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Should a Highly Skilled Surgeon be an Advanced Anatomist first? - A View Point

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Abstract Skilled surgeons treat their patients by repair/removal/cutting/alteration/replacement of the diseased part/organ. So before starting to make an incision on a patient, the surgeon requires not only confidence, a sound knowledge of the organization of macro/micro forms and structures and their shapes, sizes and locations and the correct diagnosis of the disease, but also the anatomical relationship to the disease. The aim of this study is to explore the intimate involvement of anatomy with successful surgery in order to help reduce the failure rate and consequently the incidence of litigious claims. The role of anatomy in surgical procedures from diagnosis to completion is analyzed. The current failure rates in surgery due to lapses in the anatomical knowledge felt by many surgeons are revealed. Remedial measures to ensure safe medical practice have been proposed by senior surgeons and regulators involved in settling the increasing number of litigious claims, such as improving knowledge by inviting educationists to oppose the lowering standards of anatomy teaching among passing-out doctors. A balanced scheduling of medical curricula is required with emphasis on the synergistic vertically and horizontal integration of anatomy, besides mastering subject as it is taught at the outset of the course. Successful surgery and in-depth knowledge of anatomy are complementary to each other. Human anatomy can be practiced by surgeons on cadavers to help improve surgical success.

Keywords Skilled surgeons, Integration of anatomy, Balanced scheduling, Safe medical practice

1. Introduction

Surgery is the art/science of treating diseases by cutting/repairing/removing and/or replacing the defective / infected part/organ with minimum injury to other surrounding structures. One who masters and performs surgery or specialized surgery in the interests of health care, treating diseases in defective human organs, is a surgeon. Successful surgical procedure is wholly, dependent on a thorough knowledge of the organization of macro/micro forms and structures and their shapes, sizes and locations i.e. of human anatomy. Therefore surgery and anatomy are complementary to each other; moreover, successful surgery rests on a strong foundation of human anatomy.

Highly skilled surgeons are medical doctors with particular expertise. Expertise and success in surgical procedures can be achieved by precise and thorough understanding of human anatomy and diseases/traumas but the present trend towards reducing the anatomical schedule, deployment of inadequate faculties and allocation of fewer resources leaves passing-out doctors with an inadequate knowledge of anatomy and consequently of surgical science. "Our results indicate that the majority of clinicians feel that the current anatomical education of medical students is inadequate, and below the minimum necessary for safe medical practice. There is widespread support among clinicians for more vertical integration of anatomy teaching throughout the undergraduate curriculum", [1]. This situation has led to an increased number of surgical failures and dissatisfaction among patients.

The aim of this paper is to explore the intimate relationship between surgery and anatomy, to establish that a highly skilled surgeon has to be an advanced anatomist, and also to improve the surgical failure rate by upgrading the standard of sustainable quality medical education.

The nature of surgery

In clinical science, there are two general methods for treating diseases: 1. Treatment by medicines; 2. Treatment by surgery Here our focus is on surgical treatment carried out by surgeons via the following steps to eliminate diseases that cause inconvenience and/or pain.

1. Diagnosis
2. Understanding the disease process
3. Anesthesia
4. Administration of treatment/Surgical intervention
5. Medication

In describing these crucial steps, we shall explain the

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innate association of vital human anatomy with each of them.

2. Diagnosis

The administration of surgical treatment is decided by the clinician/doctor after deterministic diagnosis of the disease in a part or organ. Diagnosis starts from communication between doctor and patient eliciting the various signs and symptoms and history of the disease in common language. This common language is then translated into medical language, primarily learned by the doctor through human anatomy [2]. This is followed by physical examination and laboratory tests. Anatomy enables practitioners of medical science to communicate with patients, the public, fellow doctors, and to diagnose and treat the disease successfully in any field of medicine [3]. The history reveals the signs, symptoms, duration and congenital (embryological) nature of disease. Physical examination by palpation, percussion and auscultation depends primarily on macro/micro forms and structures, their shape, size, configuration and location: the better the knowledge of anatomy, greater the confidence of the doctor in diagnostic physical examination. Cadaveric dissection in the study of gross anatomy helps students develop strengths in effective, independent learning strategies and professional qualities early in their medical education [4] transforming them in to medical professionals [2].

Further, neuroanatomy endows doctors with knowledge of the gross, microscopic (histological) and developmental (embryology) anatomy of the nervous system, which helps the medical students/practitioners to locate the lesions and interpret the disorders producing clinical symptoms. The focal disturbance or lesion/injury to specific structures caused by toxins, drugs, environmental hazards, accidental traumas, misuse of organs/limbs and or other factors elicits specific symptoms. These symptoms are communicated by nerves to the mind of the patient. The correlation between related structure, communication pathways, nerves and symptoms of the disease needs in-depth knowledge of neuroanatomy [5].

After investigation of the patient through history and signs and symptoms, laboratory tests are advised. These use microscopes to observe micro-organisms (pathogens) on slides. The changes in the structure of tissues at microscopic level due to infection, malignancy etc can be revealed by histological slides. Unless normal histology is understood, interpretation of pathological slides will be difficult and subjective.

Demonstrations of cadaveric dissection coupled with theoretical lectures generate a 3D vision of organ / limb / macro-to micro-structures. Additionally, anatomical illustrations help in the precise and accurate interpretation of radiographs, Magnetic Resonance Imaging and Computed Tomography (CT) scans of the area relevant for surgery [6] so diagnosis is more likely to be correct.

The above account reveals the multiple involvement of anatomy in the complete diagnostic process, so knowledge of anatomy is crucial for proper investigation of a disease. This does not mean that anatomy alone is required for proper diagnosis of diseases and all other supporting investigations are irrelevant; rather, it indicates that inclusion of detailed anatomical knowledge improves diagnosis.

3. Disease Process

After diagnosis, the anatomy of the disease is important for understanding and advancing treatment. Diseases are caused by pathogens, toxins, drugs, environmental hazards and other factors such as infection or lesions due to accidents or misuse of organs/limbs or a congenital anomaly. These causal factors deform/alter the macro /micro forms and structures of the body/organ. Extra growth associated with organs, infection and traumas (internal and external) provides an important indicator of the severity of the disease through anatomical changes. From this basis, the intervention for curing the disease is decided. A surgical procedure is finally confirmed by laboratory/imagery tests. These ought to be compared with normal anatomical structures and their non-pathological variants. At this stage, too, deep anatomical knowledge related to variations and to static and dynamic changes in forms and structures is essential.

After the diagnosis and analysis of the disease process, an attempt is made to correlate the anatomical changes with the disease stage. The final decision regarding surgical intervention is now planned on this basis.

4. Anesthesia

Anesthesia is given before surgical intervention. The structures involved in the surgical procedure and their relationship to the neurovascular system ought to be fully known to ensure the nerve is blocked successfully: the nerve must be correctly identified. This demands a sound knowledge not only of neuroanatomy but also of the gross anatomy of the surrounding structures, their configuration and their neural relationships. Finding the appropriate location necessitates a thorough understanding of surface anatomy, which is vital for nerve block.

5. Surgical Procedure

Once the decision to perform surgery has been taken and anesthesia given, the surgical intervention is meticulously planned. This includes making an initial incision, for which knowledge of surface anatomy is essential. To place the scalpel, the exact location of the affected structure, its identification, its shape and size and its configuration including variations related to it and/or surrounding structures/organs must be known. This is intimately related to the anatomical organization and variations in the shape, size and complex configuration of the relevant structures.

Clearly, in-depth understanding of anatomy is therefore essential for this step in surgical intervention. Students who are allotted this particular patient may have forgotten the detailed anatomy of relevant region, so the normal regional anatomy along with some common anatomical anomalies or variants should be demonstrated with the help of slides, plastinated specimens and models before the surgery is started. Anatomists can therefore contribute to making this method more practical and effective for students [6].

In the next step, an incision is made to create a minimal window for cutting/repairing/removing and/or replacing the defective/infected part/organ and to economize on damage/injury to other surrounding structures during surgery. This again requires in-depth knowledge of the precise shape, size, location and configuration of the macro/micro structure of the body part (s) concerned. Any decrease in the study / teaching of anatomy can therefore result not only in dissatisfaction and/or serious risk to the patients' life, but also in failure cases as revealed by litigious claims, which dishonor the noble profession of health care.

Therefore, a group of students deployed for a surgical procedure can be requested to attend the anatomy museum one day before the operation is performed, so anatomists can reveal the gross anatomy of that particular region to them with the help of illustrations, models and dissection of cadavers. The structures in layers to be dissected can also be demonstrated during the operation. To start with, this method can be practiced for commonly-performed operations such as nephrectomy, herniorrhaphy, laporotomy, cholecystectomy and fracture dislocations. During the operation, when it is safe for the patient, the operating team should pause to look at the illustrations pertaining to those phases of the procedure. Students can be asked to identify the anatomical structures on the patient and confirm them from the illustrations. There are many steps from, say, the first incision to removal of the kidney during a nephrectomy. The surgeon can ask the students about the structures encountered during these steps, proceeding from skin to kidney. Similarly, the students can view the illustrations of normal inguinal anatomy during a herniorraphy. They can be asked to identify the external oblique, internal oblique and transversus abdominis muscles, the inguinal ligament, ilio-inguinal nerve and vessels, deep inguinal ring and inferior epigastric vessels. These illustrations can give frontal, sagittal and three-dimensional views [6]. This will improve surgical outcomes and the skills of students undergoing training in surgery.

In addition, the authors suggests that if **a cadaver is kept ready for demonstrating the surgical intervention concerned before surgery** on the patient, it could foster greater confidence and success. This can best be exercised by synergistic analysis and discussion with both the surgeon and the anatomist.

6. Medication

After surgery, the patient is kept under intensive care during post operative administration of medicines and the condition is monitored closely pending relief.

The surgical process elaborated above illustrates the intimate relationship between anatomy and surgery. Surgery cannot exist without anatomy. Failures of surgical treatment will now be analyzed with the aim of ensuring excellent results in such treatment.

Why are there failures in surgical treatment?

Failures in treatment are not only hazardous to patients, creating fear and dissatisfaction in them, but also defame the health care community, reducing confidence in revered medical professionals. Therefore, the causes of failures need an in-depth analysis of lapses in treatment. The overall surgical treatment process was elaborated in earlier sections, consisting of diagnosis, analysis of the stage of disease, anesthesia, surgical intervention and medication. Major lapses can be associated with any of these steps. Besides human error and other factors in surgical treatment failures, lack of anatomical knowledge is highly significant, as implied in the above sections pertaining to diagnosis, disease process, anesthesia and surgical procedure. For example:

During diagnosis, suppose the patient complains of swelling at a location indicated by showing or description, which can be translated into medical language as the inguinal region. Swelling in this region can be due to inguinal or femoral hernia. If the precise anatomy is not known, it will be impossible to differentiate the two types of hernia and reach the definitive diagnosis. Here is another example: suppose the patient complains of pain at a location translated into the right hypochondium radiating to the right shoulder and inferior angle of the scapula. If the correct anatomy of the gallbladder is not known, it is not possible to diagnose correctly. The physical examination, pathological tests and imagery can only be carried out deterministically when the detailed anatomy is known. It is beyond doubt that insufficient knowledge of anatomy can result in failure to diagnose the diseases so surgery is also likely to fail.

To monitor the stage of diseases such as cancer and tuberculosis, changes in the structures of the affected tissues can be examined deterministically only if the extent of disease over those tissues is precisely known, along with relevant anatomical variations. This is possible only if the anatomy of the tissues is well understood; if it is not, the surgical procedure will be a failure.

For giving anesthesia, the corresponding nerve must to be located precisely so that nerve block can be administered successfully. As illustrated in the previous sections, surgical intervention can result in failure if anatomical knowledge of the organ/region/part of the body is lacking.

Inadequate knowledge of anatomy has been perceived in the following cases:

There is a general perception of falling standards of anatomical knowledge among medical graduates [7, 8, 9, 10]. A study by Cottam [11], in the United States found that most residency program directors felt that new graduates were insufficiently schooled in anatomy to prepare them for work.

There is a very large community of surgeons who consider knowledge of anatomy among passing-out doctors of surgery inadequate and the number of failure cases is rising because exposure to anatomy teaching during later training is insufficient. The study by Waterston and Stewart [1] revealed the feeling of most clinicians that the level of anatomical knowledge among current students is below the minimum necessary for safe medical practice. There is widespread support among clinicians for more vertical integration of anatomy teaching throughout the undergraduate curriculum [1]. The steadily increasing trend towards litigation for alleged surgical malpractice [12] may be partly attributable to 'anatomical ignorance' [13, 14]. An analysis by the Medical Defense Union of claims against general and vascular surgeons found that the most common reason for litigation was injury to an underlying structure, for example ligation of the femoral vein instead of the long saphenous vein during varicose vein surgery, or injury to the accessory nerve during open lymph node biopsy [12].

Feeling the need for more anatomy in surgical procedures, the University of South Florida developed a system of instruction in which regional anatomy is taught both before and during surgical procedures in the operating room [15] to refresh knowledge of clinical anatomy among students of surgery. The above citations clearly reveal that teaching of anatomy is under-delivered/comprehended and knowledge is insufficient for practicing medicine in general and surgery in particular. Now the question arises as to why the delivery of anatomy is below an adequate level. Most anatomists including the author of the present study consider the recent decline in knowledge of anatomy to have been caused by shrinking the anatomical schedule, insufficient faculty deployment and meager resource allocation, undermining its importance.

How should the failures be contained?

The falling standard of anatomy has been inferred as a major factor in the rising failure rate in surgery. The failure rate can therefore be contained by improving knowledge of anatomy. This can be brought about by improving/curbing the adverse shrinking of the anatomical schedule, deploying adequate faculties and planning for a future pool of competent and committed faculties, allocation of sufficient resources, and acknowledging due significance to anatomy by adopting new technologies and teaching methods.

As anatomy, a vast subject, delivered at the start of the medical course and learned by rote, it might be forgotten at the stage of application during clinical training. As explained above, anatomy is vital so not only must it be integrated vertically and synergistically along the entire length of medical education to graduation and post-graduation but it must also be commanded at the outset.

In addition, to strengthen confidence and precision in surgery further, it is recommended that 'refresher' instruction in clinical anatomy by anatomists and surgeons should be given in the operating theater before and during surgery. This should be done everywhere as adopted by the University of South Florida. This is the first step to successful surgery. Also, to ensure greater confidence in the surgeon/student and precise incisions, it is further recommended that the specific **surgical procedure should be demonstrated on a readily-kept standby/reserved cadaver through a synergistic approach by anatomists and surgeons.**

What can be concluded?

This paper demonstrates that surgery can be performed with an improving success rate by ensuring a proper command of anatomy at the outset and during procedures, by its synergistic integration. A skilled and successful surgeon has to be a perfect anatomist first, by not only mastering anatomy at the start of medical education but also by commanding/refreshing it during surgical practice. Before surgery is performed on actual patients, it is strongly recommended that the same procedure be attempted, with precision, on a cadaver to provide not only greater confidence but also more precision and a higher success rate.

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