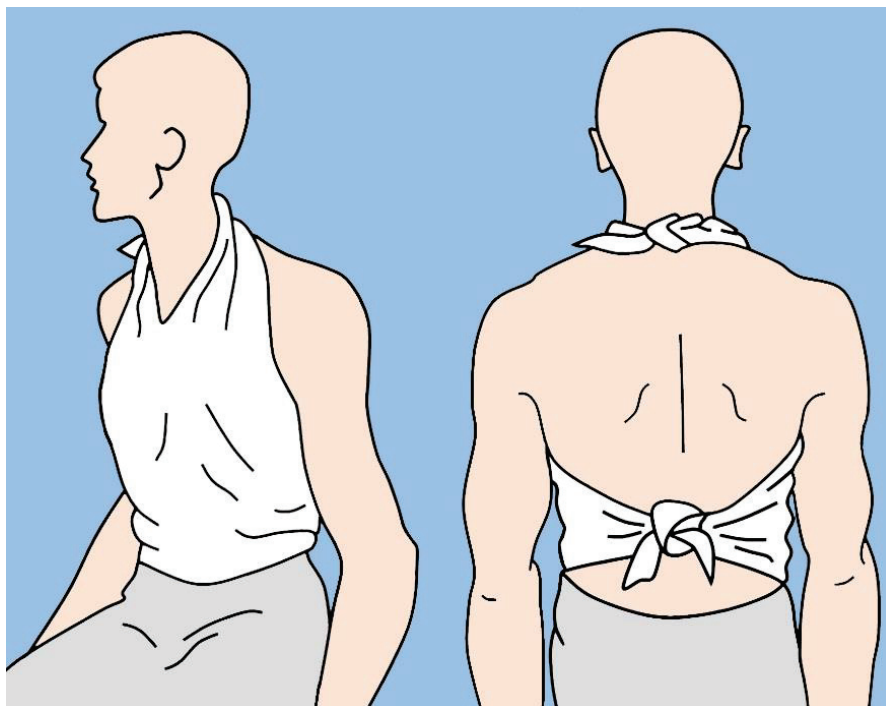
**Fig.42A.** Triangular bandage for the shoulder (initial step).

Fold the base to the desired width, grasp the ends, and fold or roll the sides toward the shoulder to store the excess bandage. Wrap the ends around the upper arm, and tie on the outside surface of the arm (Fig.42B).



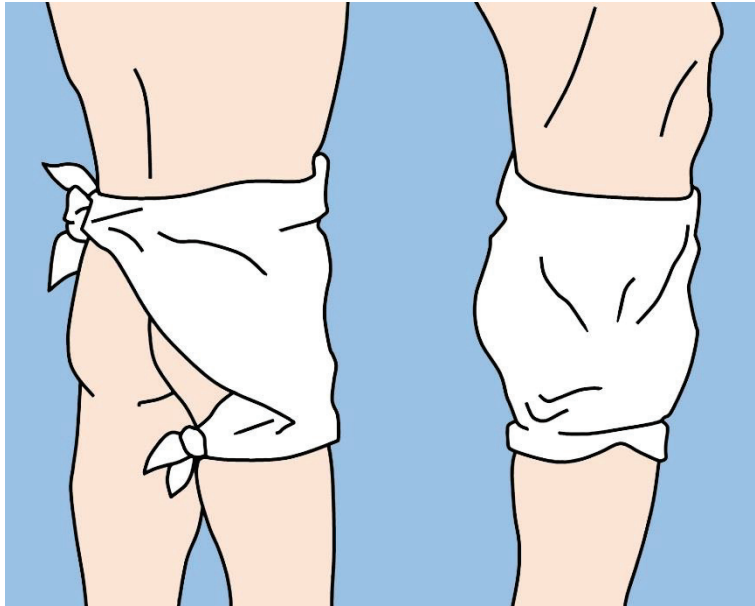
**Fig.42B.** Triangular bandage for the shoulder. Explanation in the text.

**Triangular bandage for chest.** Cut or tear the point about 25 cm, perpendicular to the base. Tie the two points loosely around the patient's neck, allowing the bandage to drape down over the chest. Fold the bandage to the desired width, carry the ends around to the back, and secure by tying (Fig.43).



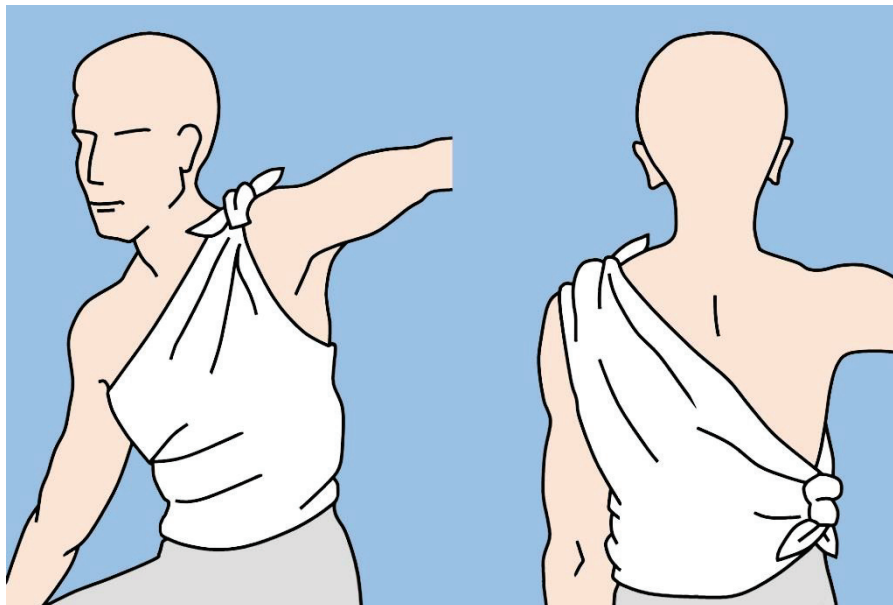
**Fig.43.** Triangular bandage for the chest.

**Triangular bandage for hip or buttock.** Cut or tear the point about 25 cm, perpendicular to the base. Tie the two points around the thigh on the injured side. Lift the base up to the waistline, fold to the desired width, grasp the ends, fold or roll the sides to store the excess bandage, carry the ends around the waist, and tie on the opposite side of the body (Fig.44).



**Fig.44.** Triangular bandage for the hip and buttock.

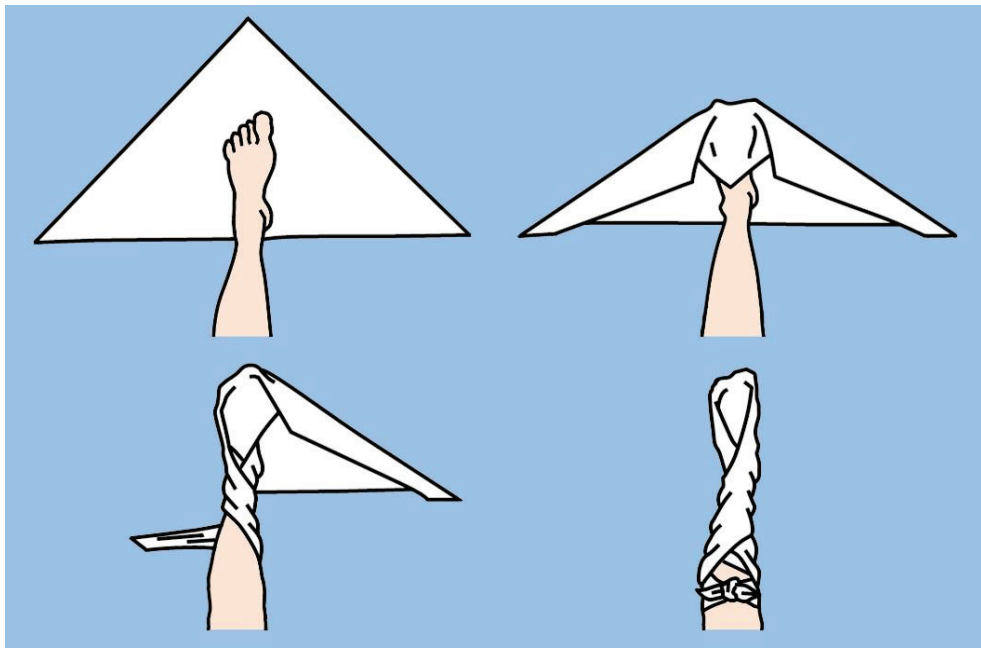
**Triangular bandage for side of chest.** Cut or tear the point about 25 cm, perpendicular to the base. Place the bandage, with the points up, under the arm on the injured side. Tie the two points on the top of the shoulder. Fold the base to the desired width, carry the ends around the chest, and tie on the opposite side (Fig.45).



**Fig.45.** Triangular bandage for the side of the chest.

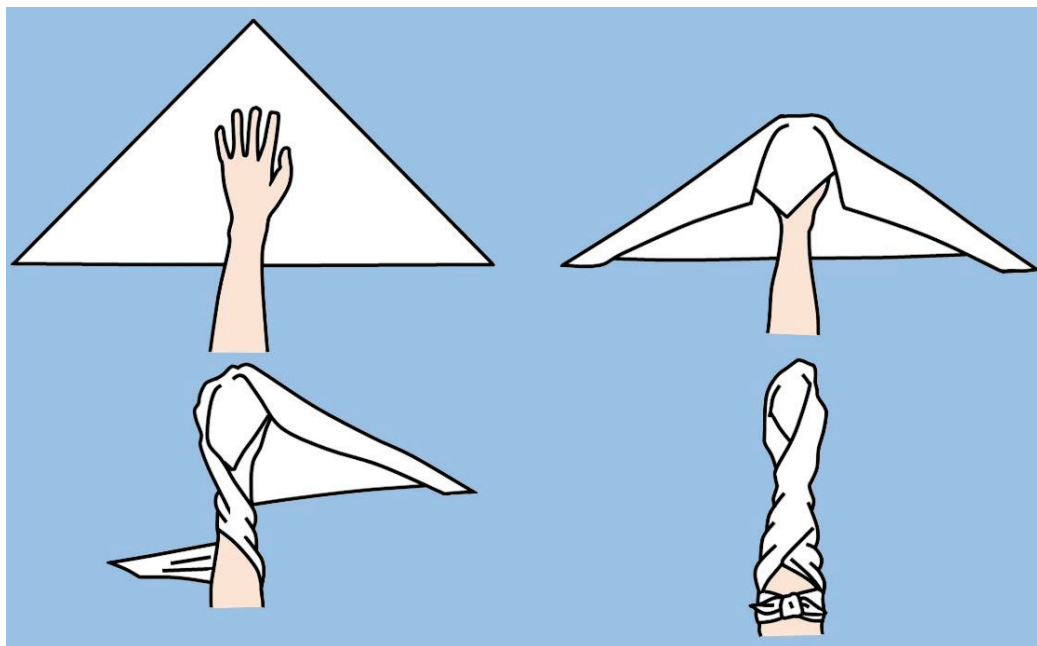
**Triangular bandage for foot.** This bandage is used to retain large compresses on the foot. After the compresses are applied, place the foot in the center of a triangular bandage and

carry the point over the ends of the toes and over the upper side of the foot to the ankle. Fold the excess of bandage at the side of the foot, cross the ends, and tie them in a square knot in front (Fig.46).



**Fig.46.** Triangular bandage for the foot. Explanation in the text.

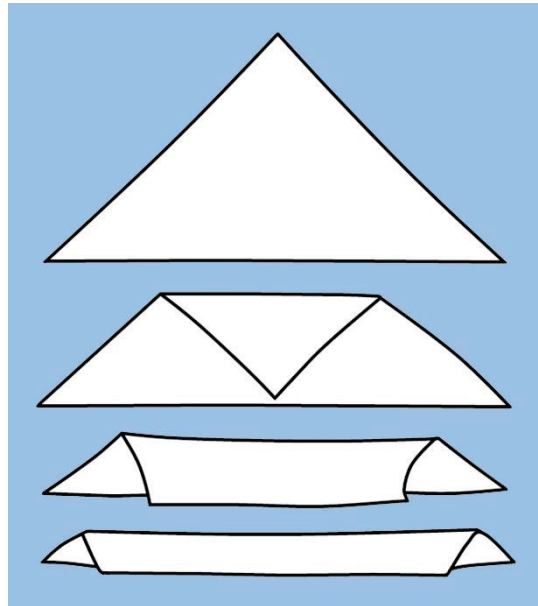
**Triangular bandage for hand.** This bandage is used to retain large dressings on the hand. After the dressings are applied, place the base of the triangle well up in the palmar surface of the wrist. Carry the point over the ends of the fingers and the back of the hand well up on the wrist. Fold the excess of bandage at the side of the hand, cross the ends around the wrist, and tie a knot in front (Fig.47).



**Fig.47.** Triangular bandage for the hand. Explanation in the text.

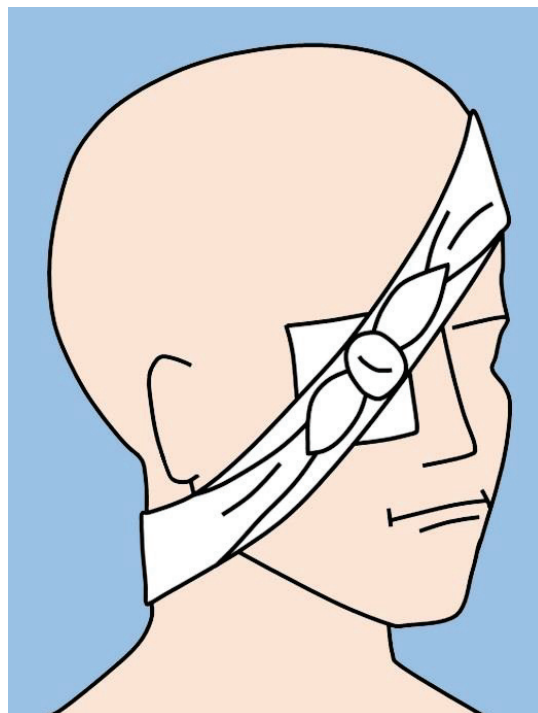
## CRAVAT BANDAGES

To make a cravat bandage, bring the point of the triangular bandage to the middle of the base and continue to fold until a 5 cm width is obtained (Fig.48).



**Fig.48.** Folding of cravat bandage.

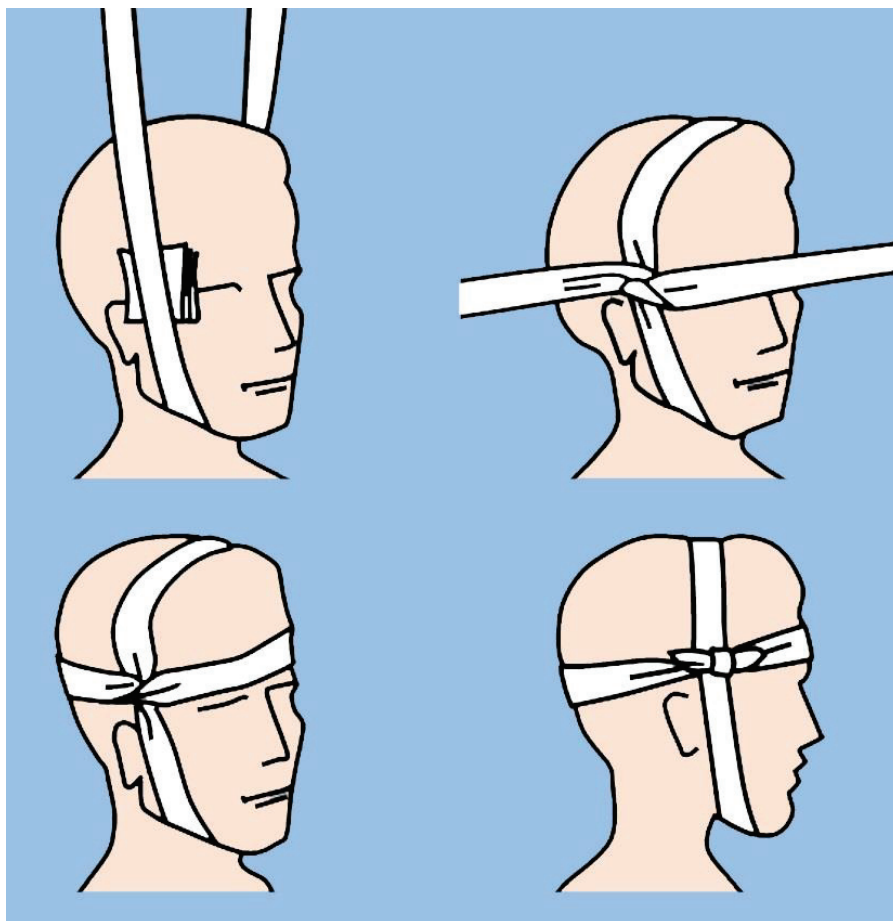
**Cravat bandage for eye.** After applying a compress to the affected eye, place the center of the cravat over the compress and on a rotation so that the lower end is directed downward. Bring the lower end around under the ear on the opposite side. Cross the ends in back of the head, bring them forward, and tie them over the compress (Fig.49).



**Fig.49.** Cravat bandage for the eye.

**Cravat bandage for head.** This bandage is useful to control bleeding from wounds of the scalp or forehead. After placing a compress over the wound, place the center of the cravat over the compress and carry the ends around to the opposite side; cross them, continue to pull them around to the starting point, and tie in a knot.

**Cravat bandage for temple, cheek, or ear.** After a compress is applied to the wound, place the center of the cravat over it and hold one end over the top of the head, carry the other under the jaw and up the opposite side, over the top of the head, and cross them at right angles over the temple on the injured side. Continue one end around over the forehead and the other around the back of the head to meet over the temple on the uninjured side. Tie the ends in a knot (Fig.50).

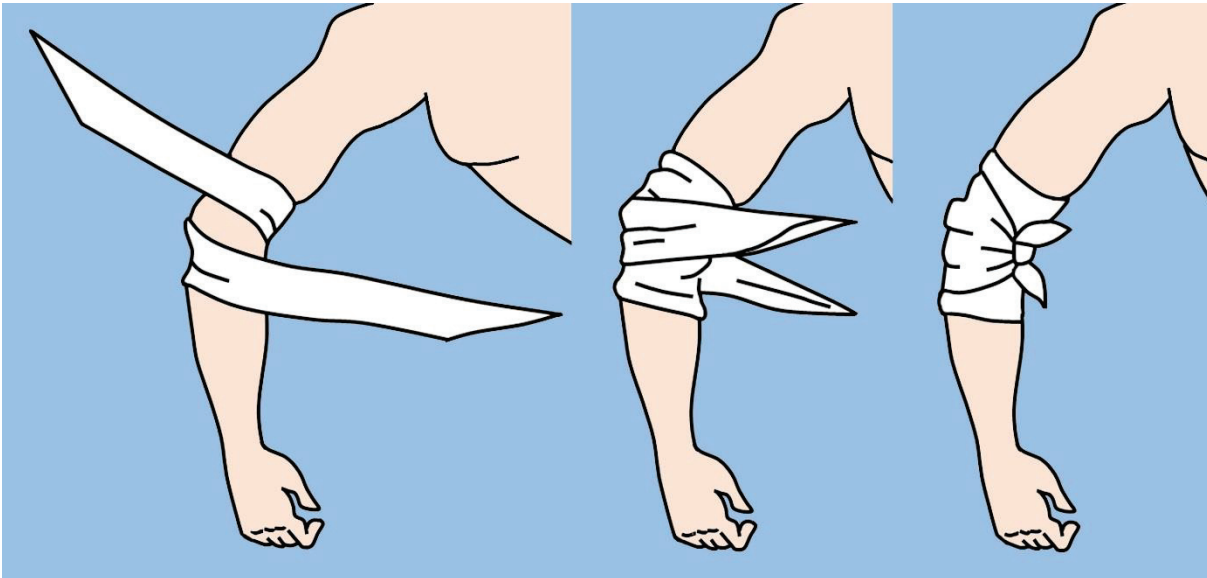


**Fig.50.** Cravat bandage for the temple, cheek or ear. Explanation in the text.

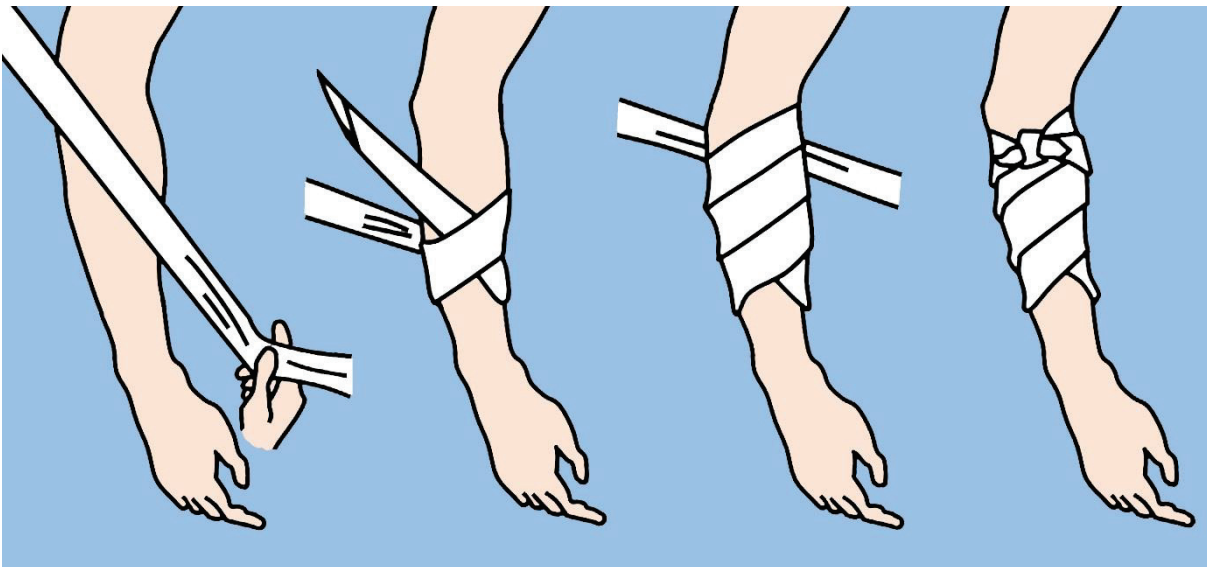
**Cravat bandage for elbow or knee.** After applying the compress, and if the injury or pain is not too severe, bend the elbow or knee to a right angle position before applying the bandage. Place the middle of a wider cravat over the point of the elbow or knee, and pull the upper end around the upper part of the elbow or knee, bringing it back to the hollow, and the lower end entirely around the lower part, bringing it back to the hollow. Check that the bandage is smooth and fits comfortable; then tie in a knot outside of the hollow (Fig.51).

**Cravat bandage for arm, forearm, leg or thigh.** The width of the cravat you use will depend on the extent and area of the injury. Place a compress over the wound and center the cravat

bandage over the compress for a small area. Bring the ends around in back, cross them, and tie over the compress. For a small extremity it may be necessary to make several turns around to use all the bandage for tying (Fig.52).



**Fig.51.** Cravat bandage for the elbow. Explanation in the text.

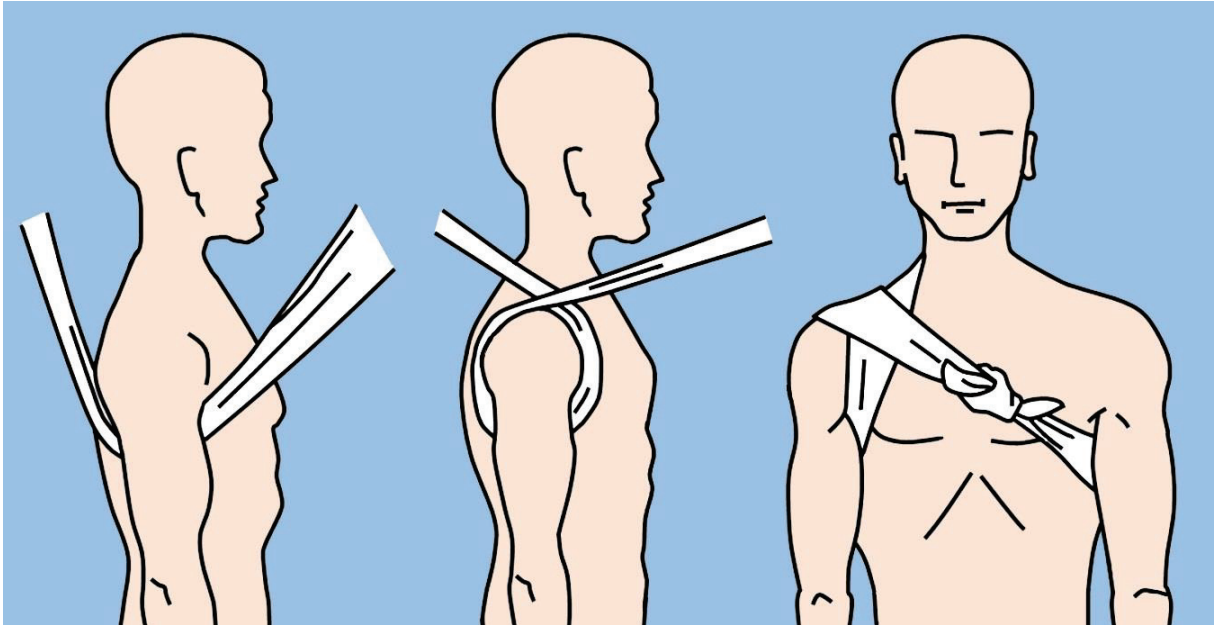


**Fig.52.** Cravat bandage for the forearm. Explanation in the text.

If the wound covers a larger area, hold one end of the bandage above the compress and turn the other end spirally downward across the compress until it is secure, then pull it upward and around again, and tie a knot where the both ends meet.

**Cravat bandage for axilla.** This cravat bandage is used to hold a compress in the axilla. It is similar to the bandage used to control bleeding from the axilla. Place the center of the bandage in the axilla over the compress and pull the ends up over the top of the shoulder and cross them. Continue to pull the bandage across the back and chest, to the opposite axilla and tie them (Fig.53).

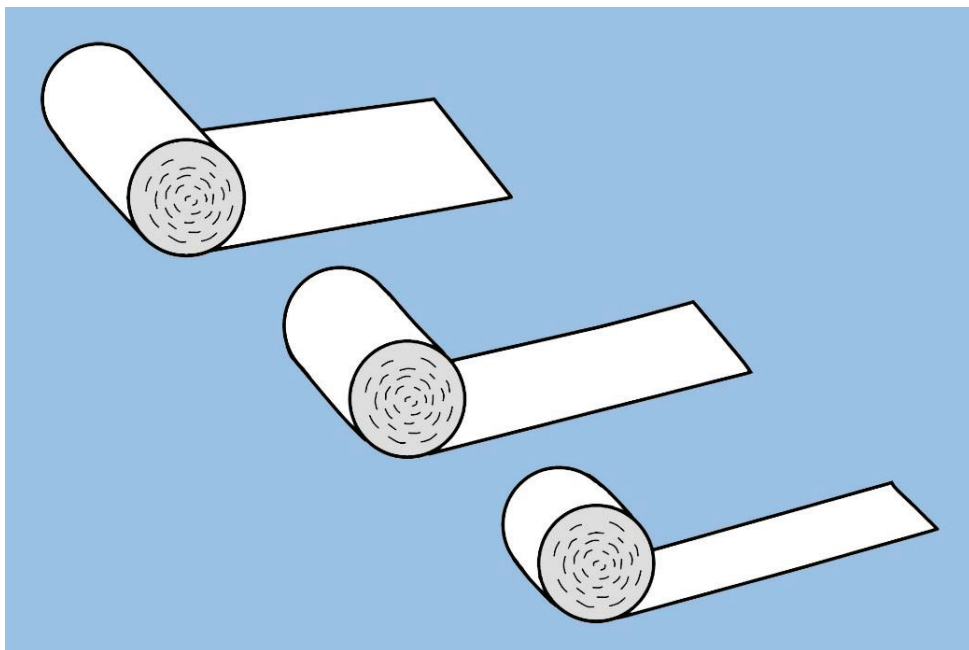




**Fig.53.** Cravat bandage for the axilla. Explanation in the text.

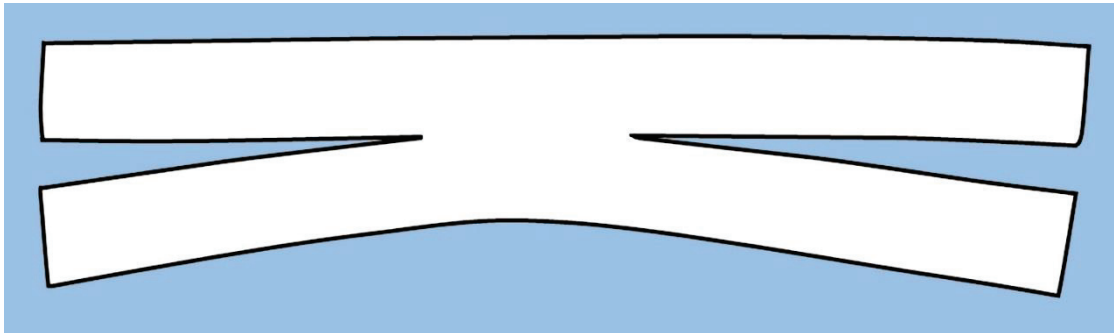
### **ROLLER BANDAGES**

Roller bandage, shown in Fig.54, consists of a long strip of material (usually gauze or elastic) that is coiled into a cylindrical shape. Roller bandages are available in various widths and lengths. If the roller bandage has been sterilized, it may be cut off and used as compresses in direct contact with wounds. If you use a piece of roller bandage in this manner, you must be careful not to touch it with your hands or with any other unsterile object.



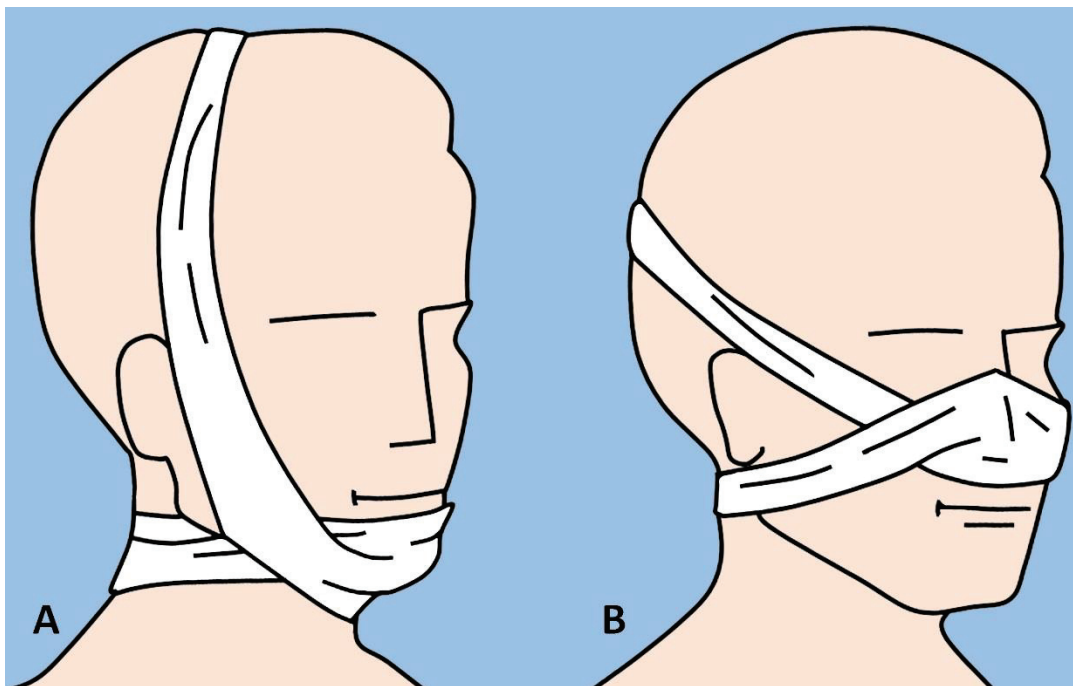
**Fig.54.** Roller bandages.

A piece of roller bandage may be used to make a four-tailed bandage. This is done by tearing the cloth from each end, leaving the center area as large as necessary. It is good for bandaging any protruding part of the body, because the center portion of the bandage forms a smoothly fitting pocket when the tails are crossed over. This type of dressing is shown in Fig.55.



**Fig.55.** Four-tailed bandage.

The four-tailed bandage is often used to hold a compress on the chin (as shown in Fig.56A) or on the nose (Fig.56B).



**Fig.56.** Four-tailed bandage: A. On the chin; B. On the nose.

In applying a roller bandage, hold the roll in the right hand so that the loose end is on the bottom; the outside surface of the loose or initial end is then applied to the body part and held on by the left hand. The roll is then passed around the body part by the right hand, which controls the tension and application of the bandage.

Two or three of the initial turns of a roller bandage should overlie each other to secure the bandage and to keep it in place (Fig.57).



**Fig.57.** Applying a roller bandage. Explanation in the text.

In applying the turns of the bandage, it is often necessary to transfer the roll from one hand to another. Bandages should be applied evenly, firmly, but not too tightly. Excessive pressure may cause disturbances of circulation and may lead to ischemic complications.

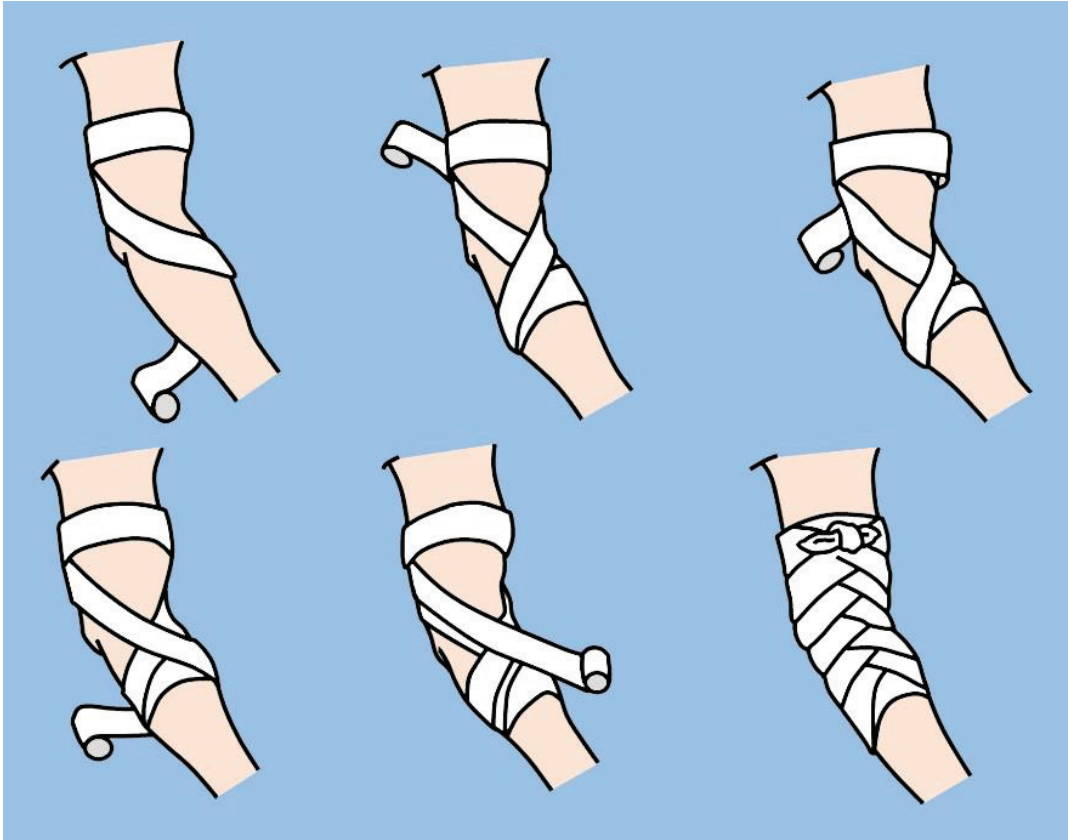
In bandaging an extremity, it is recommended to leave the fingers or toes exposed so the circulation of these parts may be permanently observed. It is likewise safer to apply a large number of turns of a bandage, rather than a few turns applied too firmly to secure a compress.

In applying a wet bandage, or one that may become wet, you must take into account a following contraction. The turns of a bandage should completely cover the skin, because any uncovered areas of skin may become pinched between the turns and result pain. In bandaging any extremity, it is advisable to include the whole member so that uniform pressure may be maintained. In bandaging a limb, it is also mandatory, that the part is placed in the position it will occupy when the dressing is finally completed, because variations in the flexion and extension of the part will cause changes in the pressure of the bandage.

The initial turns of a bandage on an extremity should be applied firmly, and when possible, around the part of the limb, that has the smallest circumference. Thus, in bandaging the arm or hand, the initial turns usually are applied around the wrist. In bandaging the leg or foot, the initial turns are applied immediately above the ankle. The final turns of a completed bandage usually are secured in the same manner as the initial turns, by using two or more overlying circular turns. The terminal end of the completed bandage is turned under and secured to the final turns by either a safety pin or adhesive tape. When these are not available, the end of the bandage may be split lengthwise for several centimeters, and the two resulting tails may be secured around the part by tying.

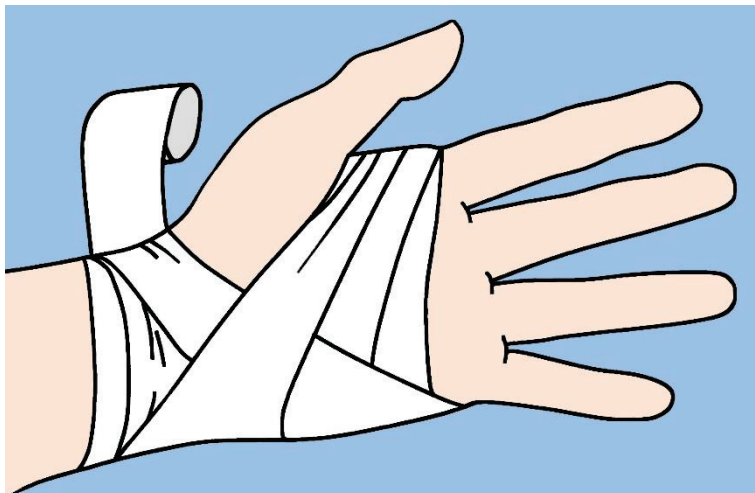
**Roller bandage for elbow.** A spica or figure-of-eight type of bandage is used around the elbow joint to retain a compress in the elbow region and to allow a certain amount of movement.

Flex the elbow slightly, if you can do so without causing any additional pain or injury, or anchor a medium-width bandage above the elbow and encircle the forearm below the elbow with a circular turn. Continue the bandage upward across the hollow of the elbow to the starting point. Make another circular turn around the upper arm, carry it downward, repeating the figure-of-eight procedure, and gradually ascend the arm. Overlap each previous turn about two-thirds of the width of the bandage. Secure the bandage with two circular turns above the elbow and tie. To secure a dressing on the tip of the elbow, reverse the procedure and cross the bandage in the back (Fig.58).



**Fig.58.** Roller bandage for the elbow. Explanation in the text.

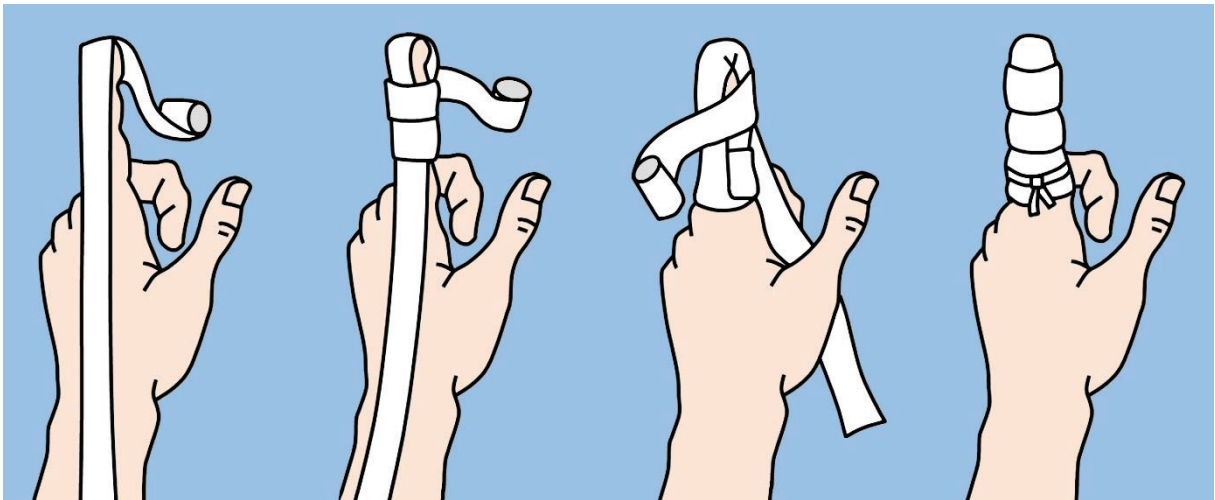
**Roller bandage for hand and wrist.** A figure-of-eight bandage is ideal for the hand and wrist. Anchor the dressing, whether it is on the hand or wrist, with several turns of a medium-width bandage. If it is on the hand, anchor the dressing with several turns and continue the bandage diagonally upward and around the wrist and back over the wound. Make as many turns as necessary to secure the compress properly (Fig.59).



**Fig.59.** Roller bandage for the hand and wrist.

**Roller bandage for finger.** Place sterile dressing upon the wound and cover the dorsal surface of finger with free end of narrow roller bandage leaving excess of approximately 40 cm. Then pull the bandage downward covering the tip and palmar surface of finger and change direction

of bandage applying two-three circular turns around the finger. Repeat this technique using both ends of bandage. Continue as long as necessary and secure around base of finger (Fig.60).



**Fig.60.** Roller bandage for the finger. Explanation in the text.

**Spiral reverse bandage for thumb.** Anchor the bandage making two or three circular turns around the wrist. Then cover the finger downward to the tip, going around and making the reverse laps on each turning, overlapping about one-third to one-half the width of the previous turn. Continue as long as each turn lies flat.

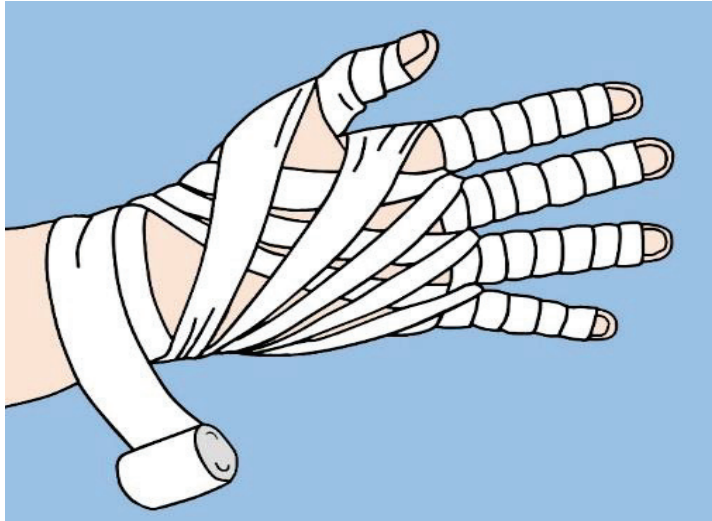
Then go up, repeating the manipulation, and tie the end around the wrist (Fig.61).



**Fig.61.** Spiral reverse bandage for the thumb.

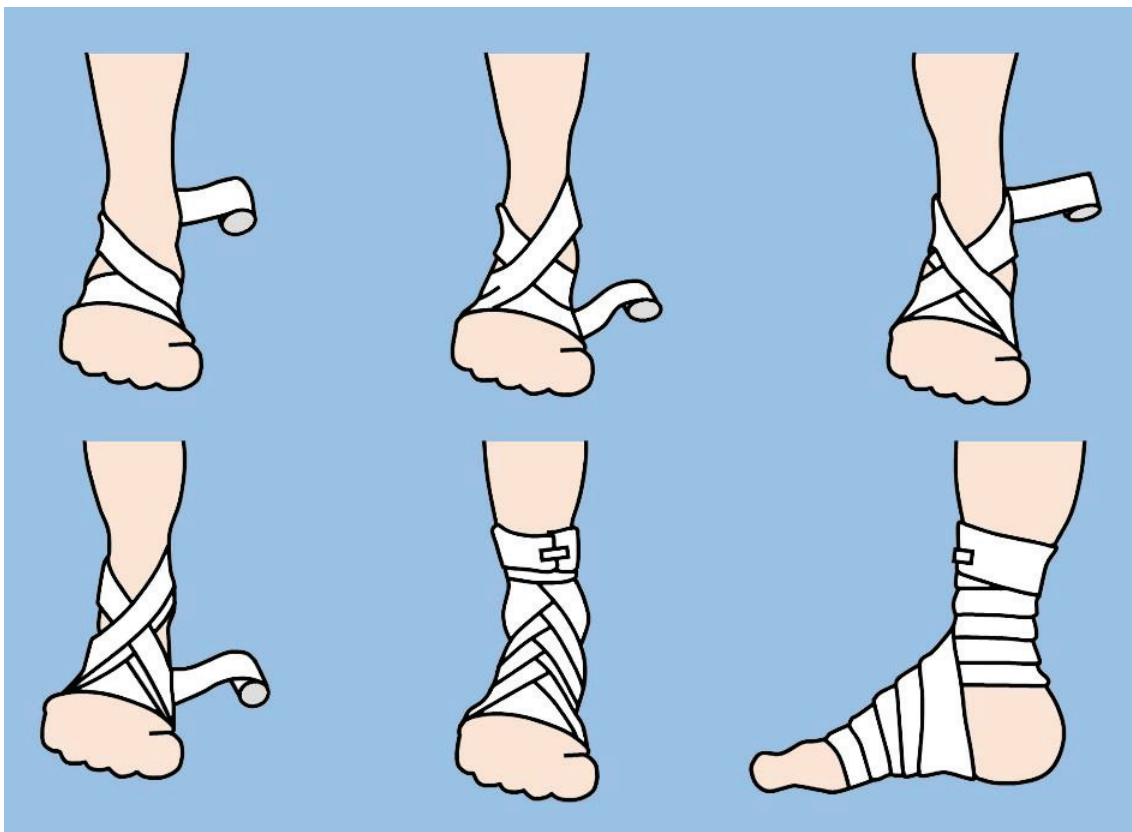
**Roller bandage for all fingers.** Make two or three circular turns around the lower and smaller part of the limb to anchor the bandage and go downward cross the dorsal surface of hand to the tip of finger. Roll the bandage around the finger upward, continue the bandage crossing the dorsal surface of hand and making several turns around the wrist, then make the same on the next finger (Fig.62).

Start the bandage from the first finger on the right hand and from fifth – on the left hand. Finish the bandage on the wrist.



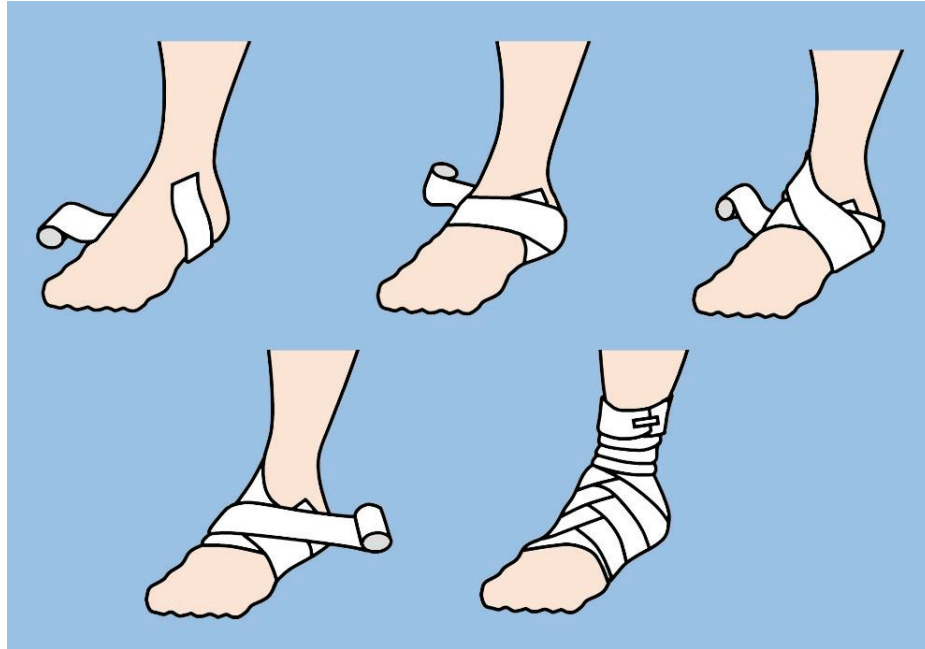
**Fig.62.** Roller bandage for all fingers.

**Roller bandage for ankle and foot.** The figure-of-eight bandage is also used for dressings of the ankle, as well as for supporting a sprain. While keeping the foot at a right angle, start a medium-width bandage around the instep for several turns to anchor it. Pull the bandage upward over the instep and around behind the ankle, forward and again across the instep and down under the arch, thus completing one figure-of-eight. Continue the figure-of-eight turns, overlapping one-third to one-half its width, with an occasional turn around the ankle, until the compress is secured or until adequate support is obtained (Fig.63).



**Fig.63.** Roller bandage for the ankle and foot. Explanation in the text.

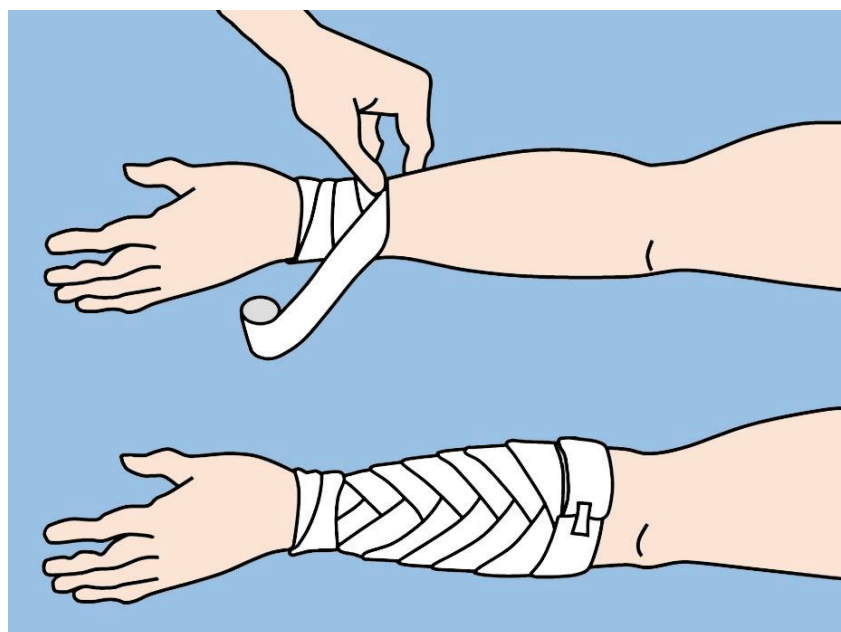
**Roller bandage for heel.** The heel is one of the most difficult parts of the body to bandage. Place the free end of the bandage on the external part of the ankle and bring the bandage under the foot and up. Then carry the bandage over the instep, around the heel, and back over the instep to the starting point. Overlap the lower border of the first loop around the heel and repeat the turn, overlapping the upper border of the loop around the heel (Fig.64).



**Fig.64.** Roller bandage for the heel. Explanation in the text.

Continue this procedure until the desired number of turns is obtained, and secure the bandage with several turns around the lower leg.

**Roller bandage for arm or leg.** Spiral reverse bandage must be used to cover wounds of the forearms and lower extremities; only such bandages can keep the dressing flat and smooth.



**Fig.65.** Roller bandage for the arm. Explanation in the text.

Make two or three circular turns around the lower and smaller part of the limb to anchor the bandage and start upward, going around and making the reverse laps on each turning, overlapping about one-third to one-half the width of the previous turn. Continue as long as each turn lies flat. Continue the spiral and tie the end when completed (Fig.65).

**Velpeau's bandage** is a bandage which serves to immobilize arm to chest wall, with the forearm positioned obliquely across and upward on front of chest. Velpeau's dressing generally is used in case of clavicular fracture and after reduction of humeral dislocation.

Anchor the dressing with several turns of a medium-width bandage around the chest taking affected arm. Continue the bandage under the armpit of the healthy arm crossing the back and covering the affected shoulder. Carry the bandage crossing the clavicle down, turn around the elbow grasping it and go to the armpit of the healthy arm to make another turn around the chest and so on. Horizontal turns gradually progress downward; vertical turns go from outside to inside (Fig.66).

**Desault's bandage** is a bandage which serves to immobilize arm to chest wall, with the forearm positioned horizontally making with upper arm an angle of 90°. It is also used for immobilization in case of clavicular fracture after reduction of humeral dislocation.

Place a cotton bolster under the armpit of affected arm. Anchor the dressing with several turns of a medium-width bandage around the chest taking affected arm. Bandaging left arm start the turns from left to right and bandaging right arm go from right to left (Fig.67).

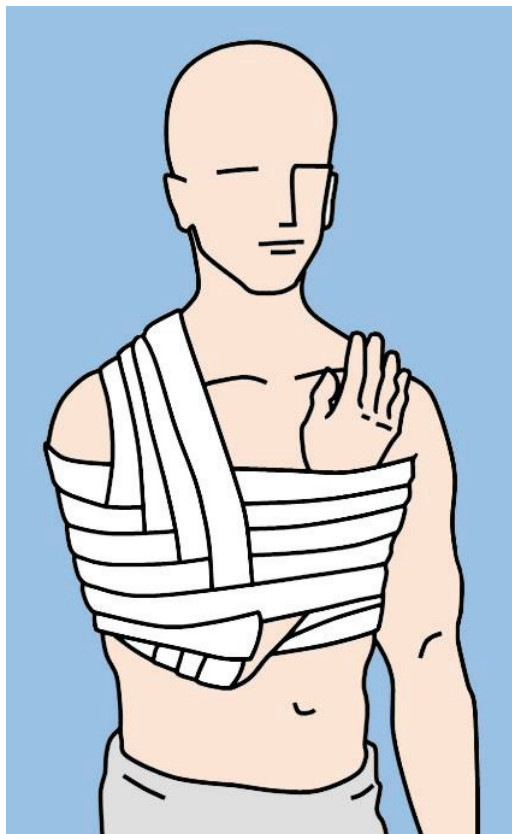


Fig.66. Velpeau's bandage.

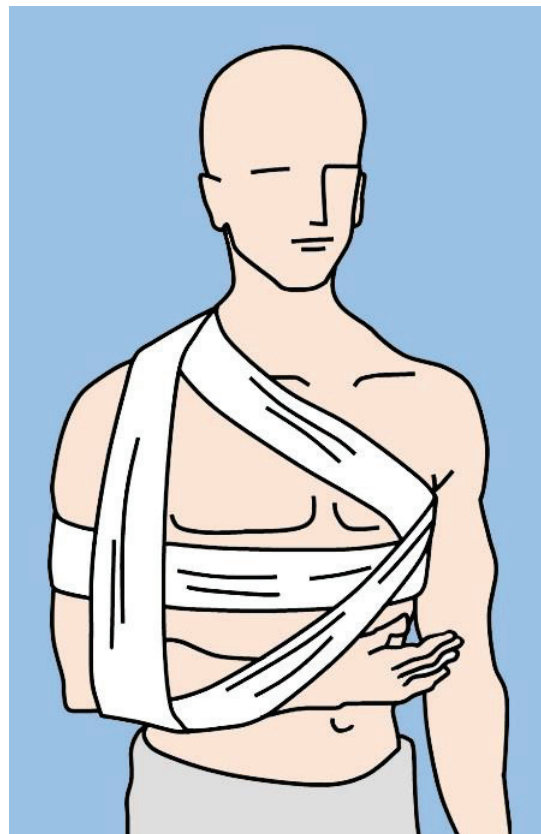


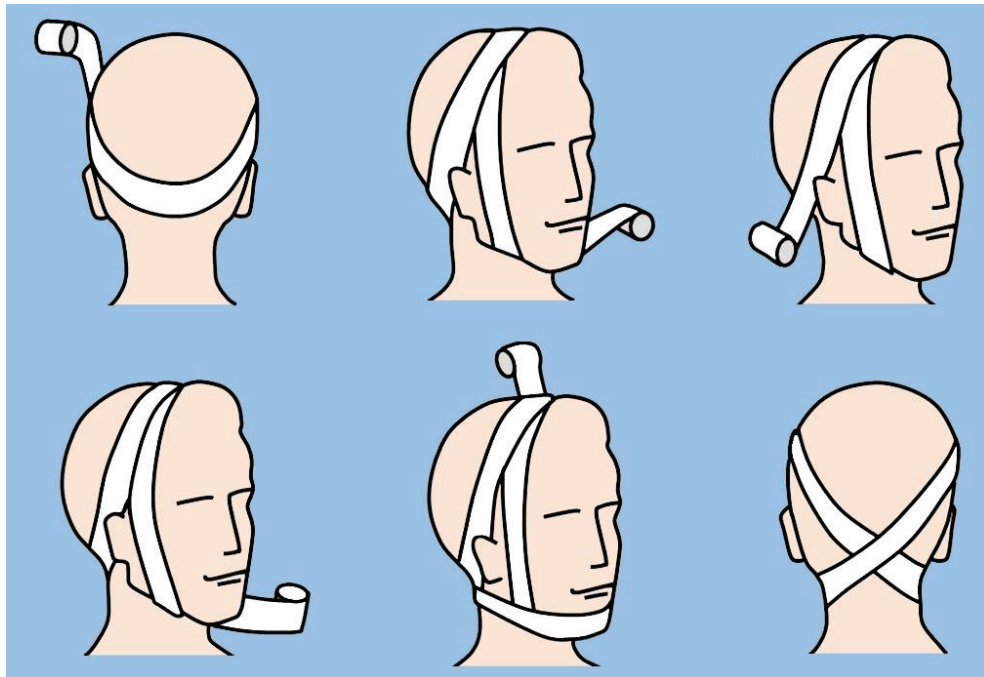
Fig.67. Desault's bandage.

Continue dressing from healthy armpit across the chest to affected clavicle; cover it go down making a turn behind the shoulder and upper arm. Then carry the bandage under the elbow



raising the arm up, continue dressing to the healthy armpit across the chest, go to the affected shoulder behind the back. Make a turn going down, covering the upper arm in front, turn round the elbow and go behind the back to the healthy armpit. Continue the bandage in the same way.

**Barton bandage.** With the initial end of the roller bandage applied to the head, just behind the right mastoid process, the bandage is carried under the bony prominence at the occipital region, upward and forward back of the left ear, obliquely across the top of the head, and downward in front of the right ear (Fig.68).



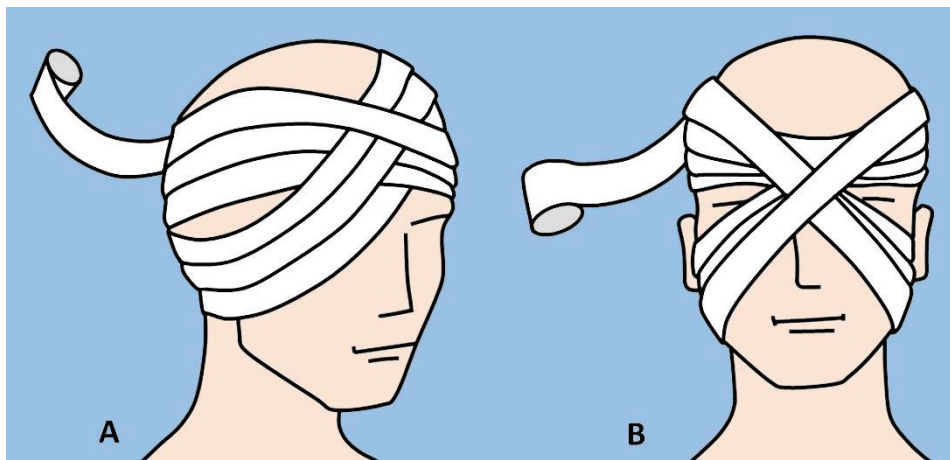
**Fig.68.** Barton bandage. Explanation in the text.

It is then carried under the chin, upward in front of the left ear, obliquely across the top of the head, crossing the first turn in the midline of the head, and then backward and downward to the point of origin behind the right mastoid. Now it is carried around the back of the head under the left ear, around the front of the chin, and under the right ear to the point of origin. This procedure is repeated several times; each turn exactly overlying the preceding turn. The bandage is secured with a pin or strip of adhesive tape at the crossing on top of the head. It may be used for fractures of the mandibula and to retain compresses to the chin.

**Roller bandage for eye.** Take the bandage in the right arm applying a bandage on the right eye and in the left arm in case of applying on the left eye. Place some gauze on the affected eye and make two or three circular turns around the forehead and occiput to anchor the bandage. Continue the bandage moving from occiput behind the ear across the face covering the affected eye. Then repeat a circular turn around the forehead and occiput, go behind the ear and repeat the same movement across the face covering the former turn for a third. Repeat the same several times to cover completely affected orbital area (Fig.69A).

Bandaging starts from right eye in case of necessity to cover both eyes. Make two or three circular turns around the forehead and occiput to anchor the bandage. Continue the bandage moving from occiput behind the right ear across the face covering the eye. Then repeat a

circular turn around the forehead and occiput. Make a turn above the right ear across the face behind the left ear, covering the left eye, go upward and make a turn around the head. Repeat the same until both orbital areas are covered completely (Fig.69B).



**Fig.69.** Roller bandage for eyes: A. For one eye; B. For both eyes.

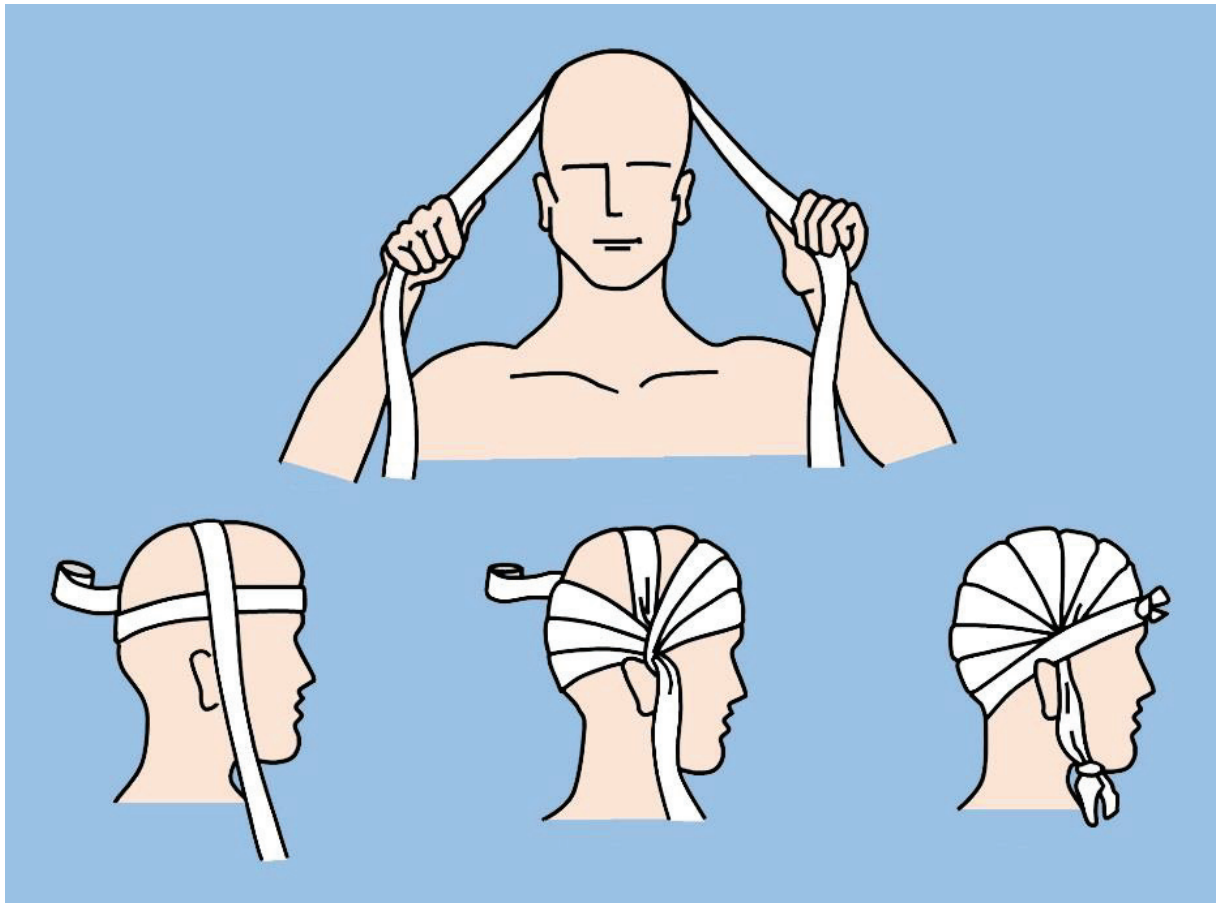
**Hippocrates' bandage** is a complicate bandage of head, and is used for wounds and injuries to the scalp.

It is applied using a double-headed bandage, moving its heads in two perpendicular planes, periodically crossing them to form a bandage looking like hat or Hippocrates' bandage (Fig.70).



**Fig.70.** Hippocrates' bandage. Explanation in the text.

**Capeline bandage** is a complicate bandage of head, applied using a medium-width bandage, crossing a band of gauze in that way changing its direction to cover completely the head in the form of a capeline (Fig.71).



**Fig.71.** Capeline bandage. Explanation in the text.

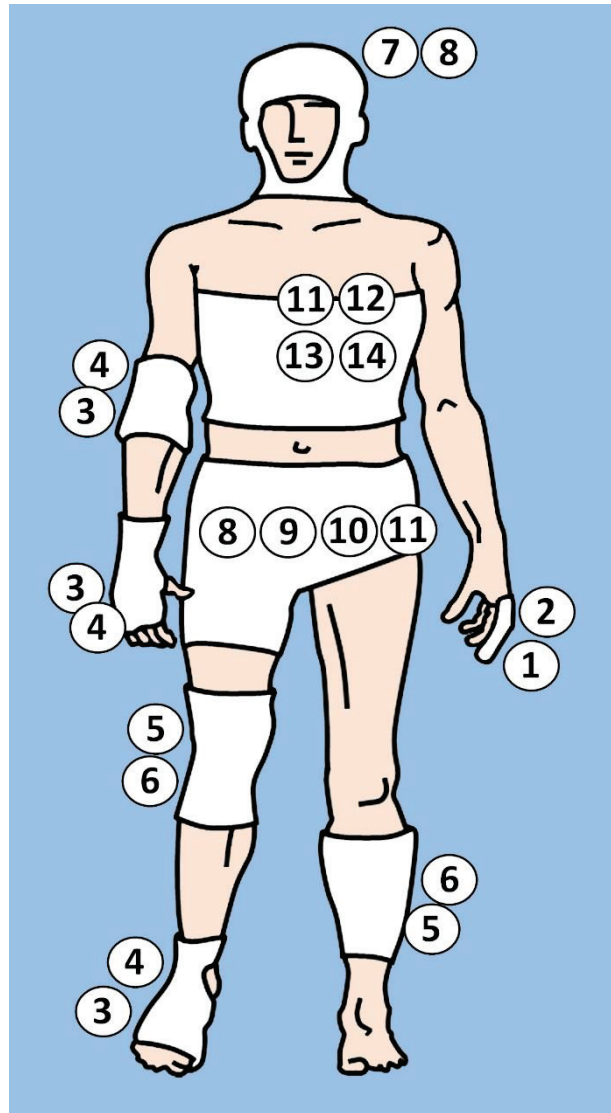
### **ELASTIC NET RETENTION BANDAGES**

Elastic net retention bandage is designed to secure other dressings in place without using adhesive. Possessing the elastic property, it fits tightly to any part of human body, and does not become loose during cutting and does not disturb movement. This type of bandage also allows monitoring the damaged area (Fig.72).

There are several sizes of elastic net retention bandage: size 1-3 for toes, fingers, wrist or ankle; size 4-7 for hands, feet, legs, arms, head and neck; size 8-14 for torso, abdomen, perineum; size 20 for large chest and abdomen. One can choose appropriate bandage to be applied on different part of the human body (Fig.73).



**Fig.72.** Elastic net retention bandage in the box.



**Fig.73.** Recommended sizes of net retention bandage for use on different parts of the body.

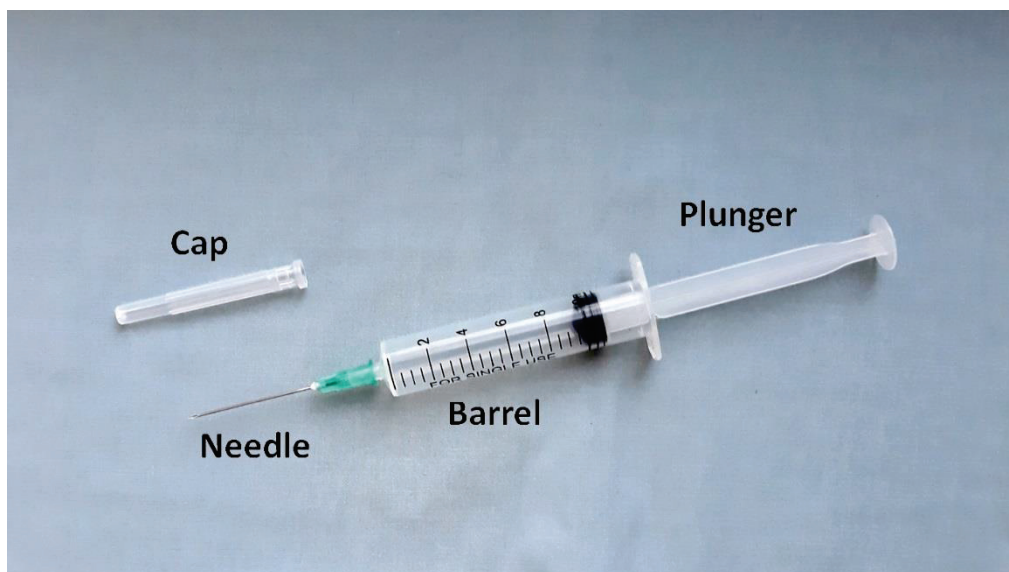
### III. MINOR INVASIVE SURGICAL MANIPULATIONS

#### INJECTIONS

Parenteral route of drug administration is the most requested in surgical patients. Intravenous, intramuscular and subcutaneous ways being more widely used in clinical practice.

**Subcutaneous injection.** There is little blood flow to fatty tissue, and the injected medication is generally absorbed more slowly, sometimes over 24 hours. It is important to explain the procedure to patient before and to check whether the patient has any known allergies to the drug expected to be injected.

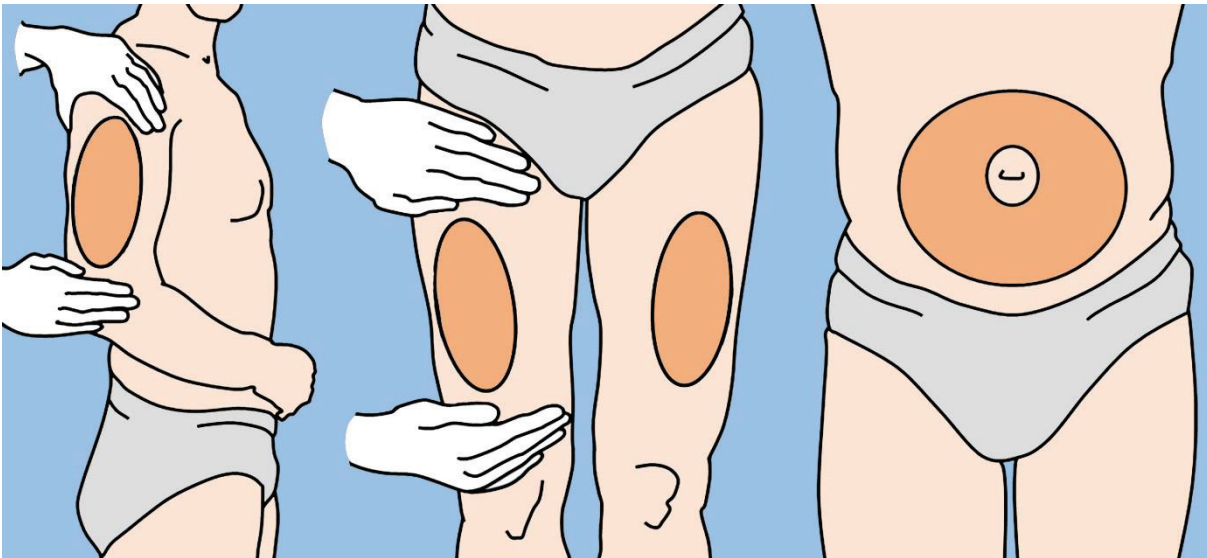
Hands must be washed and dried thoroughly and gloves should be worn before starting any kind of injections. Is necessary to open the packaging of the syringe at the plunger end and remove the syringe, and then to open the needle packaging at the hilt end and then attach the needle firmly. Terminology for the various components of a sterile disposable syringe is shown in Fig.74.



**Fig.74.** Components of a sterile disposable syringe with a needle.

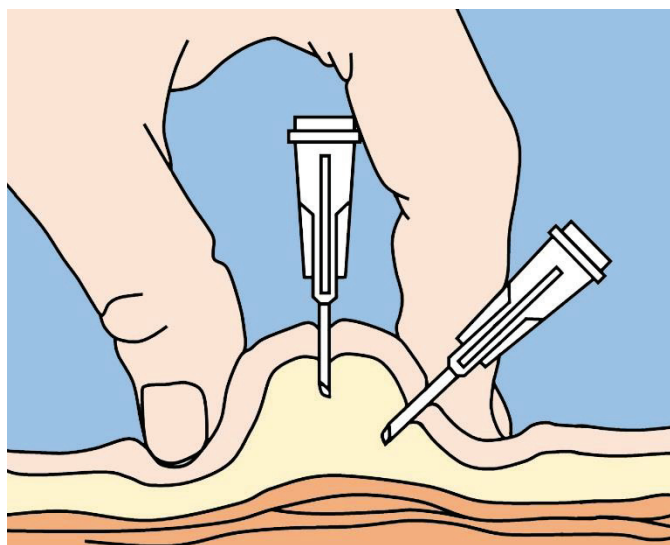
Pick up the syringe and insert the needle into the solution of the ampoule. When drug is in powder form is necessary to dilute it according to the manufacturer's recommendations. All solutions need to be inspected for precipitation and cloudiness. While holding the syringe upright, at eye level and remove all air from the syringe by slowly pressing the plunger.

Subcutaneous injections can be given in the arms, legs, or abdomen (Fig.75). It is extremely important to rotate (change) sites to prevent scarring and hardening of fatty tissue, and to keep the skin healthy.



**Fig.75.** Common sites for subcutaneous injections.

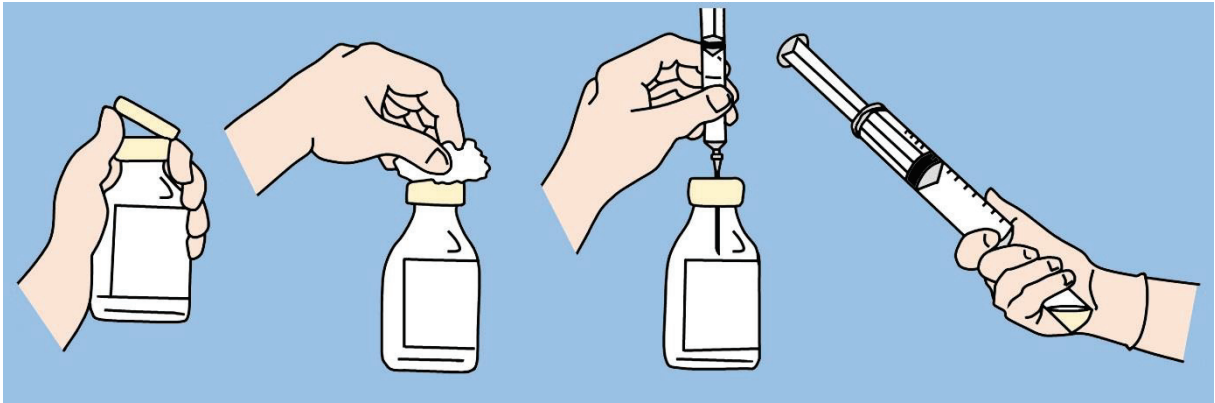
Cleanse the skin with an alcohol swab and allow the alcohol to dry completely by air. Take the cover off the needle. Hold the syringe in one hand like pencil or a dart. Grasp the skin and pinch up (Fig.76). Quickly insert the needle at an angle of  $90^\circ$  (when using a small needle) or at an angle of  $45^\circ$  (when subcutaneous tissue is less developed), and then release the skin. Press down on the plunger to release medication into the subcutaneous layer. As the needle is pulled out of the skin, gently press gauze onto the injected site.



**Fig.76.** The technique of subcutaneous injections. Explanation in the text.

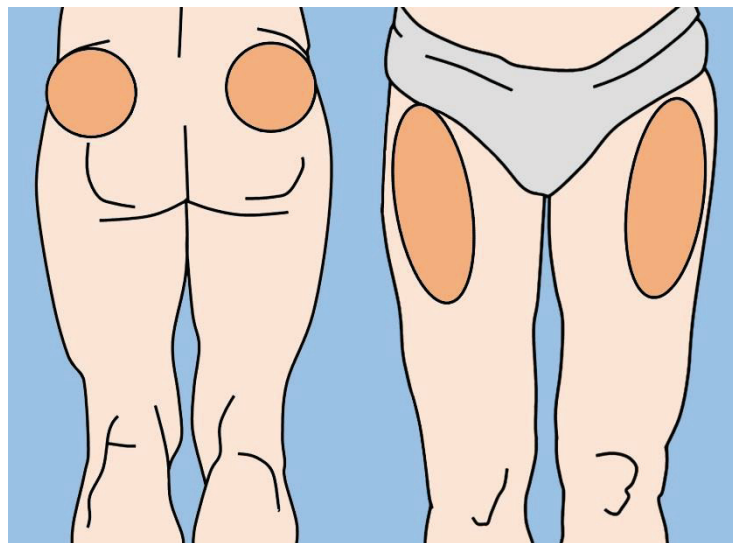
**Intramuscular injection.** An intramuscular injection is chosen when a reasonably rapid systemic uptake of the drug (within 15-20 minutes) is needed and relatively prolonged action is required. The amounts of solution that can be given range from 1 to 5 milliliters for adults. Skeletal muscles have fewer pain-sensing nerves than subcutaneous tissue and can absorb larger volumes of solution because of the rapid uptake of the drug into the bloodstream via the muscle fibers. This means that intramuscular injections are less painful and can be used to inject concentrated and irritant drugs.

Vial of liquid is accessed by removal of the soft metal or plastic cap (Fig.77). Then rubber stopper is cleaned using an alcohol swab. The syringe is removed from the cover and needle is securely attached. Pull back the plunger, filling the syringe with air equal to the amount of medication to be administered. After, remove the cap covering the needle and push the needle through the cleansed rubber stopper in vial. Inject the air, and turn the vial upside down, with the needle remaining inside. Pull back on the plunger to fill the syringe.



**Fig.77.** Filling the syringe with medicinal solution from vial. Explanation in the text.

There are 5 sites that can be considered suitable for intramuscular injections: *vastus lateralis* and ventro-gluteal (these two are most recommended sites) (Fig.78). Additional sites: mid-deltoid site, dorso-gluteal, *rectus femoris*.



**Fig.78.** The most recommended sites for intramuscular injections.

Skin of injection site must be cleaned with an impregnated alcohol swab and then allowed to dry. With the non-dominant hand, the skin should be slightly stretched over the chosen site. With the dominant hand is necessary to hold the syringe, then quickly and firmly in a dart-like motion – to insert the needle into the patient’s skin at an angle of 90 degrees until approximately 1 centimeter of the needle is left visible (Fig.79). Hold the skin and the colored part of the needle to maintain stability and prevent any movement. Depress the plunger and carefully inject the solution at a rate of 1 milliliter per 10 seconds until the syringe is empty. Wait 10 seconds to allow the drug to diffuse into the tissues then quickly and smoothly

withdraw the needle. Apply pressure to the injection site until any bleeding ceases and cover injection site with sterile small gauze. Discard the needle and syringe immediately in a special medical waste container.

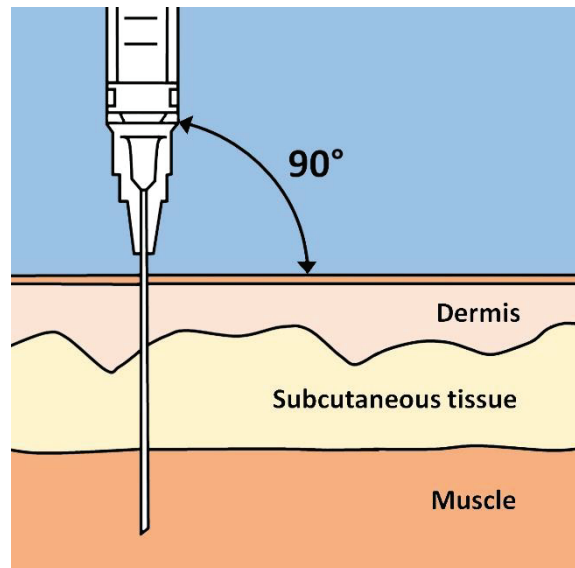


Fig.79. Correct placement of the needle during intramuscular injection.

**Intravenous injection.** Intravenous administration of a drug ensures that the entire dose enters into the general circulation. Intravenous administration bypasses the absorption phase and the hepatic first-pass effect, bioavailability is therefore complete. Injecting into a vein is considerably more complicated and dangerous than other types of injection. After cleaning the skin is necessary to wrap the tourniquet around the arm, just above the injection site (Fig.80). Anchor the vein and ask the patient to form a fist (veins become more prominent).

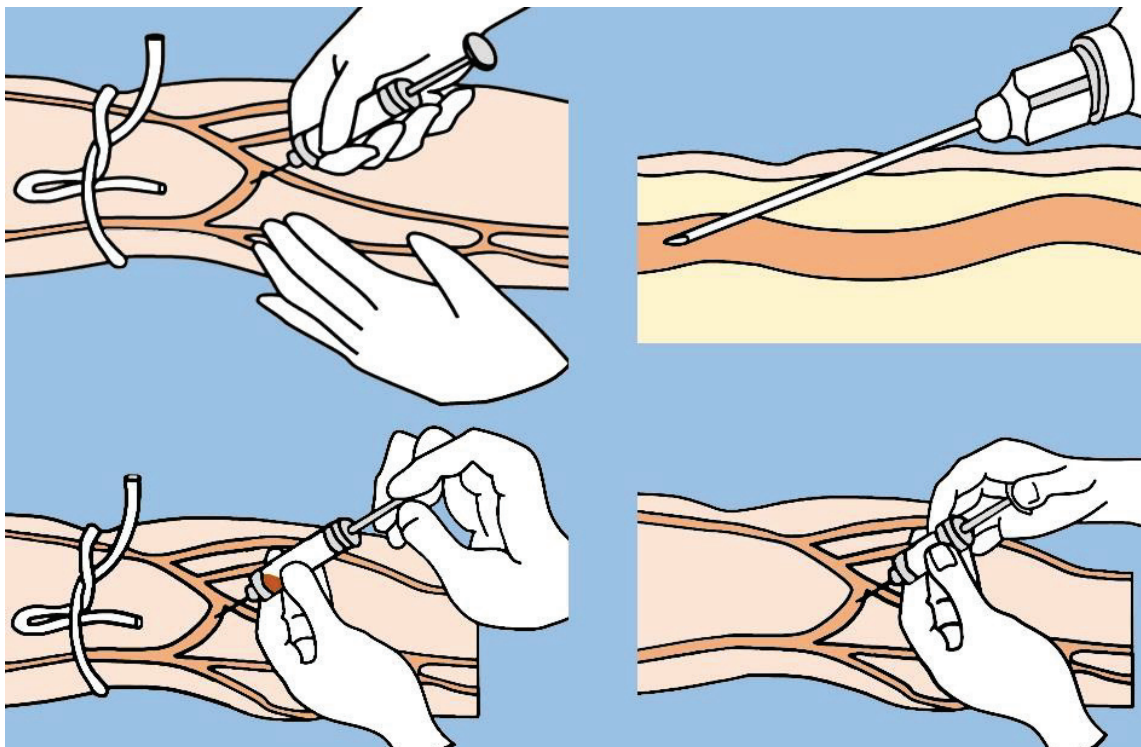


Fig.80. The technique of intravenous injection. Explanation in the text.

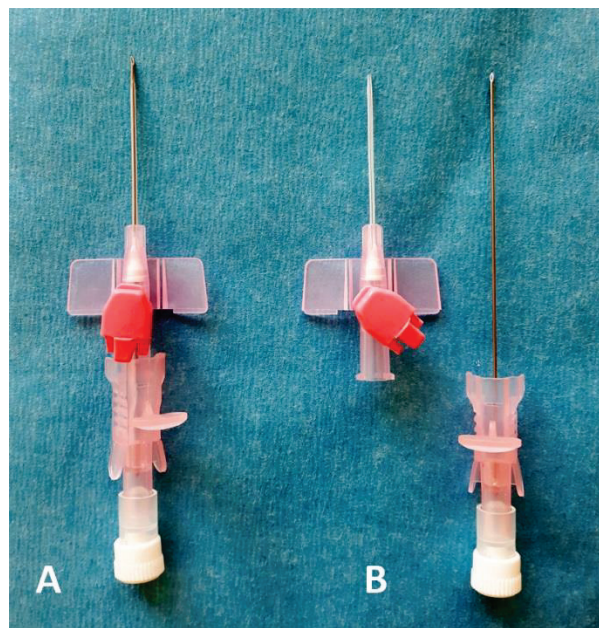


Needle is inserted in the vein at an angle of 30 degrees or less. Continue to introduce the needle along the vein. When vein is hitting, pull back the plunger slightly to test for blood. If aspirated blood is dark (it means that needle is in the venous lumen) tourniquet should be removed. Slowly push in plunger and administer drug. Pull out then needle and apply pressure with clean gauze.

**Vascular access.** Intravenous way is the most important vascular access for surgical patients. Although simple injection of peripheral veins with a needle is effective for short-term use, but is not suitable for long-term use. Moreover, superficial peripheral veins may be difficult to locate in emergent situations, central venous access being required. That suppose insertion of special devices called catheter (flexible thin plastic tube) inside a major vein (generally in one of the large veins in the neck or in the arm).

There are 3 basic methods of inserting the catheter.

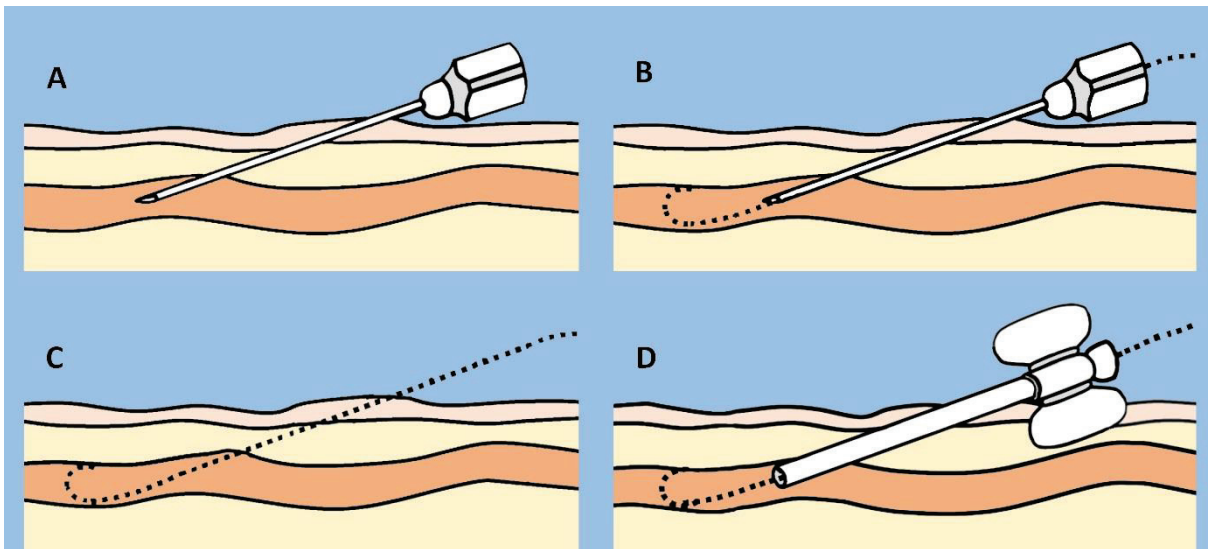
**(1) Catheter over the needle.** The needle is surrounded by a plastic tube up to the bevel end (Fig.81). After puncture of the vein, the needle is withdrawn out of the catheter. The catheter is then advanced further into the blood vessel.



**Fig.81.** Catheter over the needle: A. Needle with catheter assembled, ready to be inserted into a vein; B. After puncture, the needle is removed, only plastic catheter remains in the lumen of vein.

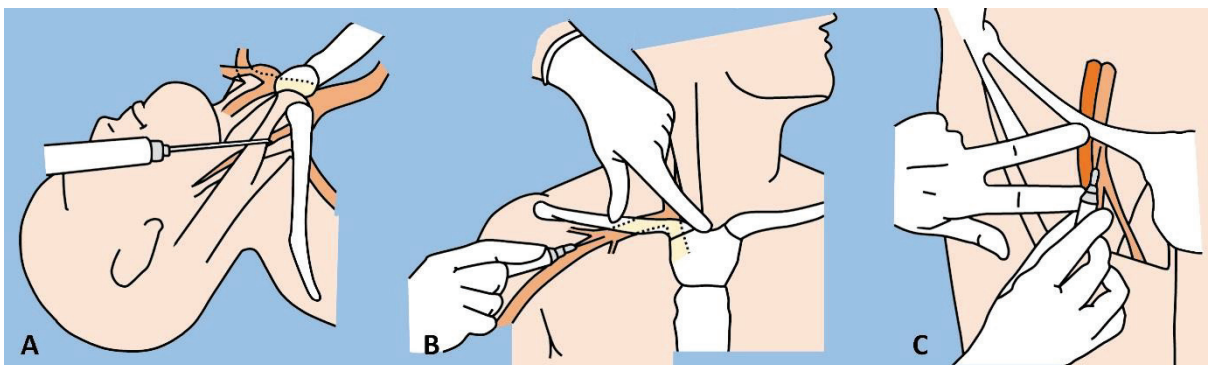
**(2) Catheter through the needle.** The catheter is passed through the needle placed in the vein. The vessel is first punctured with a steel needle. Then the catheter is advanced into the vein. Then the steel needle is withdrawn and the end of the catheter is fixed.

**(3) Catheter over guide-wire (Seldinger technique)** – is the preferred method of insertion. A small diameter needle is used to find the vein (Fig.82). A guide-wire is passed down the needle into the vein and the needle is removed. The guide-wire commonly has a flexible J-shaped tip to reduce the risk of vessel perforation. Once the wire is placed in the vein, the catheter is passed over until it is positioned in the vein.



**Fig.82.** Steps of vein catheterization according to Seldinger technique: A. Puncture of the vein with a needle; B. Introduction into the lumen of vein of a flexible guide through the lumen of the needle; C. Removing the needle; D. Introduction of a plastic catheter into the lumen of vein over the guidewire.

For peripheral venipuncture the common site is usually a vein in the arm or on the flat bony area (dorsum) of the hand. In opposite, routes for central venous cannulation include: internal jugular, subclavian, femoral, antecubital and external jugular veins. First three ways are typically used for venous access (Fig.83).

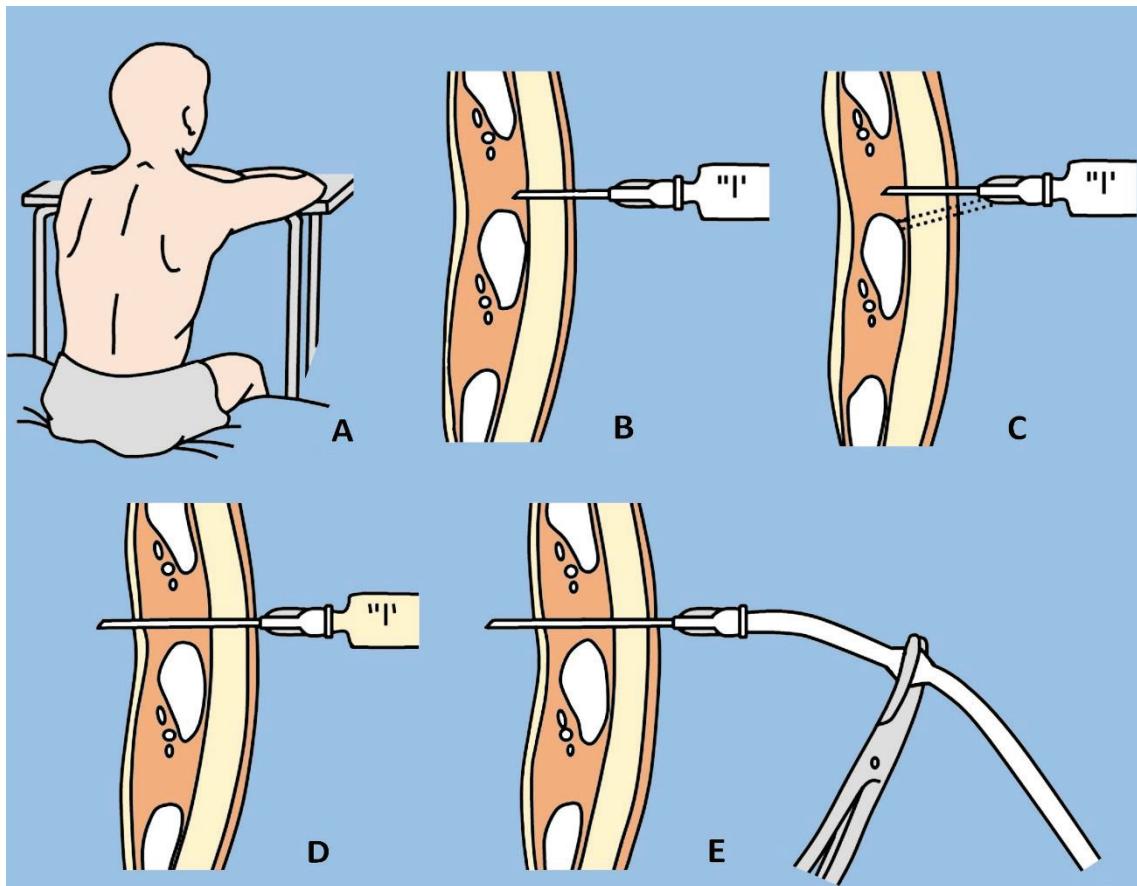


**Fig.83.** Central venous catheterization: A. Internal jugular vein cannulation; B. Subclavian venous access; C. Femoral venous access.

### THORACIC PROCEDURES

**Thoracocentesis** is a puncture of the pleural cavity to remove fluid or air for diagnostic or therapeutic purposes. The most common causes of pleural effusions are pneumonia, congestive heart failure, cancer, recent surgery, tuberculosis.

Cooperative patients will in a seated position leaning, slightly forward, with arms/hands placed on an adjustable chair or table (Fig.84). Unstable patients and those who are unable to sit up may be supine for the procedure. As general landmarks, the puncture is performed on midclavicular line, in the 2<sup>nd</sup>-3<sup>rd</sup> intercostal space in case of air accumulation, and on the midaxillary line in the 7<sup>th</sup>-9<sup>th</sup> intercostal space – in case of fluid accumulation.



**Fig.84.** Thoracocentesis (puncture of pleural cavity): A. Recommended position of patient during thoracocentesis; B. Local anesthesia of the skin, fascia, intercostal muscles and parietal pleura; C. If needle stops on the rib, direction of its movement should be changed a little upward; D. Puncture of the pleural cavity and test aspiration of pathological contents; E. Replacing a conventional needle with a thicker and longer thoracocentesis needle with a rubber tube attached to it.

A wide skin area is cleaned with an antiseptic solution, and then soft tissue is well infiltrated with anesthetic (Lidocaine of 1-2%). Anesthetize the superior surface of the rib and the parietal pleura also. The needle is inserted above the rib into the pleural space and not below, in order to prevent lesions of vessels and nerves. As the needle is inserted, aspirate back on the syringe to check for pleural fluid or air. Then remove the anesthetizing needle and advance the centesis' needle until it encounters the superior aspect of the rib.

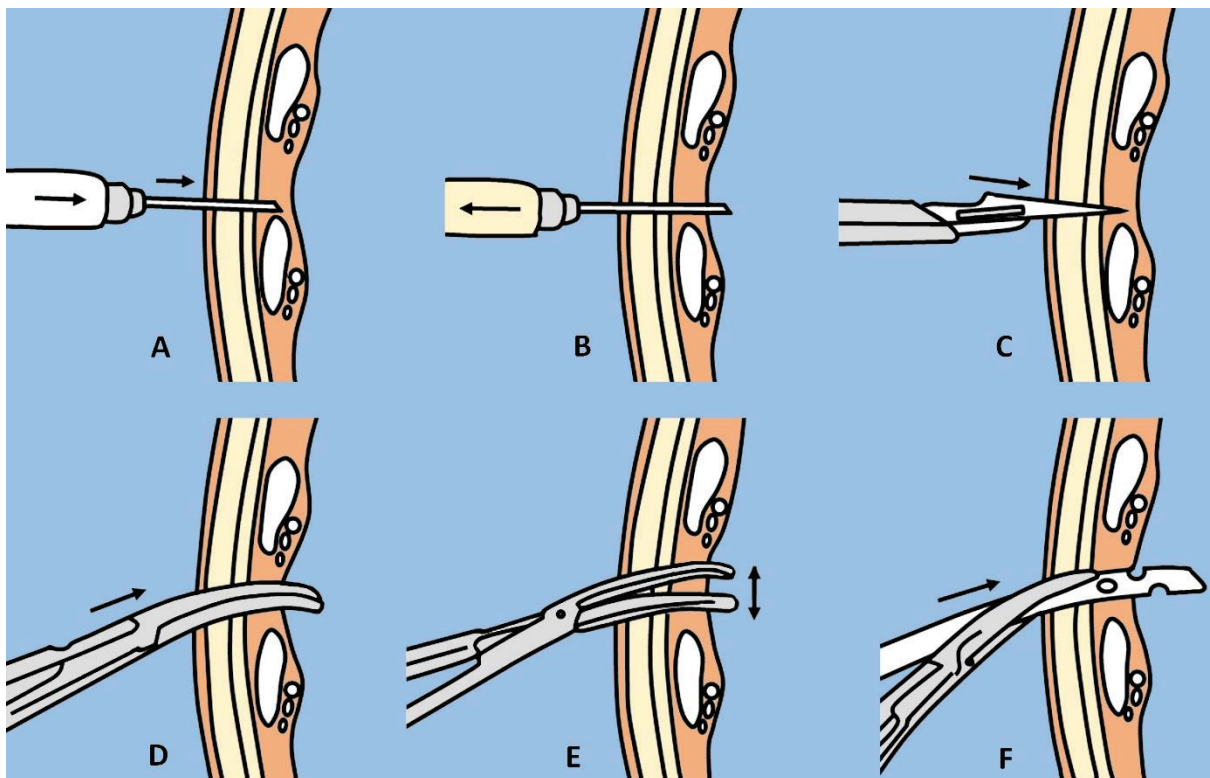
When pleural cavity is reached attach the tube and withdraw the required amount, closing the tub when evacuate the fluid or air from syringe (to prevent penetration of air in the pleural cavity). When draining of fluid is completed, asked the patient to take a deep breath and gently remove the needle. Cover the insertion site with a sterile occlusive dressing.

**Thoracostomy** (also known as a Bulau drain, chest tube or intercostal catheter) is insertion of a drain through the wall of the chest into the pleural space. As thoracocentesis it is used to remove air or fluid from the intrathoracic space but in cases when there is larger volume of pathological contents. So indications are: pneumothorax, chylothorax (a collection of lymphatic fluid in the pleural space); pleural empyema; hemothorax; hydrothorax or penetrating chest wall injury.

First, is necessary to assemble the drainage system, to attach a valve mechanism at external end of drainage tube, usually made from finger of surgical glove. The last one is V-shaped cut,

allowing the removal of pathologic content in a reservoir with antiseptic solution, but prevents air penetration into the pleural cavity. The tube more frequently is inserted into the fifth intercostal space slightly anterior to the mid axillary line. The patient should be positioned supine or at a 45° angle. The arm on the affected side should be abducted and externally rotated.

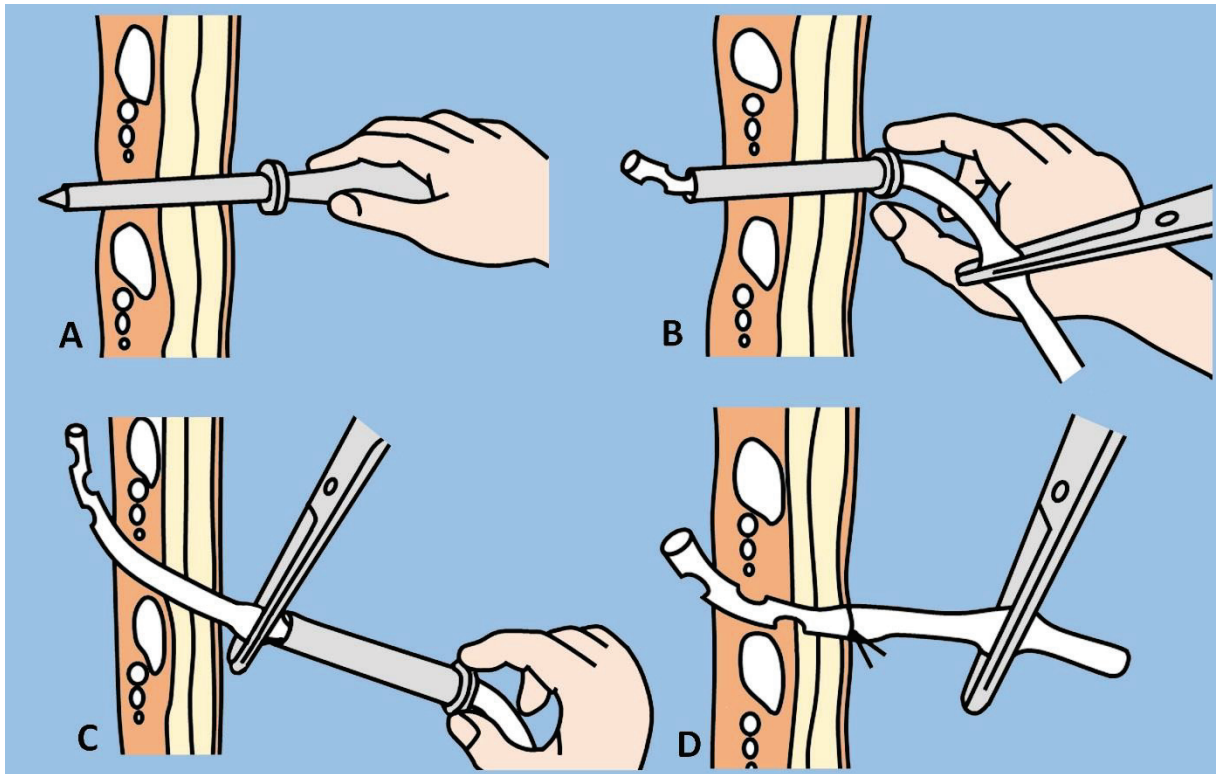
After local anesthesia (until parietal pleura) and small skin incision (in the same direction as the rib) a passage is made through muscle into the pleural cavity over a rib that is below the intercostal level selected for chest tube insertion (Fig.85). Tube thoracostomy can be performed by either the blunt dissection technique or the trocar technique. In first case passage is made using blunt dissection down to the intercostal muscle. Grasp the proximal (fenestrated) end of the chest tube with the clamp and introduce it into the thoracic cavity (keeping distal end clamped). Then tube is sutured to the skin and an occlusive bandage is applied. The outer end of the drain is attached to an underwater seal, below the level of the chest. This allows the air or fluid to escape from the pleural space, and prevents a reverse flow to the chest.



**Fig.85.** Tube thoracostomy by blunt dissection technique: A. Local anesthesia of the skin, fascia, intercostal muscles and parietal pleura; B. Puncture of the pleural cavity and test aspiration of pathological contents; C. A small incision in the skin and underlying soft tissues; D. Insertion of surgical forceps through the wound into the pleural cavity; E. Expansion of the created canal by blunt tissue dissection; F. The proximal fenestrated end of the drain is grasped and inserted into the pleural cavity.

Chest tubes can also be placed using a trocar. In this case, grasp trocar with one hand close to the sharp end and, after anesthesia and small incision of skin and underlying tissues, propel it slowly and gently above the costal margin into the pleural cavity (Fig.86). Then remove the stylet, keeping closed external hole of trocar. Through the lumen of trocar will be pass a

drainage tube into chest. Then trocar is removed, keeping in place the drainage tube and then fixing it. The outer end of the tube is connected to a drainage system with underwater seal.



**Fig.86.** Tube thoracostomy by trocar technique: A. With careful movements a trocar with stylet is inserted into the pleural cavity above the costal margin; B. The stylet is removed and a drainage tube is passed through the trocar canal into the pleural cavity; C. The trocar is removed while drainage tube remains in pleural cavity; D. Drainage tube is sutured to the skin.

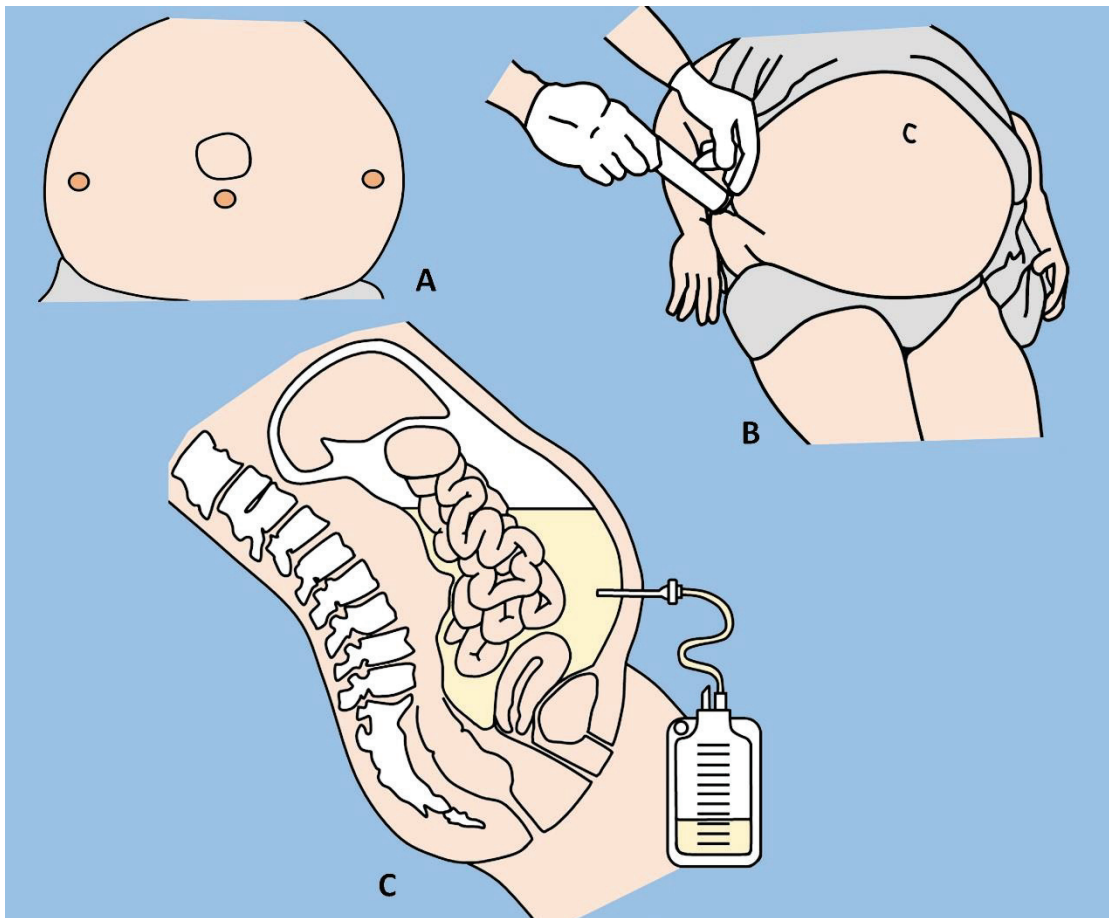
### ABDOMINAL PROCEDURES

**Laparocentesis (or abdominal paracentesis)** is a medical procedure involving puncture and drainage of fluid from peritoneal cavity. More frequently it is done for accumulation of free fluid called – ascites, which may be caused by infection, inflammation, an injury, cirrhosis or cancer. Therapeutic paracentesis is indicated when ascites fluid causes respiratory compromise, or abdominal pain (tense ascites).

First is necessary to empty the patient's bladder. The preferred site of entry into the peritoneal cavity is in the midline (2 centimeters below the umbilicus), and 5 centimeters superior and medial to the anterior superior iliac spines on either side (Fig.87).

The patient is placed in supine position, with head elevated at an angle of 45-60° (to allow fluid to accumulate in lower abdomen), or in lateral decubitus position. After preparation of field around the entry site with an antiseptic solution, local anesthesia is performed. Alternating injection of anesthetic or saline solution and intermittent aspiration until ascitic fluid is noticed in the syringe is recommended. Avoid advancing the needle deeper 1 centimeter beyond the depth at which ascitic fluid was noticed in the syringe. Small incision in the skin will allow an easier catheter insertion to reach the peritoneal fluid. The needle is

then removed. Catheter can be fixed to the skin or extracted at the finish of procedure, placing a firm bandage over the skin puncture site.



**Fig.87.** Paracentesis: A. Preferred sites of abdominal cavity puncture; B. Position of patient during paracentesis lying on his back with the head elevated by 45-60°; C. Removal of fluid from abdominal cavity through a catheter.

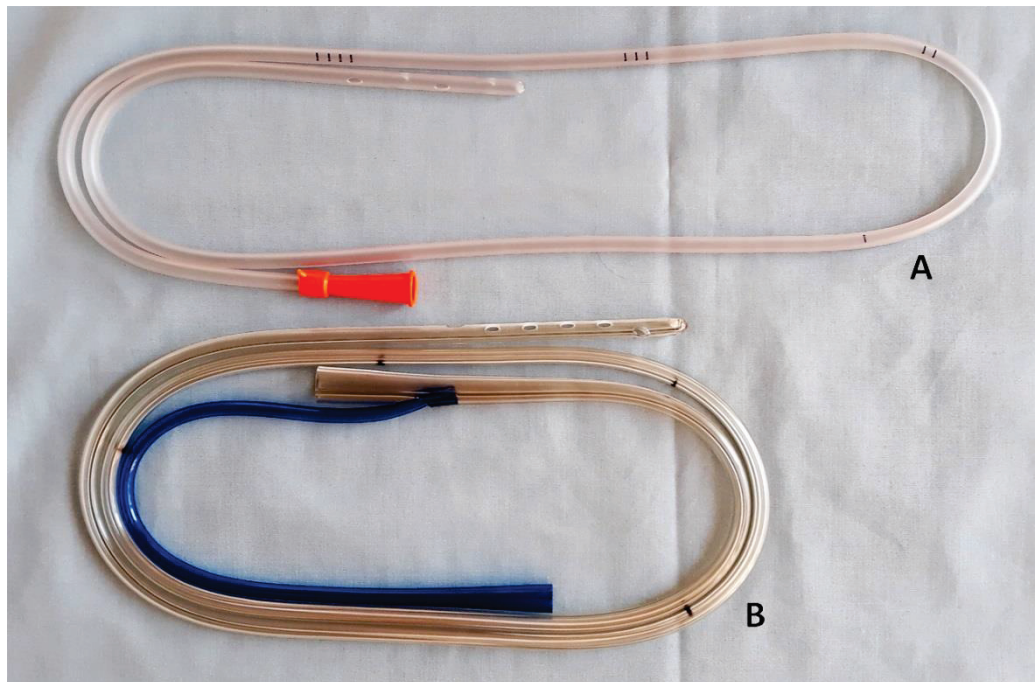
It is recommended that in patients without peripheral edema, the upper limit of extracted fluid should be 1500 milliliters, but patients with peripheral edema may tolerate larger volumes without hypotension (up to 5 liters).

### GASTROINTESTINAL PROCEDURES

**Gastric intubation** is the insertion of a plastic tube usually through the nose down into the stomach. There are diagnostic and therapeutic indications for nasogastric tube placement. As diagnostic indications serve: evaluation of upper gastrointestinal bleeding, aspiration of gastric content, identification of the esophagus and stomach on a chest radiography, administration of radiographic contrast to the gastrointestinal tract. Therapeutic indications are: gastric decompression, relief of symptoms in bowel obstruction, administration of medication, enteral feeding.

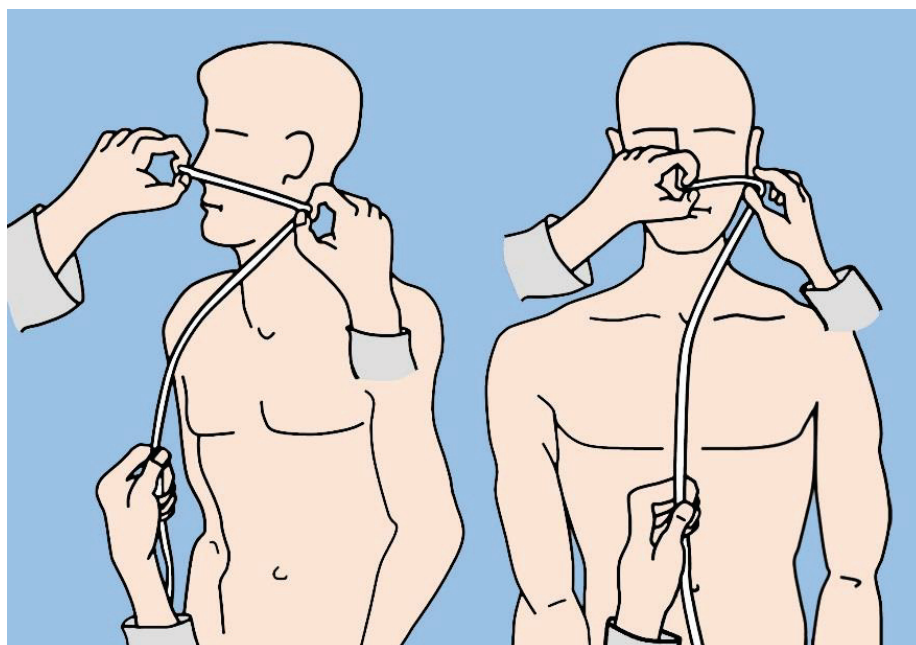
Levin tube (tube with one lumen) and Salem-sump tube (tube with two lumens) are the most commonly used in surgical practice (Fig.88). However, there are and another kind, such

as Miller-Abbott and Cantor tubes. The last two have an inflatable balloon, which facilitates distal propulsion of tube by peristaltic wave.



**Fig.88.** The most commonly used gastric tubes: A. Levin's tube; B. Salem's tube.

Estimate the length of insertion by measuring the distance from the tip of the nose, around the ear, and down to just below the left costal margin, marked this point with a piece of tape on tube (Fig.89).

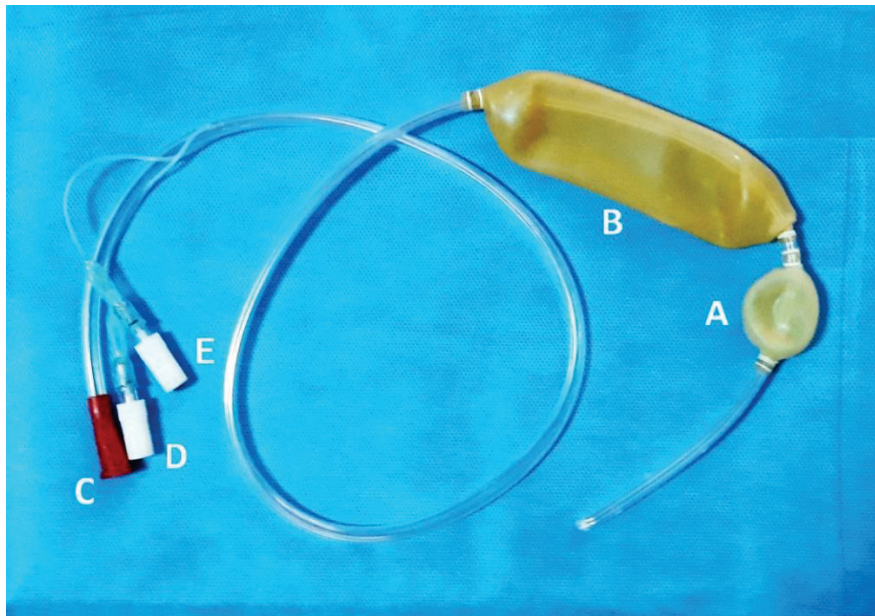


**Fig.89.** Assessment of the required length of nasogastric tube. Explanation in the text.

After lubrication the tube is placed through more patent nostril along the floor of the nose and is advanced till nasopharynx. The patient is asked to sip some water and to start swallow.

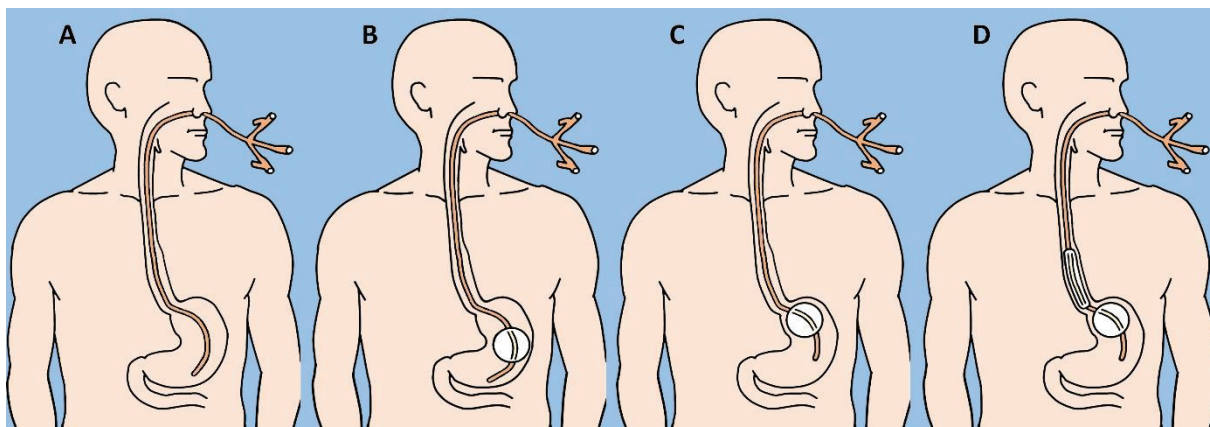
Then nasogastric tube is advanced to stomach until previously estimated length is reached or when gastric contents are aspirated. Fix (tape or bind) the tube to secure it in place.

**Balloon tamponade of upper digestive tract.** Balloon tamponade is used in the management of upper gastrointestinal hemorrhage due to gastro-esophageal varices. Major components of Sengstaken-Blakemore tube used for this purpose are gastric balloon, an esophageal balloon, and a gastric suction port (Fig.90).



**Fig.90.** Sengstaken-Blakemore tube for stopping bleeding from gastro-esophageal varices: A. Gastric balloon; B. Esophageal balloon; C. Gastric suction port; D. Port of the esophageal balloon; E. Port of the gastric balloon.

The technique of balloon tamponade is as follows. The head of the bed should be elevated to 45 degrees, patient being in supine position or in the left lateral decubitus. The tube can be passed through the nostrils or through the mouth. First it's necessary to ensure that the balloons are free of leaks (by inflating with water or air). When, all contents must be aspirated from the balloons.



**Fig.91.** Installation of Sengstaken-Blakemore tube: A. Tube is inserted into the stomach as with a conventional nasogastric tube; B. After tube insertion, the gastric balloon is firstly inflated; C. Then the tube with inflated gastric balloon is pulled outward, thus fixing it in the gastroesophageal junction; D. The esophageal balloon is then inflated, thereby compressing the esophageal varicose veins.

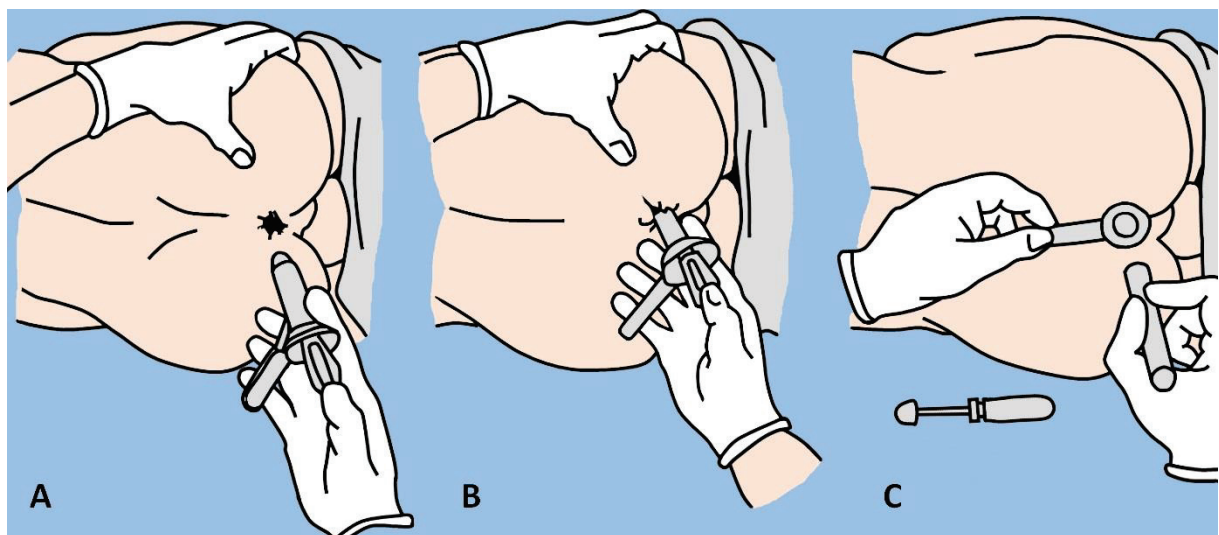


After coating the balloons with water-soluble lubricant, the tube is passed to the stomach (Fig.91). First is performed inflation of gastric balloon (clamping the inlet), following by pulling back the tube until resistance is felt. At this moment the proximal end of the tube should be attached to traction device or secured with tape. Then, esophageal balloon is inflated to the lowest pressure needed to stop bleeding, and inlet port is clamped.

Generally, the esophageal tamponade tube is a temporizing measure and should not be left in place for more than 24 hours (due to the risk of mucosal necrosis, ulceration and perforation). When hemorrhage is controlled deflation of esophageal balloon is performed first. If there is no evidence of bleeding gastric balloon is deflated but tube is left in place for 24 more hours. If bleeding recurs balloons may be re-inflated for an additional 24 hours.

**Anoscopy.** Anoscopy is an examination of anal canal using a small, rigid, tubular instrument called an anoscope. The latter may be of metal or plastic. The rectum should be emptied before the procedure using laxative or an enema. Initially is necessary to perform a physical examination of the abdomen, a visual inspection of the anus and perineum, and a digital rectal examination.

The most common position of patient is the lateral decubitus with the contralateral leg flexed at the knee and the hip, or the knee-shoulder position. After generously lubrication anoscope is gently introduced and slowly advanced with a slight side-to-side twisting motion (Fig.92). Once the anoscope is inserted the obturator should be removed. Anoscope allows thoroughly inspecting of entire anal canal during slowly withdrawing.

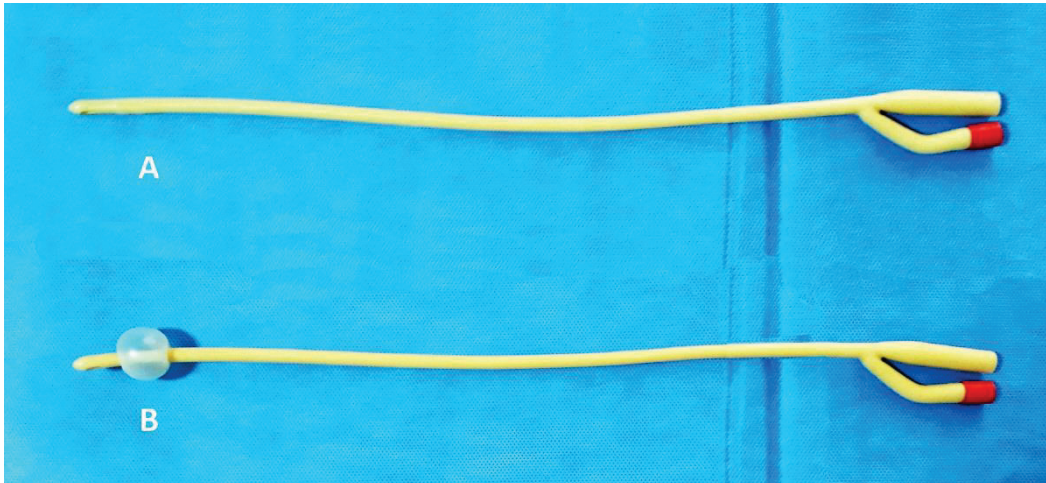


**Fig.92.** Anoscopy: A. Patient lies on his side with the legs adducted; B. Anoscope with inserted obturator is lubricated with ointment and carefully introduced into the anal canal; C. The obturator is then removed and anal canal is inspected, using additional light.

## UROLOGICAL PROCEDURES

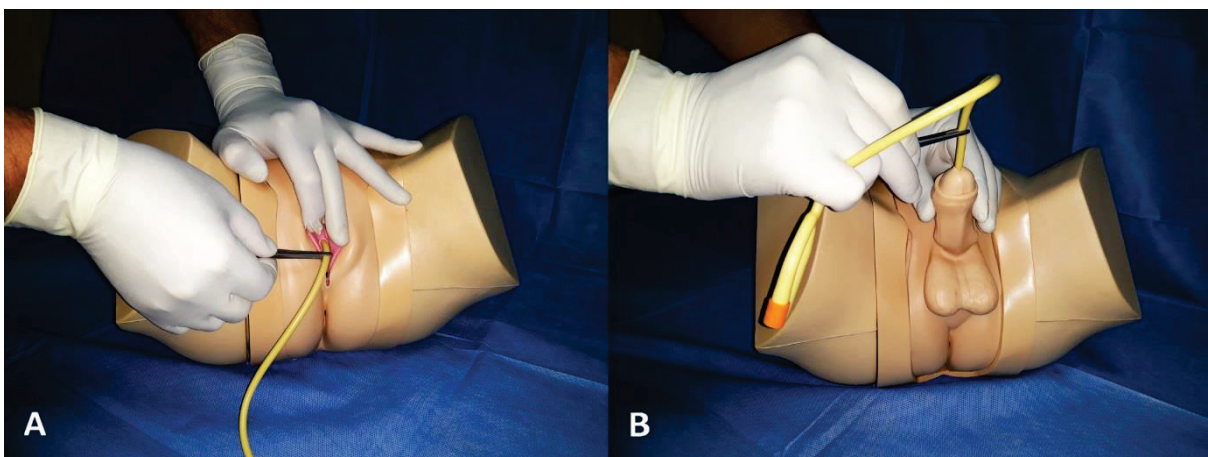
**Urethral catheterization** is the insertion of a tube into the bladder via urethra. Common indications include acute or chronic urinary retention, collection of urine for analysis, orthopedic procedures that may limit a patient's movement, the need for accurate monitoring of fluid volume output.

There are some types of catheters: Foley catheter (with a balloon at the tip, for continuous catheterization) (Fig.93); Robinson catheter (without balloon, used for a short-term drainage of urine); Coudé catheter (with a curved tip that makes it easier to pass through the curvature of the prostatic urethra), and also steel catheter.



**Fig.93.** Foley catheter: A. Before insertion into the urethra; B. With an inflated balloon for secure fixation in the urinary bladder.

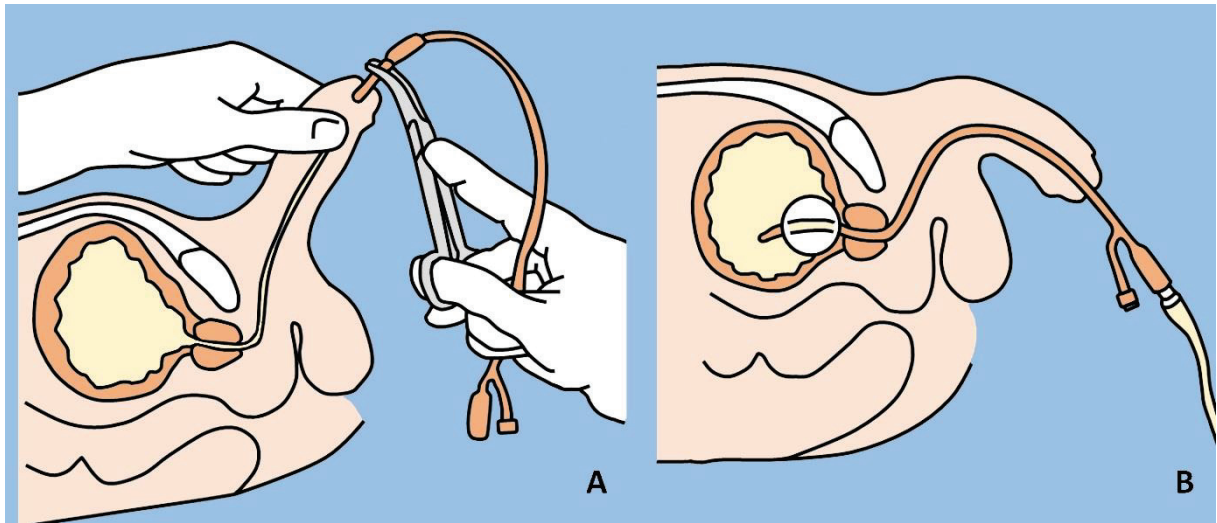
Patient should be in the supine position with legs slightly apart for the male, and with legs apart and knees flexed for the female patient. In addition to lubrication of catheter, preparation of genitalia with antiseptic solution is required. Catheter is inserted slowly and gently into the urethral meatus (in female) or penile urethra (in male) (Fig.94).



**Fig.94.** Urinary bladder catheterization: A. In women; B. In men.

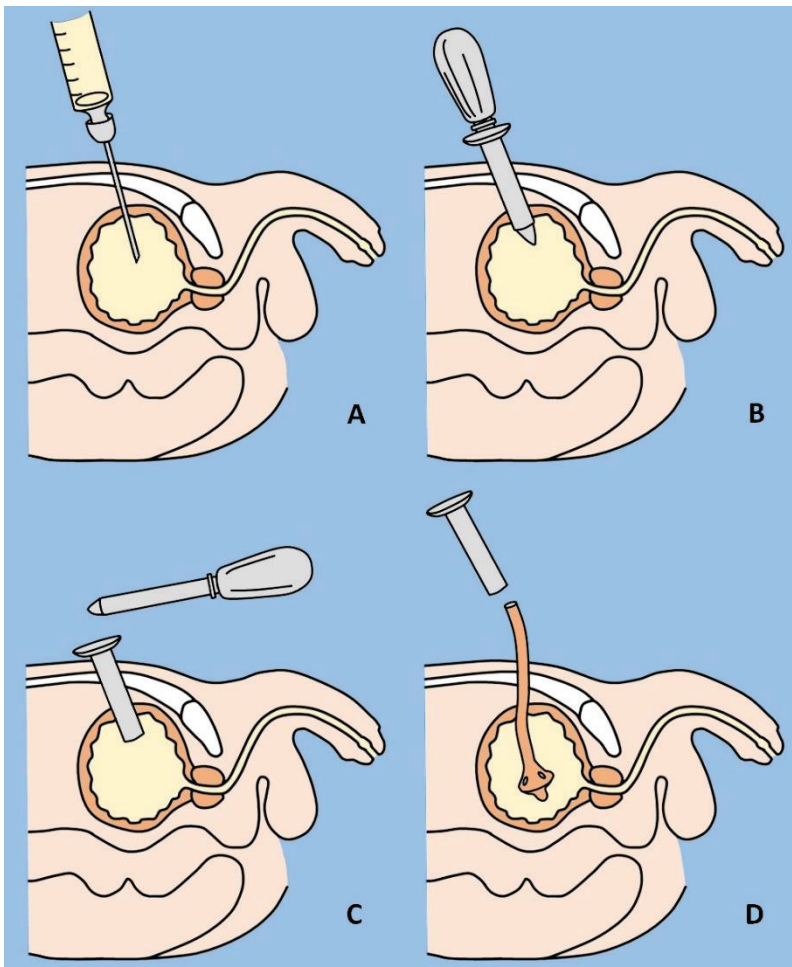
When the catheter passes into the bladder, urine will be seen coming through the catheter. At this point, it is advanced by another 1-2 centimeters and the balloon of Foley catheter is inflated with 5 ml of saline solution (Fig.95). Then catheter is gently withdrawal from the

urethra until resistance is met. Catheter is secured to the patient's thigh with a wide tape and connected to a receiving flask.



**Fig.95.** Catheterization of the urinary bladder in men with a Foley catheter: A. Introduction of catheter into the urethra, respecting of asepsis rules; B. Balloon is inflated, the catheter is pulled back and attached to collector.

When is necessary to remove, a syringe is used to empty complete the balloon, and then gentle traction of catheter is applied.



**Fig.96.** Cystostomy with a trocar: A. Suprapubic puncture of the bladder with a needle and urine aspiration; B. Insertion of trocar with a stylet into the bladder; C. Removing the stylet; D. Introduction of Pezzer catheter into the bladder through the trocar canal.

**Suprapubic cystostomy** is percutaneous puncture and drainage of urinary bladder. Procedure represents an alternative when urethral catheterization is either undesirable or impossible, for example, in case of prostatic cancer or urethral trauma.

Cystostomy may be performed under ultrasound guidance via the trocar technique when the bladder is fully distended. Intravenous analgesia or local infiltration anesthesia is recommended. Patient should be in supine Trendelenburg position. Bladder access is made approximately 3-4 centimeters above pubic symphysis. Needle should be oriented at a 20° angle (from vertical line) toward the pelvis, performing continuous aspiration (Fig.96).

When urine is obtained the needle is removed. A stab incision through the skin and subcutaneous tissue is making, and a trocar with a stylet inserted in the same direction into the bladder. Then the stylet is removed and a Foley or Pezzer catheter is passed into the bladder through the trocar canal. Check the position of the catheter for the presence of urine flow. The catheter is fixed to the skin and connected to a urine collection bag.