

UNDERSTANDING THE MECHANISM OF DISEASE IS THE BASIS OF SOUND MEDICAL PRACTICE

INTRODUCTION

“Does a doctor need to understand the mechanisms of disease in order to achieve sound medical practice?” If you were to ask a patient in a waiting room this question, they would almost certainly reply yes. It is an unsaid given that the doctor understands the patient’s particular disease, the mechanisms underlying the disease and consequently is able to explain the disease to the patient, suggest appropriate investigations and treat accordingly.

However, if you were to ask a medical student a similar question following a detailed pathology lecture, they might not respond in quite the same way! As a fourth year medical student, I have observed many of my peers frustrated following thoroughly comprehensive lectures focusing on the intricate details of disease mechanisms, such as the particulars of the morphological features of apoptosis or of the cytokine pathways. Their frustration results mainly because they struggle to find the relevance these topics have to clinical practice or how they will be of use in the diagnosis and management of disease.

In fact, the understanding of the mechanisms of disease is increasingly being limited in the undergraduate curriculum as time is made for more clinical

practice and newer educational strategies (Dick et al 1998). As outlined in Tomorrow's Doctors (GMC 1993), the foundations for a good medical education are currently thought to include reducing the burden of factual learning, promoting learning of core material and encouraging learning through curiosity and independent learning. More emphasis is now being placed on the teaching of communication skills and public health medicine, and the development of attitudes and behaviour that befit a doctor. The divide between clinical and preclinical studies is now bridged by a systems based curriculum and early contact with patients (GMC 1993). The theory behind this method of teaching is that the early clinical experience and patient contact will enable us to hone our clinical and communication skills. Furthermore, meeting a patient with a specific condition or using our own initiative in a problem based learning format helps the student to remember the salient points and promotes the development of life long learning skills.

The benefits of these changes in medical education are well recognised and irrefutable. What, therefore, is the advantage of a deep understanding of the mechanism of disease for our jobs as doctors, where communication and clinical experience account for so much? Aside from the core knowledge obtained from understanding mechanisms of disease, there are several other significant reasons why it is an essential component of an undergraduate medical degree and why it enables sound medical practice, long after the teaching has ceased and the student has established themselves as a doctor.

Figure 1 summarises the possible benefits to medical practice that the process of studying the mechanisms of disease brings.

- Improvement of medical knowledge
- Improvement of the doctor/patient relationship
- Improvement of patient education & compliance
- Improvement of understanding of investigation techniques
- Promotes understanding of disease as part of whole body
- Development of valuable transferable skills

Figure 1: Benefits gained from understanding the mechanisms of disease

This essay discusses in detail the benefits gained from the study of the mechanisms of disease, as well as the alternatives that are also believed to lead to sound medical practice.

BENEFITS TO MEDICAL PRACTICE

IMPROVEMENT OF MEDICAL KNOWLEDGE

The first benefit to medical practice that arises in understanding the mechanisms of disease is simply the gain of medical knowledge. Pathology involves the study of the mechanisms underlying the disease processes. It is a diverse discipline, encompassing many specialities, all of which are important in developing an understanding of the mechanisms of disease (Marshall et al 2004). Figure 2 highlights some of the specialities that help in the understanding of the mechanism of disease.

- Histopathology: general and organ specific disease processes at both a microscopic and gross level;
- Cytopathology: the study of dispersed cells;
- Anatomical pathology: disease processes in cadavers and promotes recognition that medical conditions do not occur in isolation.
- Haematology: study of blood constituents and coagulation mechanisms.
- Immunology: immune system diseases, caused by dysfunction, overactivity or underactivity of the normal system.
- Molecular pathology: disease mechanisms that arise at the level of genes and chromosomes.
- Microbiology: study of infectious diseases, their causes and treatment.

Figure 2: The various specialities that help in the understanding of the mechanism of disease (Marshall 2004).

It is clear looking at these varied specialities that pathology, or the understanding of the mechanism of disease, is a major informing discipline, and helps to link the practice of clinical medicine to the core knowledge learnt from the basic sciences (Boulay 1997). The main focus of study is of the structural and functional changes that occur in cells, tissues and organs when they are diseased. By understanding these processes, it is then possible to explain the basis of the signs and symptoms manifested by disease whilst also providing the basis for rational care and therapeutics (Robbins).

For example, learning about the cellular and molecular processes encompassed in basic pathology will enable an understanding of the basics of many disease processes, their investigations and treatment. A classic

example is found in the learning and understanding of the process of inflammation. Inflammation is a complex reaction in the vascularized connective tissue in response to certain stimuli. It is the reaction of blood vessels leading to the accumulation of fluid and leukocytes in extravascular tissues and is closely entwined with the process of repair (Robbins). Fundamentally, the process of inflammation is a protective response but it can lead to potentially harmful outcomes. Chronic inflammation in rheumatoid arthritis results in a chronic systemic disorder that may affect many tissues, including skin, blood vessels, heart, lungs and muscles. It principally attacks the joints, producing a non suppurative proliferative synovitis that often progresses to destruction of the articular cartilage and ankylosis of the joints (Robbins). Understanding inflammatory reactions is important in being able to comprehend the basis of this disease process. It also enables understanding of the rationale of investigations. In the example of rheumatoid arthritis, analysis of synovial fluid confirms inflammatory arthritis with neutrophils, high protein content and low mucin content, and laboratory tests may identify the presence of rheumatoid factor. Finally, it helps with the understanding of treatment. Prednisolone, one of the first line treatments for rheumatoid arthritis, is a synthetic corticosteroid that reduces inflammatory mediators. Its action thereby suppresses the inflammatory process. (BNF 2005)

The macroscopic concepts of disease are also an integral part of medical education as the visual concept of disease at the level of gross morphology assists students in the understanding of the pathogenesis of disease (Dick et al 1998). An improved knowledge of the pathogenesis will result in improved

understanding of signs and symptoms and improved medical practice. A classic example of the benefit of macroscopic or gross pathology is in the understanding of the process that results in myocardial infarction. In macroscopic pathology it is possible to observe a clot blocking a coronary artery. Consequently, the student can observe first hand how a totally excluded coronary artery clearly cannot supply blood to the heart muscle. Following on from this, it is clear that ischaemia will result due to lack of oxygen and if this is prolonged, the damage is irreversible and necrosis results. Necrosis refers to a spectrum of morphological changes that follows cell death in living tissue and results from the progressive degradation by enzymes on lethally injured cells. The appearance of necrosis is as a result of the enzyme digestion of the cell and the denaturation of proteins (Robbins). This process takes hours to develop and so there is no immediate change detectable. Understanding this development enables the student to realise that a myocardial infarct that causes sudden death will demonstrate no gross pathological change. If however death occurs at a later stage after the pathological changes have been established, the changes of necrosis will be visible. Actually visualising a heart that has been damaged by the process of necrosis enables the student to understand the process more fully and the effects that it has on the function of the heart become clearer. The muscle is evidently damaged, the wall may be thinner, with reduced ability to contract or conduct the electrical impulses required for the coordinated muscle contraction of a heart beat. It is not difficult for the students to then extrapolate the complications that can follow a myocardial infarction, such as rupture of

the heart, development of a ventricular aneurysm or mural thrombus, development of an arrhythmia or worsening of pre-existing angina.

UNDERSTANDING INVESTIGATIONS & INTERPRETING RESULTS

Pathology as a speciality encompasses morphology, diagnostic pathology immunology, cytogenetic and molecular analyses. Studying this as a medical student enables understanding of the techniques available for diagnosis but also interpretation of the results. Being aware of these techniques is essential as it will enable the doctor to know about what tests are available and also to interpret the results of any investigations ordered. For instance, when interpreting the results of a biopsy for neoplasia, it is essential to understand the basis of the pathological grading and staging. This is essential for explanation to the patient, treatment and prognosis.

IMPROVING THE DOCTOR-PATIENT RELATIONSHIP

The understanding of disease processes enables explanation to patient in a logical and consistent manner. It also allows for understanding of the treatments which are often devised as a result of understanding the disease process. A patient newly diagnosed with a disease will inevitably ask the doctor questions about the mechanism of disease. It is essential for the doctor patient relationship that the doctor is able to explain clearly and in suitable language the essentials that the patient needs to know. A thorough knowledge is required to be able to answer any questions that may be asked and an understanding of the mechanisms of disease will ensure the answers to questions are logical, succinct and clear. Following on from this,

understanding the mechanisms of disease will also help in explaining treatments to the patient in a manner that is rational. Improving patient understanding is essential for compliance to treatment. For instance, it has been shown that one of the factors influencing adherence in a complicated diabetes mellitus type 2 regimen is patient comprehension of treatment. Patients need to understand the importance of compliance and the risk of long term diabetic complications such as retinopathy or neuropathy. Emphasis is placed on the effective communication of this knowledge in order to overcome adherence issues (Rubin R 2005). Similar research in the compliance of complicated drug regimens in asthma and rheumatoid arthritis have also shown that effective patient education has an effect on patient behaviour and compliance (Cochrane et al 1999, Schreiber et al 2004).

IMPORTANCE OF WHOLE BODY, NOT SYSTEMS

Another important aspect of pathology is the fact that it promotes understanding of medical disease as part of a whole body rather than just an organ system or speciality; an important realisation in medical practice as it is clear patients may have multiple problems. The autopsy heightens the awareness of the large number of patients with multiple conditions and the level of uncertainty in medicine, an experience perhaps not easily gained elsewhere (O Grady).

One disease may have consequences on other systems and it is important to recognise this in the diagnosis of these conditions so that appropriate prophylactic or screening measures can be undertaken. For example,

diabetes mellitus frequently causes retinopathy and peripheral neuropathy. Treatment strategies now focus on screening patients to ensure these problems are caught early and also on strict control in order to limit the risk of these complications occurring in the first place.

Furthermore, it is important to realise that new symptoms can be caused by complications of a prior diagnosis, or alternatively, an entirely new condition. For example, in a patient with pre-existing liver cirrhosis, the development of a gastric ulcer could be mistaken for oesophageal varices due to portal hypertension (Davidsons). These are important differential diagnoses to make as they have huge implications on prognosis and treatment.

In a systems based course, the different specialities are taught independently, and there is a risk that students compartmentalise their medical knowledge. However, following an anatomical pathology session, students can think laterally about how the disease will affect other organs. They can begin to predict future outcomes or complications. The links between the disease processes will become clearer than having just read them in a textbook. Also, the notion that diagnoses can occur together or new diseases occur in patients with previous disease is reinforced. It is essential to ensure that students understand that medical diseases do not occur in isolation and that they learn not to make assumptions about a case but keep an open mind.

GAINING VALUABLE TRANSFERABLE SKILLS

Finally understanding the mechanism of disease enables students to develop important, irreplaceable skills that are of immense value in the practice of medicine. The autopsy has long been used as an educational tool for medical students. Attending an autopsy promotes core clinical skills such as clinicopathological correlation, pathophysiology, anatomy, and observation skills (Hill, Anderson 1991). Furthermore, the autopsy, promotes valuable transferable skills such as deductive reasoning, integration of diverse material, and clinical problem solving; skills which are clearly useful in other areas of medicine.

The understanding of mechanisms and principles, rather than detailed facts, promotes a thought process which will be useful for medical practice. In education theory, the acquisition of new knowledge depends on activation of prior knowledge and its reorganisation and elaboration, allowing it to be applied to different situations (Schmidt HG 1993). Within clinical medicine, there will be cases or unusual presentations of diseases which the doctor has never seen before. By applying a set of principles to the situation, it is possible to come up with a reasonable differential diagnosis, or to come up with ideas of the disease process involved, which may lead to an eventual diagnosis. Rather than having to remember the details of an entire medical text book, the doctor can establish likely processes that may be going on and thus limit their differential or search for a cause. It is not possible to learn the pathological basis of all diseases, but by applying knowledge gained from studying the basic processes, it may be possible to use the knowledge to the doctor's benefit when diagnosing unusual conditions. These techniques of

problem solving and analysis are crucial to medicine and clearly are developed in the study of the mechanisms of disease (Marshall et al 2004).

THE ALTERNATIVES

Pathology is unique among medical disciplines because it encompasses both a basic and a clinical science. It is an incredibly detailed speciality, with immense knowledge base and diverse skills required. In teaching pathology to undergraduate students, there is a risk that there is too much detail, and irrelevant knowledge that will not be helpful to their future clinical practice. As the GMC publication states, the focus should no longer be on obtaining huge factual knowledge, but rather emphasis should be placed on learning core material and learning by curiosity or self direction (GMC 1993). There are several aspects of the new curriculum that help to promote sound medical practice: self directed learning, in-depth projects, emphasis on communication and clinical skills.

Case based learning sessions involve the in-depth study of a clinical scenario, with presentation of the case, evaluation of a clinical problem, inquiry and hypothesis, gathering and application of information, and finally review and synthesis of what has been learnt (Kruger et al 2004). The areas investigated include the basic sciences, pharmacology and therapeutics, psychological aspects, epidemiology and public health, evidence based medicine, communication, and ethical and legal responsibilities. The case based learning approach motivates the learner because the student is engaged

clinically relevant topics and it enhances their ability to solve problems. It promotes skills such as critical thinking, decision making, analysis and problem solving (Kruger et al 2004). Research has suggested that there is no difference in assessment results between the problem based approach and a more traditional method (Dyke et al 2001). Thus, problem based learning produces a deep level of understanding and an ability to apply basic knowledge in the clinical setting (Newble DI, Entwistle NJ 1986).

Student selected components are detailed projects that are undertaken throughout the curriculum and allow the study of particular areas of interest in depth. These are incredibly useful because they promote the attitudes and skills of self directed learning, research, academic and scientific attitudes. Students learn to develop and carry out a research project, critically appraise and evaluate their own work.

Integration of the clinical and basic sciences throughout the curriculum promotes recognition of the link between the two. It also promotes the development of competent communication and clinical skills, which are essentials to good medical practice. No amount of knowledge base will replace the need to have these skills in order to achieve good medical practice and the only way to obtain these skills is by practicing them on the ward. By promoting early patient contact and clinical experience, as well as structured teaching of clinical skills the theory behind good communication, the opportunities for developing these skills are rife in the undergraduate medical curriculum.

CONCLUSION

There is clearly a basis for arguing that the understanding of the mechanisms of disease provides a basis of sound medical practice. Essentially, the benefits can be summarised in two main categories: the development of essential knowledge and also the development of vital transferable skills.

Understanding the mechanism of disease establishes basic necessary facts of diseases, why the symptoms occur and the rationale behind treatment. It also establishes thought processes to enable the clinician to apply their knowledge to any situation or clinical scenario and consequently develop their diagnostic skills from first principles. They should be able to attempt to tackle any clinical scenario and develop a logical differential.

Understanding the mechanism also promotes the development of certain skills that are useful in other areas of medicine. These include critical thinking, observation skills, integration of facts, problem solving and analysis. All of these are essential to becoming a good doctor and are transferable so may be used in all specialities and disciplines.

However, a sound knowledge base, although the foundation to good medical practice, is not the sole proficiency necessary. Doctors, as well as possessing fundamental core knowledge, need to be competent in communication and clinical skills and also be capable of critical self appraisal and continued

learning long after medical school has finished. It is not possible to have sound medical practice without either a sound knowledge base or good communication and clinical skills. The opportunities for learning and developing communication and clinical skills are improved with the new course. A combination of studying the basic understanding of disease and also the newer learning opportunities such as problem based learning and student selected components provide an excellent basis for obtaining the valuable transferable skills necessary in all areas of medicine. It is essential that the understanding of the basic mechanisms of disease is not forgotten. These basic processes must be studied by medical students so that they obtain the basic knowledge they require to be good doctors and in doing so, they will also obtain highly valuable skills that will serve them throughout their career.

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