

The Role of Anatomy in Clinical Practice: A Participant Observation Study of Use of Anatomy in Clinical Practice

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ABSTRACT

Purpose: The study investigated, using the participant observation method, how clinicians use knowledge of anatomy in clinical settings. The aim of the study was to inform clinically oriented anatomy teaching with regard content selection and how to teach anatomy to medical students.

Method: The researcher, a medical doctor and anatomist, was attached to clinical units over a period of 46 weeks (surgery 28 weeks, internal medicine 6 weeks, paediatrics 4 weeks, and obstetrics gynaecology 8 weeks) totaling 2,216 contact hours with clinical practice. The researcher studied clinicians dealing with clinical situations that required knowledge of anatomy by active looking, natural conversation, informal interviewing of various sorts, and checklists. Participation included partaking in the clinical responsibilities of the clinical team.

Results: The role of anatomy in clinical practice was classified into two broad themes: practical processes and cognitive processes. With regard practical procedures clinicians use anatomical knowledge as a rationale (basis) for where and how clinical procedures or operations are done; in orientating themselves on the human body; in reading clinical images which involves recognizing anatomical structures; and in recognizing aspects of clinical practice in which anatomy is an outcome determinant. The cognitive aspects involve problem identification; explaining clinical phenomena; understanding pathogenesis, signs and symptoms, and complications; and problem solving where the knowledge of anatomy is applied to solve a clinical problem.

After consideration of the major result categories, i.e. practical and cognitive processes the author developed a conceptual framework based on the categories developed from field notes and attempts to show how the categories are inter-related in clinical practice.

Conclusions & Implications: The study has generated some evidence about the kind of anatomy and how it is used in clinical practice. The broad categories indicate that anatomical knowledge is used for performing clinical procedures and in cognitive processes. The use of anatomical knowledge is part of clinical skills and reasoning paradigm. The anatomical facts are intertwined to considerations with information about disease and problem solving. The study suggests that to enhance the use of anatomy in clinical practice it should be learned by medical students in clinical context. The finding supports earlier works that have advised that planning and research should address the relationship between teaching and subsequent clinical practice.

INTRODUCTION

Using participant observation (a qualitative method) the current study investigated how clinical anatomy is used in clinical practice. Over the years some scholars have advised that qualitative research has a role in broadening the 'evidence base' for clinical practice. This paper may add to that 'evidence base' but, more specifically, is aimed at understanding how anatomy is used in clinical practice with a view of informing selection of content and method of teaching. The study could make a contribution to the current debate about how anatomy should be taught and what should be taught.

Participant observation 'examines real life situations from the inside'¹ by immersing the researcher in the day-to-day activities of the people under study and rather than test ideas (deductive) the researcher develops ideas from observations (inductive)². Participant observation has been successfully used by many researchers^{1,3,4,5,6,7,8}.

Key Words: *Anatomy, Clinical practice, Clinical Reasoning, Clinical Procedures, Students.*

For the study being reported on the process involved the researcher, a medical practitioner and anatomist, joining clinical teams and blending into the team so that clinicians acted naturally although they were initially aware about the aim of the researcher. The researcher then studied clinicians dealings with clinical situations that required knowledge of anatomy by active looking, natural conversation, informal interviewing of various sorts, and checklists. Participation included partaking in the clinical responsibilities of the clinical team. The study started in January 2000 and lasted for 46 weeks. The participant observations consisted of separate periods on the four major clinical disciplines (internal medicine, obstetrics and gynaecology, paediatrics, and surgery). The researcher attended the range of 'events' which constitute in-patient care, such as ward rounds, clinical procedures, and surgical operations. Additionally, the researcher also participated in clinical audit meeting, teaching sessions and 'social' interactions of the teams.

The data collected were recorded as field notes. Analysis of the observations included three stages whose overall aim was the categorization of collected data within the context of anatomy usage in clinical practice:

1. To select and define clinical problems, procedures and operations demanding the knowledge of anatomy.
2. A check on the frequency and distribution of these phenomena.
3. The construction of a conceptual framework; i.e., moving from substantive to formal theory.

There were no previous studies in the literature, based on investigational findings, which had defined and/or described how anatomy was used in clinical practice. The role of anatomy in clinical practice was classified into two broad themes: practical processes and cognitive processes. Doctors frequently performed clinical procedures that required practical use of hands and tools (instruments). Cognitive processes were also a key theme in clinical practice, these could not be observed directly and the results represent the reflections of the researcher upon observing particular clinical behaviours of doctors and the researcher's own. These results are therefore an interpretation of the directly observed behaviour of doctors in the clinical setting. The author has

generated a conceptual framework for understanding the role of anatomy in clinical practice. The qualitative evidence is analysed and the paper examines the ways in which the conceptual framework can be utilized in clinically oriented anatomy teaching.

Possible limitations of the study were that the sample size was small and the clinical teams and events observed may not be representative of other clinical teams in their field (local, specific and not generalisable). It is however, considered that the six indices of subjective adequacy^{1,2} (time, place, social circumstance, language, intimacy and social consensus) that promote the understanding of the setting and ensure validity of the research were adequately attended to. This study was considered important to clinical anatomy and medical education because it could be the first to use participant observation as an investigational method to define the anatomical knowledge that was required for clinical practice.

METHODS

The study was conducted by the researcher, a licensed practitioner, at the national referral hospital in a developing sub-Saharan African country. The hospital, a tertiary health care center, had 1,800 beds. Ethical approval and consent of the hospital were obtained before commencing the study. The participant observations were conducted in the departments of surgery (general surgery, orthopaedics, urology, neurosurgery, and paediatric surgery), internal medicine (one general unit), paediatrics and child health (a general unit with neonatology attachments), and obstetrics and gynaecology. The settings of observations included ward rounds, outpatient clinics, theatre operations, and admissions (on call duty). The duration of departmental attachments were as follows: surgery 28 weeks (1,400 contact hours), internal medicine six weeks (264 contact hours), paediatrics four weeks (176 contact hours), obstetrics and gynaecology eight weeks (376 contact hours) all together giving a total of 46 weeks (2,216 hours) spent in the clinical setting. The researcher, in all the units, had no special privileges and worked according to the responsibilities appropriate for his skills and as assigned by the responsibilities of the firm.

The time spent was shorter in internal medicine, paediatrics, and obstetrics and gynaecology because after 28 weeks of exploratory work and piloting the data format during the surgery rotation, the study became more focused, refined, and better informed enabling the experience to be more efficient and quicker. Secondly, the departments of internal medicine, obstetrics and gynaecology, and paediatrics did not have as many sub-specialty units as in surgery; the firms in these other departments were, by and large, identical. In any case, the decision as to withdraw from the fieldwork was taken when there was theoretical saturation – when observations no longer serve to question or modify the theories generated from earlier observations.

The data collected was recorded as participant observer's field notes. All field notes were recorded within 48 hours of the field experience. Most were recorded at the earliest opportunity soon after the session (either at a subsequent break or during lunch break) and were therefore recorded within 24 hours. Each set of field notes indicated the department of attachment and the unit/firm. The daily field note entries included the setting and anatomical note, examples are provided in figure 1 below.

Anatomical Note: On review of the chest x-ray, 7th year students able to identify posterior and anterior ribs, all 5th year students were not able; Noted that the students were unable to divide the chest x-ray into upper, mid and lower zones; were unable to discuss the parts of the heart represented in the cardiac silhouette. One patient had superior vena cava obstruction – students barely conversant with the arrangement of great veins in the thorax and neck to explain the engorged neck veins and suffusion of the face.

Figure 1 Examples of Participant Observer Field Notes

The setting described who was in attendance, the physical setting of the event under observation and the clinical context at hand. The anatomical note described the discussion of the relevant anatomy that ensued or that the observer noted as lacking or being used. The anatomical notes also included the observer's reflections about what had been observed.

Data Analysis and Interpretation

The field notes were separated into observation field notes (observation of others) and participatory field notes (reflections on the experiences of the participant observer). The data was then classified into emerging themes. An analysis and interpretation are conceptually separate processes, the analysis involved formulating order on the data so that comparisons, contrasts, and insights could be made. This was achieved by categorising the data. The purpose of categorisation was to reflect on the range and diversity of perspectives studied and not mere count of number of instances falling in each category. Once the categories were developed and pieces of data were being allocated to categories the researcher remained open to changing and developing the categorisation system. Realisation of inadequacies of the categorisation system led to categories being renamed, merged or split as appeared to suit the data. Analysis involved consideration of words, context, frequency, extensiveness, and specificity of the data. Interpretation on the other hand involved attaching meaning and significance to the analysis, explaining descriptive patterns, and looking for relationships and linkages in the themes and categories developed. The researcher finally developed his interpretations and conclusions.

Example 1

Field Note Entry:

Department: Surgery

Unit: Identity withheld (Ed)

Setting: Operating theatre, assisting the surgeon doing above-knee amputation.

Anatomical Note: Noted that the surgeon did not know the anatomical names of most of the muscles, the blood vessels and nerves. He emphasised more the levels of incisions for the skin, muscle, and bone. He also was able to ligate (tie) any 'bleeders' but was not able to clearly describe the blood vessel arrangement in the thigh, nor name them individually. I realised that for some operations surgeons only know where to make incisions in the skin, muscles, and bones; how to arrest bleeding; and what to suture. Anatomical knowledge of the names and relations does not seem critical in such incidents.

Example 2

Field Note Entry

Department: Medicine

Unit: Identity withheld (Ed)

Setting: Ward round as lead physician (consultant and registrar away on other duties). Had SRMO's, JRMO's and new set of clinical students.

RESULTS

The role of anatomy in clinical practice was classified into two broad themes: practical processes and cognitive processes. After consideration of the major result categories, i.e. practical and cognitive processes the author developed a conceptual framework based on the categories developed from field notes and attempts to show how the categories are inter-related in clinical practice.

Practical Processes

Doctors frequently performed clinical procedures that required practical use of hands and tools (instruments).

Rationale (basis) for Clinical/operative Procedures

Anatomical knowledge was a common basis for protocols of procedures in clinical practice. It was the basis for choice of site for invasive procedures; the approach of structures lying deep to the skin; and manoeuvres for physical manipulation to correct altered structure.

Selected field note:

“...Patient with dislocated shoulder...performed Kocher’s manoeuvre and successfully reduced the shoulder. Wondered how the manoeuvres take into consideration the muscle pull, position of bones, joint space, for example. Made it a learning issue to analyse the manoeuvres in this context.”

During the fieldwork it was sometimes apparent that doctors did not know the anatomical basis for the clinical procedures they performed. Many had learned how to do the procedures and the desired outcome with little consideration for the anatomical basis. Several (especially the senior ones) doctors did, however, pay attention to the anatomical basis for the procedures and explained them to colleagues.

Orientation

In several instances doctors needed to locate structures that were deep to the skin and could not be viewed directly. In such situations doctors used other visible or palpable landmarks to indirectly reach their desired structures. Knowledge of the general topography of the body served as a map for

orientation of where you are and where you desired to be. Knowledge of specific surface landmarks, palpable structures or pulses, and the topographical relations of structures in the vicinity were used to locate or orient oneself in clinical procedures.

Selected Field Note

“...registrar called to assist two JRMOs who had failed to do a lumbar puncture. The registrar discussed the surface landmarks, the position, and the target structures in the procedure (in this case the subarachnoid space to access CSF). I noted he had applied the use of surface landmarks to assess deep structure.”

Reading clinical images

Clinical images are representations of body structures in a pictorial form. The most common being x-rays. X-rays are taken from different directions, the commoner ones were postero-anterior, antero-posterior, and lateral. Sometimes special positions, and contrast media were used to demonstrate specific structures. Cross-sectional anatomy assumed more importance with computerised axial tomography (CT Scan) at UTH.

The field notes below illustrate the demand for anatomy to read clinical images.

Selected Field Note

“Ward round, consultant reviewing lateral x-ray of the skull...he identified the sella turcica and stated its relation to the nasal cavity, cranial sutures, sinuses, and the middle meningeal artery.”

A beginning point for reading clinical images was to know what you were seeing, i.e., which section of the body, what specific region, identifying the structures that were visible. Determining the pathology was in many instances secondary to identifying the anatomical structures.

There were many practical procedures that doctors performed on the wards and in the operating theatres. In the conceptual map (figure 4.1), these constituted clinical performance. It can thus be stated that anatomy played a significant role in good clinical performance.

Anatomy was an outcome determinant

The knowledge of anatomy was found to be an important factor in whether the outcome of a clinical procedure was successful or not. It was also an important determinant in whether the procedure resulted in a complication or not. Generally the doctors that were aware of structures to avoid, who could identify the structures and how to do the procedure manifested more confidence and were also more competent. They also undertook complicated procedures.

Selected Field Note

“...Assisting a consultant doing a mandibulectomy. Anatomical note: Consultant was well-oriented with the anatomy of the area. He identified and preserved the lingual nerve and hypoglossal nerve. He pointed out the relations of these nerves and also how to ensure they are not damaged.”

Anatomical note: Surgeons with good anatomical knowledge are more daring and adventurous with their operations because they do not worry about getting ‘lost’ and also inadvertently causing damage. In contrast, lack of anatomical knowledge does contribute to the surgeon being hesitant and tentative.”

Lack of knowledge of anatomy in terms of structures that will be encountered in a procedure, what to avoid damaging, what can be sacrificed frequently prevented doctors from doing clinical procedures. It was also a common reason for consulting senior colleagues for advice on further management of patients.

Cognitive Processes

Cognitive processes cannot be observed directly, therefore, this part presents the reflections of the researcher upon observing particular clinical behaviours of doctors and the researcher’s own. These results are therefore an interpretation of the directly observed behaviour of doctors in the clinical setting.

Problem Identification

Knowledge of normal structure and function enabled the doctor to identify altered structure and function.

Selected Field Note

“...loss of contour of the shoulder in a patient with a dislocated shoulder. X-rays confirmed the dislocation – subcoracoid anterior dislocation of the right shoulder. Anatomical note: Familiarity with normal form is important for one to identify altered form.”

When doctors assessed a patient the form was inspected for deviation from the norm. Recognition of such deviation served as a beginning point in problem identification.

Explanation

There were many instances in clinical practice in which the doctor could only explain the clinical condition encountered, anatomically. In some situations the pathogenesis of the clinical condition was anatomical (in many cases developmental). In some instances the observed clinical phenomenon was explained by knowing the anatomical structure involved and its function. Knowledge of anatomical relations explained why pathology on a particular site manifested elsewhere.

Selected Field Note

“Anatomical note: saw a patient with complete heart block (pulse 45 – 50 per minute), relied on the knowledge of the conducting system (in this case the role of SA and AV nodes) to explain the slow rate and even consider heart block as a differential diagnosis.”

Understanding

To understand, in this context, refers to the ability to evaluate the appropriate knowledge one possesses and to make meaningful interpretation and offer explanations, and interventions based on this knowledge. As a result of this understanding, one can then conceptualise – have a mental grasp of what is ‘going on’ in a disease process.

“...Noted the need for sound anatomical knowledge of ascending and descending tracts to assess the CNS comprehensively.”

“On a ward round reviewing patient with hydrocephalus. Anatomical note: Discussed the cerebrospinal fluid (CSF) circulation, and the ventricular system of the brain. Noted that the SRMO was not conversant with the CSF circulation and the ventricular system.”

Anatomical knowledge was essential, in some clinical conditions, for the doctor to conceptualise what was going on in the patient. It helped understand the signs and symptoms, complications, and interventions. Lack of this anatomical knowledge, in such cases, prevented understanding of the clinical phenomenon.

Problem-solving

Problem-solving is a wide and encompassing concept. It can literally include all the situations cited above. In this case it is being applied to those circumstances in which the relief of the problem was immediate. The context of the problem was in this case a barrier to successful implementation of a clinical manoeuvre or the application of a manoeuvre to relieve distress. Knowledge of anatomy had dramatic impact in solving such problems.

“In operating theatre...difficulty to visualise the structures in the operative field (hand) due to excess blood. Anatomical note: surgeon achieved a dry field by requesting the assistant to occlude the ulnar and radial arteries, at the wrist, with finger pressure. Noted how anatomical knowledge of the blood supply to the hand was used to solve the problem.”

The work of a doctor invariably involves some cognitive processes. Anatomy did have a role in these cognitive processes in many clinical conditions. Possession of knowledge of anatomy, in cases requiring sound knowledge of anatomy, made the difference between informed clinical practice and uninformed clinical practice.

DISCUSSION AND CONCLUSION

Practical Procedures

Competence in practical procedures is important in clinical practice⁹. Jolly¹⁰ reported a lack of preparedness for practical clinical skills, such as suturing and nasogastric tube insertions, amongst pre-

registration house officers in the UK. The findings by Jolly¹⁰ were in agreement with those of Board and Mercer⁹ who surveyed basic practical skills of final-year medical schools in a United Kingdom university medical school. Board and Mercer⁹ found that lack of knowledge of basic practical skills as well as inability to perform them was distressing to doctors and dangerous to patients.

Board & Mercer⁹ identified nine practical skills, which they considered commonly required for the daily activities of the pre-registration doctor in the United Kingdom. They observed that lack of knowledge of basic practical skills, together with inability to effectively and efficiently perform them, was dangerous to the patient. Moercke and Eika¹¹ list of procedures is compared and contrasted from the list generated in the study in table 1.

Table 1: Practical Procedures of the Pre-registration Doctor in the United Kingdom compared to that of the Pre-registration Doctor in Zambia.

Moercke and Eika (2002) List of Procedures of the Pre-registration doctor in the United Kingdom	Procedures Observed in the Study in Zambia
Emergency Procedures	Observed Ward Procedures (Frequency)
<ul style="list-style-type: none"> • Securing patient airways • Endotracheal intubation • Performing ECG • Setting up an IV drip 	<ul style="list-style-type: none"> • Setting up and IV drip (159) • Urethral catheterisation (53) • Examination of placenta (51) • Nasogastric intubation/lavage (50) • Abdominal/ Ascitic tap (49) • Lumbar puncture (47) • Fundoscopy (24) • Vaginal examination (19) • Ear nose throat examination (15) • Per rectal examination (14) • Venous cutdown (12)
Casualty Procedures	Observed Clinic and Minor Theatre Procedures (Frequency)
<ul style="list-style-type: none"> • Simple wound suturing • Ophthalmoscopy • Local nerve analgesia 	<ul style="list-style-type: none"> • Lymph node biopsy (49) • Manual vacuum aspiration of products of conception (37) • Intercostal drainage (23) • Episiotomy (19)
Gynaecology-Obstetrics Procedures	Observed Operations (Frequency)
<ul style="list-style-type: none"> • APGAR scoring • Examining the newborn • Cervical swab • Estimating pelvis • Normal vaginal delivery 	<ul style="list-style-type: none"> • Herniorrhaphy (32) • Circumcision (28) • Bowel resection with anastomosis or colostomy (28) • Salpingectomy (26) • Skin grafts (11) • Arthrotomy (11) • Amputations (11)
General Practice Procedures	
<ul style="list-style-type: none"> • Proctoscopy • Urethral swab 	

The knowledge of anatomy was found to be an important factor in whether the outcome of a clinical procedure was successful or not. It was also an important determinant in whether the procedure resulted in a complication or not. Generally the doctors that were aware of structures to avoid, who could identify the structures and how to do the procedure manifested more confidence and were also more competent. They also undertook complicated procedures.

Lack of knowledge of anatomy in terms of structures that will be encountered in a procedure, what to avoid damaging, what can be sacrificed frequently prevented doctors from doing clinical procedures. It was also a common reason for consulting senior colleagues for advice on further management of patients.

It can be argued that knowledge of anatomy and its basis for clinical procedures and other clinical skills contributes to clinical competence and performance¹².

The list by Moercke and Eika¹¹ was different from that found in the study probably because the Moercke and Eika¹¹ list was based on the competencies required for clinical practice for the newly graduated physicians but the list from this study was generated from clinical procedures commonly encountered in Zambia.

Cognitive Processes

When considering anatomical knowledge in clinical settings the reasoning algorithm progresses as follows: Is anatomical knowledge required? If yes, which system is involved, which topographical region of the body? Which organ? Which tissue? This is can be considered the TORS Analysis (Tissue Organ Region System – Analysis), for example ‘this is problem in the respiratory system, in the thoracic region, affecting the endothelium and lung parenchyma – Carcinoma of the Bronchus’. This information then enters the loop that is used for problem identification, explanation, understanding, problem solving, all variants of clinical reasoning, when applied to the clinical setting. This approach is consistent with the hypothetico-deductive clinical reasoning model¹³, that states that the so-called routine questions in a workup (history-taking,

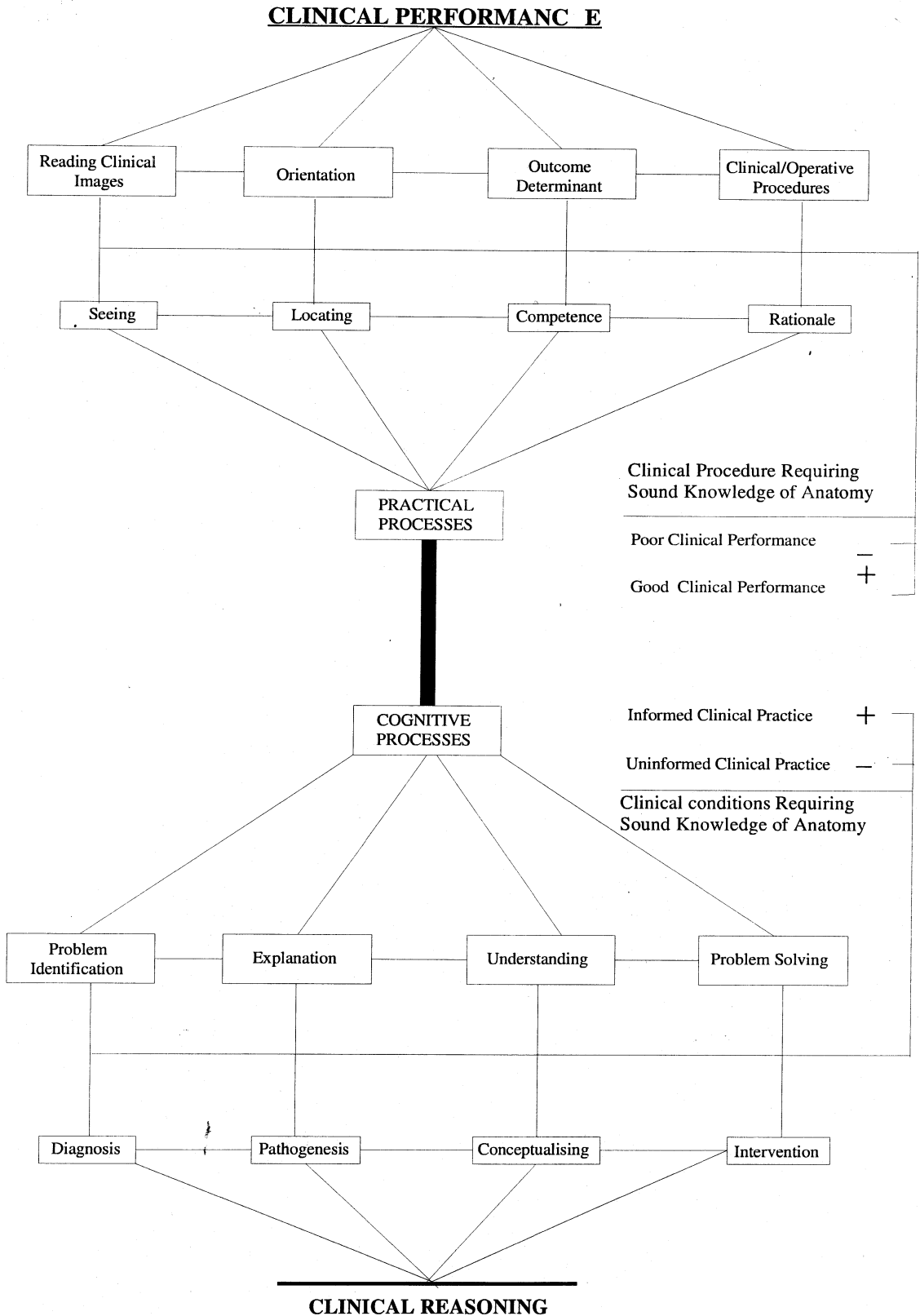
physical examination, and investigations) were really aimed at testing particular hypothesis or at least determining whether further inquiry into a particular hypothesis was warranted. The process involves considering the hypothesis with known information about disease processes and characteristics of the part under consideration. If they match the hypothesis is accepted, if they don't match the hypothesis is rejected. The same reasoning applies when interpreting imaging films (e.g. x-rays), and in understanding complex clinical conditions (e.g. homonymous hemianopia, coning of the brainstem). This hypothesis testing approach approximates “Test Operate Test Exit (TOTE) programme” described by Cohen¹⁴.

Based on semantic memory and model theories^{14,15,16} it appears that what and how knowledge of anatomy is used in clinical practice is dependent on the store of knowledge of anatomical facts and the cognitive skill of relating it and applying it to clinical context. “How knowledge is arranged determines how we speak and how we understand, how we solve problems and how we remember.”¹⁴. Therefore, students, must learn anatomy, not for the sake of knowledge of anatomy, but with diagnosis, characteristics of anatomical structures, and a sense of clinical application in mind all at once. Case studies, i.e., clinical presentations that discuss anatomical considerations, can help students to actively store and retrieve knowledge, all the while practicing and building a repository of anatomical knowledge applications for future ease of access and understanding when they are in the clinical arena.

Conceptual Framework

The use of anatomical knowledge is part of the clinical skills and reasoning paradigm. The anatomical facts are intertwined to considerations with information about disease and problem solving.

Figure 2: Conceptual Framework of the Role of Anatomy in Clinical Practice



Conclusions & Implications

The role of anatomy in clinical practice was classified into two broad themes: practical processes and cognitive processes. With regard practical procedures clinicians use anatomical knowledge as a rationale (basis) for where and how clinical procedures or operations are done; in orientating themselves on the human body; in reading clinical images which involves recognizing anatomical structures; and in recognizing aspects of clinical practice in which anatomy is an outcome determinant. The cognitive aspects involve problem identification; explaining clinical phenomena; understanding pathogenesis, signs and symptoms, and complications; and problem solving where the knowledge of anatomy is applied to solve a clinical problem.

The study has generated some evidence about the kind of anatomy and how it is used in clinical practice. The broad categories indicate that anatomical knowledge is used for performing clinical procedures and in cognitive processes. The use of anatomical knowledge is part of clinical skills and reasoning paradigm. The anatomical facts are intertwined to considerations with information about disease and problem solving. The study suggests that to enhance the use of anatomy in clinical practice it should be learned by medical students in clinical context. The finding supports Bligh^{17,18} who have advised that planning and research should address the relationship between teaching and subsequent clinical practice.

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