

Anthropological and archeological sources in medical historian's studies

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Summary:

Medical historians most often refer to written sources in their studies on the matters of health and sickness over the centuries, but also take advantage of the materials acquired through excavations – in other words anthropological and archeological sources. Skeletal material may exhibit signs of sickness, traumatic injuries, therapeutic procedures such as trepanations or amputations, as well as procedures emphasizing one's social status in a society (e.g. skull deformities). Various items for use in medical procedures may be found during excavations. Archeobotanical material contains remnants of medical plants. Immovable sources: remnants of medieval hospitals or baths also point to the means of treatment utilized by given populations. Anthropological and archeological sources are often difficult to interpret. The description of medicine on Polish territories made on their basis is certainly fragmentary. Despite that, anthropological and archeological data are important sources of knowledge for a medical historian, as they allow investigation into human past all the way to the times when written sources were not available.

Key words: history of medicine, anthropology, archeology, skull trepanations, historical sources.

There are many multidisciplinary publications appearing in the current scientific literature. Many scientists representing various fields compile a common research project. In their work, medical historians also avail from various fields of knowledge, utilize research methodology not only from the area of history, but also ethnography, archeology and anthropology. Each historical work must be based on sources. In literature, we may find several definitions of a "historical source." According to a definition published by a historian, Jerzy Topolski, "the source" encompasses all information (in an information theory sense) on social history regardless where they come from, including the mode of information transmission (information channel) [1]. Based on

the sources, one may attempt to reconstruct the lives of people in the past. Studies on the past, such as history and archeology are mutually complementary and overlapping.

In this publication we took interest in archeological and anthropological sources utilized by medical historians in their work. In our deliberations, we focused on the material obtained in Poland. The outline of periodization from neolithic to medieval times mentioned in our work also concerned Polish territories [2].

Archeological sources are material signs of human activity extracted from the earth or water (acquired through archeological methods). They

allow for reconstruction of various fields of life. During excavations we find items, which could have served during medical or hygienic procedures. Not many archeologists are concerned with medical or surgical instruments from prehistorical and medieval times. Hygienic items: knives, razors, pincers, and mirrors are more broadly described. There are numerous publications in foreign literature discussing surgical and medical instruments from the Roman period of Iron Age (since the 1st century A.D. until about 375 or the end of Roman Empire) found by the archeologists within the region of Roman Empire.

Anthropological sources (bone material) allow for observing pathological changes (injuries, illness) and traces of intentional procedures performed by the first “surgeons.” Paleoanthropology is concerned with morphological analysis of human skeletal remains. The goal of those studies is to determine important biological features (sex, age, height, body mass) of individual and entire groups of people. Paleopathology is concerned with disease lesions, developmental changes and traumatic injuries visible on excavated skeletal material. It should be noted that this field of knowledge is at the border of paleoanthropology and medicine. We are mainly interested in the structure of health in a given population [3].

Very little room is devoted in Polish scientific literature to prehistoric medicine. It is probably a result of scarce sources and difficult access to them. There are publications concerning development of medicine in the Middle Ages. Here, we can already encounter written sources: chronicles, annals and letters. They provide information on the first Polish physicians, famines and epidemics that tormented the contemporary society.

Authors of numerous publications [4,5,6] pointed to the need for further studies on history of medicine based on anthropological sources. Finding the signs of diseases besetting people ages ago in skeletal material or soft tissues may help us understand pathological phenomena occurring in the body, as many diseases have been known since neolithic era (since about 5400 until 2200/2100 B.C.). Going back in time allows for noting disease symptoms and investigating the mode of transmission of some diseases, particularly the ones causing epidemics, with groups of people.

Immunological changes occurring in a human as a result of civilization progress as well as environmental and social changes constitute another curious phenomenon. In prehistorical times, only biologically strong individuals reached adult age. Mortality of women in childbearing age was high and mean lifespan was shorter for women than for men. Today the situation became reversed, as we know from demographic studies [7].

Among the Slavs, as in case of other nations, medicine probably grew from everyday experiences, beliefs and customs. The cause of the disease was seen in natural factors such as: poor nutrition, dirtiness, infections, as well as supernatural factors: witchcraft and enchantments. According to the beliefs of ancient Slavs, deities were also responsible for health or sickness [8].

Archeological sources on medicine are scarce. First of all, we would like to understand how, with what and where people were treated. The most archeological sources, on which we may base our deliberations, come from early Iron Age (from the beginning of 1st century B.C. until about 4th century B.C.) and the Middle Ages (from 7th century until half of 16th century). Here, we can mention immobile sources: remnants of medieval hospitals and baths, as well as mobile ones: medical instruments, medicine containers (e.g. made from antlers), pharmaceutical containers. From the earliest times, people attributed therapeutic properties to various talismans made of bone, stone or fossils. Belemnites – fossilized mollusk shells (cephalopods), also called “lightning arrows”, were particularly valuable. They were applied to the affected areas, but also ground to powder and given to drink. Belemnites were used for treatment of: rheumatism, colic, eye diseases and during childbirth; they also protected from bewitchment [9]. Use of talismans was popular in folk medicine. Animal horns and bones, as well as roots of particular plant species were most frequently used as materials.

Archeobotanical studies of plant fossils provide information on plants present in human environment, including edible ones, grown or derived from natural positions. Among the archeobotanical material, we may also distinguish therapeutic plants. Plants used in medicine could be grown in home gardens or gathered near human settlements, cities or villages.

According to the data from archeological excavation sites in the area of Poland, the following plants were used in medicine: poppy (hypnotic and sedative properties), *Lithospermum officinale* (antidiabetic properties, treatment of hypertension, hyperthyroidism, contraception), *Sambucus nigra* (diuretic, diaphoretic, antipyretic actions), *Agrimonia eupatoria* (antidiarrheal, antirheumatic, antihemorrhagic properties), *Valeriana officinalis* (sedative, hypnotic), *Filipendula ulmaria* (antipyretic, diaphoretic, diuretic and antirheumatic properties), *Hyoscamus niger* (anesthetic, analgesic, hallucinogenic properties) [10, 11, 12]. Many plants such as: red raspberry, black raspberry, blackthorn, wild strawberry, bog blueberry or cranberry, were acquired from natural habitats for consumption since prehistoric times. They were processed and turned into juices. They were rich sources of vitamins for contemporary people. Oil plants (common flax, hemp, opium poppy) could be also used for therapeutic purposes. Plant leaves (common hazel, broadleaf plantain), sprouts (common yarrow), flowers (mead wort, common elder), rootstalks (gromwell), roots (valerian, common chicory) and fruits (common elder) were used. Peppermint or cumin, spices used in medieval times, also had therapeutic properties. Use of some of these plants was continued in folk medicine and they are still utilized in modern medicine, thus their application had reasonable grounds. In folk medicine, some of them (opium poppy, common St. John's wort, *Sambucus nigra*) were ascribed magical properties.

The issue of medical instruments used from prehistoric times until Middle Ages is difficult to describe. On the basis of discovered archeological items we think, that stone or flint instruments (scrapers, recoins, chipped stones), as well as tools made of organic materials such as bone and antler blades were used in skull trepanations in the neolithic era. In the following eras, people started making medical tools out of bronze and iron. With the evolution of other tools came the evolution of surgical instruments, although according to our knowledge, they derive from craft tools [13]. We possess the most information on medical tools from the following periods: La Tene (from 400 B.C. until the beginning of 1st century A.D.) and Roman period (from the beginning of 1st century A.D. until about 375). There are many publications in archeological literature

on surgical and medical instruments from the period of roman influences, while descriptions of La Tene period are significantly scarcer. Therefore, we find it easier to classify antique medical instruments gathered in museum collections coming from those two periods. However, there are few classified medical tools from La Tene or Roman periods coming from Poland. Certainly, Polish museums may contain these kinds of items, which were not correctly identified. All medical tools dated to the La Tene or Roman periods were found in southern Poland, mostly in the Silesian region. In prehistoric times, Silesia was an area under Celtic expansion. The Amber Route ran through this region, along which we found numerous antiques from Rome and its provinces. Mercantile expeditions from Southern Europe traveled this road to the southern Baltic Sea and further, toward the northeast [14]. Over the centuries people probably used tools meant for other purposes, such as food preparation, hunting, leather dressing and magical or ritual acts to perform medical activities and minor surgical procedures. Medical tools from La Tene and subsequent Roman periods were decorated (with engravings, notches and ornaments) indicating that, despite the rational foundations of interventional medicine, it was still influenced by magic and rituals. Esthetic appearance of surgical tools was supposed to inspire patient's confidence. The art of decorating gradually progressed through the ages. Shapes of medical instruments from the Iron Age often resemble the 19th century or modern tools. A knife from La Tene period – "trephine," with a semicircular working surface, resembles the 19th century trepanation knives illustrated in contemporary medical books [15]. Trepanation drills from 16th century driven by a chord tied around the working part resemble "modiolus," used for the same purpose in the Roman period. Current surgical instrumentation includes types of tools similar to those from the Roman period such as: exploration probes, scalpels, catheters and specula. During the Iron Age we may note progress in the field of medical instruments. Roman medical tools are more diverse and more precise than those made in the La Tene period.

Like in the modern era, disease morbidity depended on host factors (given organism), its genetic makeup, environmental factors and features associated with particular pathogens.

Disorders observed on osteological material may be divided into several groups: injuries, specific and non-specific inflammatory diseases, degenerative changes, systemic diseases, tumors and tumor-like lesions, developmental changes, mastication organ disorders. Improper diet, vitamin deficiency as well as periods of starvation and parasitic diseases leave traces on the bones (particularly in young individuals, whose bones are still growing). Here, we can mention changes in the orbital floor, cribra orbitalia, frequently observed since the Neolithic Age, rickets – also occurring since Neolithic era, although less frequent, enamel hypoplasia or scurvy. Children suffering from the above disorders certainly had lesser chances of surviving to adult age.

Degenerative and deforming, age-related (older age category) and work-related (overload) lesions are also often frequently observed on the skeletons. Such changes are particularly common in the Medieval Age. It may also be related to gradual prolongation of human lifespan. There are lesions seen on vertebrae, including osteophytes, flattening of vertebral bodies, Schmorl nodules, and deformations of articular surfaces. Tuberculosis is an infectious disease noted in bone material since Neolithic age. Its prevalence was influenced by poor hygienic conditions, malnutrition and domestic animals. Signs of other infectious diseases, leprosy and syphilis, which occurred endemically at that time, started to show in the Middle Ages. In prehistoric populations, caries did not pose as big a problem as currently. Carbohydrate intake increased as late as in the Middle Ages. However, other diseases of the mastication organ were also quite common, including: greater teeth effacement compared to modern times, dental calculus and paradontosis [16, 17, 18]. In prehistoric and historic times, many diseases ran different courses than nowadays, were characterized by different range of occurrence and severity in given populations. Introduction of new medicines, particularly appearance of antibiotics, decreased mortality from infectious and inflammatory diseases. One should note that not all disorders leave traces on the skeleton and many diseases might be missed during such studies.

Skeletal material from Poland bears signs of intentional procedures: amputations and trepanations. While examining anthropological

material, we can observe the process of development of interventional medicine. Trepanations constitute a broad issue and skulls with signs of trepanation coming from Poland are dated back to Neolithic Age, through the Bronze Age, early Iron Age, up to the Middle Age. However, signs of amputations are present only on the skeletons from Middle Age due to the fact that it was a very dangerous procedure associated with high risk of infection and there were no effective methods of stopping hemorrhages. Another group of intentional procedures are permanent deformations, which in Poland involved the skull. Two deliberately deformed skulls were found – one coming from Neolithic Age (the New Stone Era), the other from medieval times. They were both elongated in the lateral aspect, the forehead shifted posteriorly. Therefore, this custom was incredibly rare in Poland. Possibly, those individuals did not belong to local societies. Using bandages or wooden boards to exert pressure against the occipital, frontal or both skull regions altered the shape of the head. Performed in children, deformation changed skull proportions, particularly the length-to-width as well as height ratios [19].

Skeletal material obtained from medieval cemeteries indicates that people were able to reduce and stabilize fractures at that time. Certainly, the state and extent of such knowledge depended on given human populations. Undoubtedly, it was passed orally from one generation to another. Properly reduced fractures provide evidence of appropriate therapeutic techniques. Fractures were stabilized in wooden slates padded with moss and tied with a bandage [20].

In modern neurosurgery, skull trepanation involves drilling a hole to uncover the meninges and brain in order to perform a specific surgical procedure or evacuation of hematoma. Trepanation holes are made using a trepanation drill. One or more orifices are drilled during lobar skull opening [21]. In anthropology, trepanation is understood as intentional opening of cranial cavity through drilling, scraping or cutting four incisions. The reason for opening the cranial cavity was not to perform neurosurgical procedures, although it was probably a way of evacuating hematomas. In Poland, eight skulls bearing signs of trepanation – 5 male and 2 female – come from Neolithic era (the new Stone Age – from

about 5400 until 2200/2100 B.C.), five— all male—from the Bronze Age (from about 2200/2100 until half of 8th century B.C.), six – 4 male and 2 female – from Early Iron Age (from the second half of 8th century B.C. until the end of 7th century A.D.), and about twenty-eight— 16 male and 6 female— come from the Middle Ages (from the 7th century until half of 14th century A.D.). It should be noted that determining the sex of the buried person was not always possible. Larger number of skulls with signs of trepanation probably resulted from increasing population density, formation of large settlements and cities and, therefore, greater need for medical aid.

Most trepanations were performed in men. It was probably related to the fact that men were at greater risk of head traumas and injuries, e.g. during hunting, battles and fights. It is consistent with earlier epidemiological studies showing that, both in the Middle Ages and nowadays, men are more prone to traumatic injuries. In the medieval times, the number of skull injuries in men increased almost threefold. However, this relationship was not observed in women [22]. Skulls with trepanation holes were most often adult, although there were few belonging to young people or the elderly. Naturally, one should emphasize that the ages of these individuals were determined at the time of death. If the orifice is not obliterated, one may conclude that the person died during the procedure and the age at the time of death is consistent with the age, at which trepanation was performed. However, if the opening is well obliterated, it is then difficult to estimate the age range, within which trepanation was performed. Obliteration may be a proof of patient's survival for several months or years.

There are no children's' skulls bearing signs of trepanation in the materials obtained in our country. Possibly, this kind of procedure was rarely performed in young individuals. Fragile children's skeletons are quickly decomposed, which is the reason why the signs of trepanation are poorly visible. It is also likely that children did not suffer from conditions, which could be considered indications for such procedures. Possibly, children less often fell victims to severe head injuries in the past. However, such procedures were performed during the Greek-Roman times. In this region of the world, doctors were familiar with the works of Hippocrates and

Galen, who mentioned trepanation as one of therapeutic methods [23].

There are also very few trepanation skulls from the Bronze Age and Early Iron Age found in Poland. It could be related to the custom of body burning (cremated human remains are placed in an urn or directly in the grave), as it is much more difficult to recognize changes related to disease or surgical procedures in burnt remains.

Trepanation was most often performed in the area of parietal (more often on the left side) and frontal bones, rarely on the occiput. Trepanation holes rarely involved more than one bone. In the studied cases, holes were located at the top of the head or at a lateral surface of the skull – in such cases they involved the squama of temporal bone and occiput. Trepanation holes rarely overlapped with cranial sutures, although there were few such cases collected in Poland. Surgeons probably distinguished between cranial sutures and bone fractures. Sizes of trepanation holes vary. Some are extensive (5-6 cm in diameter), while other ones are small (less than 1 cm). Trepanned skulls collected from Poland area most often contain only one hole. In two cases from neolithic times and two cases from the Middle Ages, we were dealing with two holes. No skulls with multiple trepanation holes were obtained from Polish region. The size and positioning of trepanation hole was certainly related to the location and extent of injury (in posttraumatic trepanations), but it could be related to the site, where the patient experienced pain, treatment method and applied tools.

In Poland, since the neolithic period until Middle Ages, trepanations were performed through scraping and cutting. The first method was safer, as it was associated with lower risk of brain damage. Tools with a cutting edge were used, but only for scraping the bone. Tool motion could be performed in a vertical or horizontal motion. Sometimes, both methods were used together and both neolithic and medieval skulls bear signs of such procedures. Literature emphasizes that the cutting method was used for acquisition of bone talismans (from the dead), although there are skulls found in Poland with trepanation holes indicating that this method was also used for therapeutic purposes, particularly in the medieval period and at the turn of Middle Ages and the modern era.

Skulls containing trepanation holes constitute a subject of scientific studies since 19th century. Literature cites, that the most frequent bodily injuries are head traumas, which involve 60% of general population [24]. In the prehistorical and medieval periods head traumas were probably also very common, which was likely related to battles, fights and hunting.

Often, due to poor skull condition, it is difficult to establish the indications for trepanation, particularly when the skull does not contain any external signs of trauma. Also, illness does not always leave marks on the skeleton. However, most trepanation procedures were probably performed for therapeutic reasons, in order to remove the fractured bone. Such procedures were often performed intuitively. Leverage and removal of fractured bone fragment or fragments, as well as polishing of sharp wound edges could bring immediate effects such as regression of neurological disorders or return of consciousness, as fragments of the damaged bone ceased to exert pressure against brain tissue.

Therefore, procedures were repeated in subsequent cases. First of all, treatment was aimed at removing the source of pain, which could have been caused by various pathological changes. Medieval skulls bear the signs of trauma particularly often. Such procedure was not easy to perform. It must have been done by a medic experienced in this field and equipped with appropriate tools. Indications for skull trepanation also included: pericerebral hematomas, inflammatory lesions or brain tumors.

Several skulls described in Polish anthropological and archeological literature as trepanned, are not such. Holes present on those skulls could have been made during excavations (skull damage by a probe), as a result of processes taking place in the soil, traumatic injuries, gunshot wounds or post mortem examinations (if the hole involves the entire or almost entire skull cap). Therefore, not all skull apertures should be considered purposeful therapeutic procedures. Particularly, very small openings, 2-3 mm in diameter [25], or very large ones involving several skull bones indicate that they have not been made during an intentional surgical procedure.

Another interesting issue concerns the problem of patient survival following trepanation. Many publications indicate that the fraction of successful procedures was high. Data on trepanation skulls from South America point to osteal reactions (signs of obliteration) in 55% to 70% of trepanned skulls [26]. In cases of trepanation from the area of Poland, Czech Republic and Slovakia, professor Adam Paluch states that the success rate amounted to about 81.7% [27].

Authors of publications on trepanations from the neolithic times performed in Denmark and Germany report 80% (Denmark) and 88% (Germany) survival following trepanation [28]. Possibly, such high survival rates were related to patient care following the procedure, wound dressing and use of newly made flint and stone tools, which constituted sterile medical instruments. The reasons for this include strong immunological systems of individuals subjected to the procedure (weaker individuals died in childhood). Survival after surgery also depended on patient's general condition, extent of injury or disorder constituting an indication for trepanation. Smaller openings certainly posed a smaller risk of wound infection. It is also possible that high survival rates following these procedures are associated with the fact that most of historical trepanations were epidural. Complications of this procedure included wound infection, but also intraoperative bleeding and meningeal or brain injury. They resulted from unskillful tool use and poor surgical technique. In the 19th and at the beginning of the 20th century trepanations were carried out in hospitals, which were characterized by poor hygienic and sanitary conditions. Therefore, mortality among patients undergoing this procedure was high.

One could also ask, who performed such procedures in the prehistorical and historical times? In large societies, knowledge of medicine and surgical procedures was passed from one generation to another. Experiences gained in performing such kinds of surgeries allowed for avoiding brain and meningeal injuries or infections. During the Iron Age (La Tene period) trepanations were most likely performed by "warrior surgeons," as evidenced by their funerary items, which included medical tools, beside armament. They were probably able to perform other minor surgical procedures. In the La Tene

period, the wounded and sick warriors were also cared for by their companions. Based on archeological findings, we may conclude that a “warrior-surgeon” was equipped with medical instruments, including the following tools: bone knives, exploration probes and hooks. In ancient civilizations, with development of the art of war and formation of armies, comes the gradual progress in the areas of medicine related to military actions and frequent injuries, particularly surgery. Surgical skills and treatment of injuries and wounds were especially important in carrying for wounded warriors. During the Roman period, trepanations were performed by military doctors (specially trained) that accompanied the legions.

Military surgery went through many stages of development. In the Roman army, a qualified military doctor replaced a warrior-surgeon of the La Tene period. When it comes to the Roman Empire, we are able to identify the doctor or a medic based on archeological studies and funerary equipment. However, in the Barbarian region identification is very difficult. Three burial sites from the Iron Age were identified in Poland, which contained tools described by the archeologists as medicine-related. Two graves belonged to warriors and one is thought to be a burial site belonging to a midwife [29, 30]. There was probably also folk knowledge regarding trepanations and other surgical procedures. People involved in the surgical craft benefited from this knowledge. In the Middle Ages, as a result of separating surgery from medicine, surgical occupation could be undertaken by people without medical education, who only possessed some practical skills. However, it is emphasized that barbers performed mainly minor surgical procedures, healed wounds, reduced dislocations and fractures or opened abscesses. They could also learn about medicine from the clergy, as their work also included shaving tonsures. In the Middle Ages, demand for surgeons was high. They worked in the cities and princes’ courts. Ethnographic sources inform us that some occupations were also predestined to performing therapeutic or even surgical procedures, including: blacksmiths, shepherds, carpenters and beekeepers [31].

People who cared for animals could use their medical knowledge to perform certain procedures on men. The tools used by the mentioned

craftsmen for their everyday work could also be useful for various medical procedures. In case of a blacksmith, the transformation of metals into specific items was particularly important, as it was attributed somewhat mystical properties, as in the case of transition from illness to health.

Trepanation skulls, dated back to 11th and 14th centuries, were also found in the medieval Cracow area. In case of a 14th century skull, the procedure could have been performed by either an experienced surgeon or a craftsman. Between the 16th and 18th century, guild surgeons were familiar with the trepanation technique, but rarely used it. It probably resulted from fear of patient’s death. The only indication for trepanation included severe head injuries [32]. It was a way to decrease intracranial pressure or remove an epidural hematoma. In case of trepanation skulls from the turn of medieval and modern times, we may suspect that a guild surgeon or a craftsman performed that procedure.

Skeletons bearing signs of amputations also come from medieval cities: Wrocław and Gdansk. Amputations performed by guild surgeons were also considered dangerous and were rarely performed.

The picture of medicine in Poland, which may be reconstructed on the basis of archeological and anthropological material indicates that, since Neolithic period, people tried to use everything from human environment for medical purposes: curative water springs (votive offerings found there indicate that contemporary societies ascribed the springs healing and magical properties), medical plants. They also made the first flint and stone tools for trepanation and other minor procedures. Therefore, we may note the evidence that surgery, herbal medicine and hydrotherapy have been shaping since prehistoric times. Archeological relics and skeletal material certainly give only a fragmentary picture of medicine in Poland in the prehistoric and medieval times. Despite that, they constitute an important source in the studies of medical historians. Knowledge of medicine was passed from one generation to another in small, often isolated, societies. Medicine, magic and religion coexisted throughout the ages and some magical/therapeutic practices were still popular among rural populations at the beginning of 20th century.

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