ORIGINAL ARTICLE

Clinical rotation in pathology: description of a case based approach

J Bezuidenhout, E Wasserman, E Mansvelt, C Meyer, G van Zyl, H Orth, A Els

J Clin Pathol 2006;59:355–359. doi: 10.1136/jcp.2005.029454

See end of article for authors' affiliations

Correspondence to: Dr Juanita Bezuidenhout, Department of Anatomical Pathology, Stellenbosch University, PO Box 19063, Tygerberg, South Africa, 7505; jbez@sun.ac.za

Accepted for publication 26 September 2005

Background: The implementation of a system based, integrated curriculum at the Faculty of Health Sciences of Stellenbosch University, Western Cape, South Africa, resulted in less contact time for the pathology disciplines during theoretical modules, while a weekly rotation in pathology was introduced during clinical training in the fourth and fifth years.

Objective: To describe a problem based approach for this rotation.

Methods: Students are presented with a clinical "paper" case daily, integrating as many of the pathology disciplines as possible to demonstrate the interdependence of the various disciplines. They receive chemical pathology tutorials, visit the various laboratories, and receive practical training in fine needle aspiration biopsy. On the final day, the case studies are assessed and discussed.

Results: Most students appreciated all activities. This rotation enhanced student interactivity and autonomy and guaranteed immediate feedback. On evaluation of the rotation it was found that the students enjoyed the rotation, learnt something new, and realised the value of group work.

Conclusions: This innovation integrates pathology with clinical practice and illustrates the use of laboratory medicine in the management of common diseases seen in this country. Students appreciate learning practical skills and having to request special investigations under a pathologist's supervision changes their approach to pathology requests. Familiarity with the pathology environment empowers the student to use pathology with greater ease. A bank of case studies that can be expanded to include all medical disciplines will facilitate the application of a problem based approach and enhance communication between the basic science disciplines and the clinical and pathology disciplines.

A system based, integrated curriculum was implemented in the Faculty of Health Sciences of Stellenbosch University, Cape Town, South Africa at the beginning of 1999. In an unpublished faculty report, Terblanche and Van der Merwe (1996) listed the emphasis on community based learning and teaching, learner centred and problem orientated approaches, and the principle of developing core curricula to reduce information overload—together with the integration of subjects and a system orientated approach to organising learning content—as the major international trends in education and training driving curriculum change at Stellenbosch University.^{1–3}

It was decided to structure the students' schedule so as to allow more time for self directed learning and to keep formal lectures to a minimum, while maximising self directed learning and work in small groups. The content of the curriculum was arranged in outcomes based modules and themes that were clearly specified and made available to the learners. Subjects, including preclinical ones, were to be integrated, while optimally exposing the students to clinical material.

A systems based, problem oriented, outcome based educational approach was followed in the design of the new curriculum, which is less structured than classical problem based learning (PBL) but retains the aim of enhancing the relevance of the students' learning. It does this by incorporating clinical problems or patient cases in the system based modules, while the method of instruction concerning these problems is not defined.^{3–5} PBL is also fundamentally student centred, but changing from traditional lecture based teaching to PBL requires considerable resources, including the training of lecturers, the time that is required to develop suitable learning material, alterations to

infrastructure, and a lower faculty to student ratio, which our medical school could not comply with at the time.^{6,7}

The curriculum that was subsequently implemented in 1999 is structured in three theoretical phases (basic sciences – 6 months, pre-clinical – 1 year and clinical – 3,5 years). A basic pathology module of six weeks, "Principles of Disease Process", forms the last part of the pre-clinical phase and functions as a bridge between the pre-clinical phases and the clinical phase.⁸ Systemic pathology is incorporated into the systems-based clinical modules. The clinical phase is divided into blocks of four weeks and alternates with clinical rotations of a similar length. The intervention described here occurs in the clinical rotations.

METHODS

A week long, problem oriented clinical rotation in pathology was introduced as part of the clinical training in the fourth and fifth years with the aim of actively engaging students in the application of pathology services in clinical practice. This aim was to be reached through the following objectives: highlighting the role of pathology in the holistic approach to patient management, enhancing problem solving skills and peer learning, and establishing a practical approach to laboratory diagnoses of disease. The learning outcomes that we defined are listed in table 1.

Students, in groups of five, rotate for one week in total through the pathology services, comprising the disciplines of anatomical pathology, chemical pathology, haematology, microbiology, and virology. A case based approach that is focused on the learning objectives was selected as the core of

Abbreviations: FNA, fine needle aspiration; PBL, problem based learning

Table 1 Learning outcomes for pathology clinical rotation

At the end of the clinical rotation in pathology the student must be able to:

- Explain how the pathology disciplines can be used appropriately to facilitate/confirm clinical diagnoses
- Approach clinical cases in a problem solving manner
- Interpret laboratory reports of the most important and commonly requested laboratory tests with insight
- Plan and adjust patient management according to laboratory results in a clinical context
- Understand the importance of completing laboratory request forms accurately and comprehensively
- Explain the importance of the correct collection of various specimens frequently sent to the laboratory, the use of the correct specimen containers/tubes for specific tests and the appropriate identification of specimens
- Independently perform certain simple investigations that may be required in rural practice
- Undertake a fine needle aspiration (FNA)
- Consider the cost and time involved in the laboratory investigations most commonly requested
- Explain the significance of quality control in the pathology services
- Explain the importance of safety in the handling of laboratory specimens
- Demonstrate how laboratory reports can be obtained through a hospital computer system
- Complete a death certificate in a responsible and accurate manner

the rotation and during the first four days, the group is presented with a clinical "paper" case that is completed during the course of one day, thereby exposing each group of students to four cases. Each case is divided into approximately four to seven consecutive phases. Students have to work together in their group to complete the question sheet provided during each phase and deposit their response in an inbox. They are then allowed to take an envelope containing feedback on the completed phase, as well as the description of the of the next phase of the problem and the questions related to that phase. The cases are designed to reproduce a real patient scenario as closely as possible, including x rays, ECGs and so on where appropriate. An attempt is also made to integrate at least three of the pathology disciplines into a case study, in order to demonstrate the interdependence of the various pathology disciplines in the clinical setting. Students are prompted to request special investigations and to complete the request forms as in real life.

The students may selectively undertake certain of the laboratory tests, such as plating out a culture and examining the organisms grown, examining urine specimens and blood smears prepared by themselves, and looking at cytology or histology sections. The intent is not to teach the students how to do these procedures, but to give them insight into the functioning of a laboratory—although in rural South Africa the ability to examine urine specimens and blood smears can be invaluable to a clinician. These activities also stimulate the interested students and provide an element of fun. The feedback provided in the envelopes is not in the standard "answer to a question" memorandum, but only contains information relevant to the case, as encountered in actual practice. Students are expected to consult all appropriate resources available in the library and on the internet, and they are encouraged to consult other hospital staff. All case studies are designed to focus on common problems the

students will encounter frequently as general practitioners in South Africa.

Student feedback on the rotation was obtained by asking the students to complete a questionnaire at the end of the rotation, seeking categorical responses to Likert type statements (1 = strongly disagree; 5 = agree completely) (table 2). They were also requested to put a list of activities into rank order (1 = best learning activity; 5 = worst learning activity) (table 3), but a number of them insisted on independently ranking these activities (table 4). Free text responses to questions on the format of the rotation were also requested (table 5).

An abbreviated example of a case study is as follows.

Case study

Phase 1

Mary-Anne is a child aged three years and 10 months from a poor urban setting. Her mother reports that the child appears to be jaundiced, with a swollen face. She also vomits and is drowsy.

1. List the specific questions you will ask the patient/her mother to help you compile a differential diagnosis:
2. Which clinical signs will you look for during the physical examination?

Phase 1 feedback

1. You obtain the following information from the mother. Not exposed to anybody with jaundice. Oedema for a few weeks, worsening. Vomiting, drowsiness for a day. Productive cough a couple of weeks. Mother is a single parent, no permanent job. Four children under four years of age in the house. Grandfather (coughing), grandmother share the house. Everybody sleeps in one room.

Table 2 Responses to the evaluation questionnaire

Question	Likert scale*				
	1	2	3	4	5
I enjoyed the module	0	0	6	52	42
I learnt something new	0	0	3	39	58
The workload I had to handle was too much	49	33	17	1	0
I prefer to do the case studies electronically	60	23	9	7	1
Group interaction contributed to what I learnt	0	0	10	30	60
I feel more able to efficiently use pathology services	0	1	24	62	13

Results are given as percentages (n = 142).

*Students were requested to score the statements related to the pathology clinical rotation on a Likert scale of 1 to 5 (1, do not agree; 5, agree strongly).

Table 3 Rank order of the various activities included in the clinical rotation in pathology

Activity	Likert scale*				
	1	2	3	4	5
Laboratory visits	7	6	36	33	18
Case studies	22	35	24	13	6
Tutorials	41	21	22	8	8
Friday discussion	5	10	7	32	46
FNA practical	35	29	15	9	11

Results are given as percentages (n=83).

*Students were requested to order the value of activities to their learning experience by ranking the activities from 1 to 5 (1, affording the best learning experience; 5, not affording a good learning experience at all).

FNA, fine needle aspiration.

2. *Clinical signs present: Flaking skin, swollen abdomen, general lymphadenopathy, hepatomegaly, dyspnoea, rough crepitations and ronchi, neck stiffness.*

Phase 2

1. How ill do you judge Mary-Anne to be? Substantiate your opinion and provide a differential diagnosis.
2. Which laboratory/radiological and other investigations would you request initially? Complete the request forms and select appropriate containers for collecting the specimens.

Phase 2 feedback

1. *Mary-Anne is seriously ill and should be treated as an emergency. The neck stiffness probably indicates meningitis. Differential diagnoses include kwashiorkor with a systemic infection and malignancy with metastases.*
2. *Lumbar puncture: MCS, TB culture; Mantoux test; chest x ray; liver function tests; full blood count; sputum/stomach secretions – Zn; HIV.*

Phase 3

1. Interpret and discuss the results and/or material provided (relevant special investigations, including a chest x ray provided).
2. What is your diagnosis and motivate?

Phase 3 feedback

1. *Lumbar puncture results indicate: Raised lymphocytes and protein, glucose CSF/serum ratio slightly decreased. Bacterial culture negative. Zn negative. TB culture: awaiting result. Mantoux: positive. Chest x ray: fine, nodular opacification in both lungs. Sputum/gastric aspirates – Zn: positive. Liver function tests: indicates hepatocellular dysfunction.*
2. *Miliary tuberculosis with tuberculous meningitis. Underlying kwashiorkor.*

Phase 4

1. In the event of a negative Zn, what other investigations can you perform to confirm the diagnosis of tuberculosis?

2. Describe the macroscopic appearance of the specimen provided. What do you expect to see on light microscopy?
3. What is a Mantoux test? Discuss the underlying immunopathophysiology and histology of the Mantoux test. How do you interpret it?
4. Name the central nervous system complications associated with this organism and explain the pathogenesis.
5. Define kwashiorkor and describe the relationship between kwashiorkor and tuberculosis.

Phase 4 feedback

1. *Fine needle aspiration or lymph node biopsy.*
2. *Macroscopy: miliary tuberculosis in lungs, liver and spleen; liver fatty change. Microscopy: granulomas, fatty change in the liver.*
3. *Discussion reserved for Friday seminar.*
4. *Obstructive hydrocephalus due to thick exudate with organisation.*
5. *It is form of protein-energy malnutrition. Detailed discussion at Friday seminar.*

Phase 5

1. Describe the photographs in figs 1–5 (macroscopic and microscopic pictures of liver and CT scan of brain provided) and justify a differential/diagnosis.
2. Write short notes on the epidemiology, pathogenesis, clinical picture, pathophysiology and differential diagnosis of tuberculous meningitis.

1. Phase 5 feedback

Figure 1: Liver, macroscopy: fatty change.

Figure 2: Liver, microscopy: fatty change.

Figures 3–5: CT of brain: hydrocephalus with bilateral thalamic lacunar-type infarctions. Consult radiology.

2. Detailed notes provided and discussed at Friday seminar.

End of case study

Students also participate in a “tour” of the various laboratories and they have the opportunity to follow the

Table 4 Independent ranking of the various activities included in the clinical rotation in pathology (38% of the students insisted on an independent ranking of activities)

Activity	Likert scale*				
	1	2	3	4	5
Laboratory visits	28	28	20	17	7
Case studies	65	26	9	0	0
Tutorials	78	13	7	0	2
Friday discussion	46	19	30	0	5
FNA practical	57	28	13	0	2

Results are given as percentages (n=54).

*Likert scale: 1, affording the best learning experience; 5, not affording a good learning experience at all.

FNA, fine needle aspiration.

Table 5 Examples of frequently encountered responses to open ended questions in the questionnaire

If you learnt anything new, please tell us more about it?
Insight into what happens to a specimen; reinforcement of knowledge; practical skills (FNA)

What would you want more of?
Tutorials; case studies; less free time

What would you want less of?
Please don't change anything

Is anything lacking?
No. Well balanced, well planned programme; very enjoyable; the best so far

processing of a non-invasive specimen taken from themselves, usually a lipid profile, on a voluntary basis. This affords them the opportunity to appreciate the path a specimen follows in the laboratory. They also receive practical training in carrying out FNA and have the opportunity to examine a patient before a bone marrow biopsy and to observe the procedure. Students have to organise the work on their case study around the activities described here.

The case studies are assessed on the students' approach to problem solving, relevant and applicable use of pathology services, including technical aspects (for example, the correct completion of request forms), knowledge of special procedures for sample collection, and consideration of the cost-effectiveness. A group mark is awarded for each case and the average mark obtained for the four clinical cases comprises the students' mark for this rotation. The cases are discussed extensively during a panel discussion on the final day, with consultants representing each of the pathology disciplines. This provides ample feedback to the students and an excellent opportunity to learn more.

Student evaluation of the rotation

One hundred and forty two students had completed the questionnaire by the time this report was written. The questionnaire was completed at the end of the group discussion on the last day of the clinical rotation, and therefore we were able to obtain a 100% response rate. The answers to the Likert-type and rank order questions were collated and a quantitative analysis using Microsoft Excel was performed to determine percentages. The free text answers were not analysed, but examples of recurring answers are summarised in table 5.

RESULTS

All 142 students requested to complete the questionnaire over the period of one year complied with the request. Table 2 indicates that most students found the rotation enjoyable and considered it a valuable learning opportunity, while appreciating the opportunity for group work. The workload was not considered to be high, and we take note of this, as we plan to include more structured activities in the future. Students who put the activities in rank order (58% of 142) (table 3) rated the case studies, tutorials, and FNA practical as the most valuable. Thirty eight per cent of the students preferred to rank the activities independently (table 4) and most students responded favourably to all the activities, although the Friday discussion and the laboratory visits were not as popular as the other activities.

DISCUSSION

It is clear from the student feedback that they enjoyed the rotation, learnt something new, and realised the value of

Take home message

- A problem based pathology rotation enhances student interactivity and autonomy and guarantees immediate feedback.

group work. The students found the practical components, especially the case studies and FNA practical, to be the most valuable. Interestingly enough, the students expressed little desire to complete the case studies in an electronic format and preferred the group interaction that the current arrangement provides.

It is difficult to determine the impact of this intervention on the staff to student contact time and the number of staff hours used per week, as there is nothing to compare it to in the previous curriculum. The changes made were extensive and complicated and such an exercise would be impossible. The fact that the phases in the case studies replace a facilitator reduces the amount of contact time. There is very little cost to the departments or the medical school, as the only expense is the few tests performed on the students, as well as the paper used to print the case studies.

Our case based approach as a variation of PBL enhances active participation and peer learning and provides mechanisms for immediate feedback on the problems students that they are working on in order to enhance learning.⁴⁻⁷ The outcomes also focus on the skills and critical thinking required to obtain optimal results from a pathology laboratory and the role this plays in the management of the patient, as has been discussed by other authors.⁹⁻¹¹ The development of the students' skills to find and integrate relevant information is also a learning objective, and this promotes experiential learning and critical thinking.^{12, 13}

Undergraduate students in our previous curriculum seldom if ever visited, the pathology laboratories, and there were no opportunities for consultation with a pathologist. This rotation integrates pathology with clinical practice and illustrates the use of laboratory medicine in the management of common diseases seen in this country.¹⁴ It furthermore forms the basis for a bank of case studies that can be expanded to include all preclinical and clinical disciplines, at both the undergraduate and postgraduate level. This curriculum innovation ensures the application of an interdisciplinary problem based and the integration of disciplines.

Authors' affiliations

J Bezuidenhout, Department of Anatomical Pathology, Faculty of Health Sciences, Stellenbosch University National Health Laboratory Services-Tygerberg, Cape Town, South Africa

E Wasserman, H Orth, Department of Medical Microbiology, Faculty of Health Sciences, Stellenbosch University National Health Laboratory Services-Tygerberg

E Mansvelt, A Els, Department of Haematological Pathology, Faculty of Health Sciences, Stellenbosch University National Health Laboratory Services-Tygerberg

C Meyer, Department of Chemical Pathology, Faculty of Health Sciences, Stellenbosch University National Health Laboratory Services-Tygerberg

G van Zyl, Department of Virology, Faculty of Health Sciences, Stellenbosch University National Health Laboratory Services-Tygerberg

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ECHO.....

Gene expression identifies Budd-Chiari syndrome

Please visit the *Journal of Clinical Pathology* website [www.jclinpath.com] for a link to the full text of this article.

The first quantitative molecular study of gene expression in Budd-Chiari syndrome (BCS) has shed light on the development of the disease and its relation to other chronic liver diseases.

BCS, cirrhosis, and normal liver can be separated by their pattern of expression of 35 selected genes associated with liver disorders and fibrosis. Fourteen genes were more strongly expressed in BCS than in normal liver. They were genes for extracellular matrix remodelling, blood vessel remodelling, and growth factors and their receptors. The most upregulated was superior cervical ganglion (SCG10). Expression patterns fell into two groups, corresponding more or less to acute or chronic BCS as determined morphologically. Three genes showed differential expression: SCG10 and matrix metalloproteinase 7, both upregulated, and thrombospondin-1, downregulated, in chronic BCS. Seventeen genes were upregulated in acute BCS versus normal liver and 14 of these in chronic BCS.

Three distinct profiles were apparent in acute and chronic BCS compared with normal liver: genes with upregulated expression in acute BCS, reverting to normal expression in the chronic stage; genes with upregulated expression in the acute stage, persisting in the chronic stage; and genes with upregulated expression only in the chronic stage.

Ten genes showed differential expression when chronic BCS and cirrhosis caused by viral infection or alcohol misuse were compared with normal liver.

Gene expression was determined by real time RT-PCR in 13 cases of BCS, 13 cases of cirrhosis, and 10 samples of normal liver.

Fibrosis is common to liver diseases, but morphological features suggest a different pathogenetic mechanism for BCS and cirrhosis.

▲ Paradis V *et al.* *Gut* 2005;**54**:1776–1781.