

Johanna Kruckeberg  
Human Anatomy and Physiology  
CASTLE Case Study Analysis Questions  
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**1. What are the important teaching/learning issues in this case?**

- Some students in Human Anatomy and Physiology have little science background and are ill-prepared to master content involving complex physiological processes. This lack of experience with the content matter may make it difficult for some students to proceed beyond the lower levels of Bloom's taxonomy (Bloom et. al, 1956).
- Students' use of critical thinking skills to discern causes of homeostatic imbalances is especially problematic.
- Many Human A&P students enter the Kirkwood nursing program, where instructors report that there is sometimes poor transfer of A&P course content to new situations.
- Since Human A&P was moved from within the nursing curriculum to a prerequisite, students bring little to no clinical experience to the classroom. They are less able to make connections between what they are learning and real world situations.

**2. What teaching/learning strategies might be helpful?**

- Students may benefit from a directed case-study approach; the case-study itself provides a framework on which to build content knowledge and "directing" the students through the process assists the learning of students with little to no science background.
- Students may benefit from computer-assisted instruction designed to enhance learning.
- Students may benefit from a small group learning activity in which each group member is charged with "teaching" a portion of the information to other group members.

**Case Scenario**

**Learning Outcome:** Apply knowledge of capillary dynamics (blood hydrostatic pressure, blood osmotic pressure, interstitial fluid osmotic pressure, and lymph flow) to determining the causes of edema.

**Learning Strategies:**

A. "Mini" case studies (included after references section) were presented to students prior to instructor lecture on capillary dynamics and lymphatics.

B. The usual lecture material on capillary dynamics, lymphatics, and edema was presented.

C. In the laboratory, students completed a computer-assisted learning activity (included after references section).

D. “Rounds”: During the next lecture session, students were assigned to groups of 4; each student presented one of the cases to the others in the group as occurs in doctor’s rounds.

### **3. What learning theories might support or inform these teaching/learning strategies?**

- Advance organizers, introduced before the learning, allow students to build a bridge between new material and relevant preexisting ideas (Ausubel, 1963).
- The amount of information retained and remembered increases as processing of the information increases (Cermack and Craik, 1979).
- Critical thinking can be encouraged through use of such instructional techniques as case studies (Brookfield, 1987).
- A directed case study has been shown to be an effective tool in helping students grasp difficult physiological concepts (Cliff and Wright, 2005).
- Role playing within a case-based framework (as students did during “rounds”) and multimedia tutorials promote better depth of processing (Riesbeck, 1996).
- Learning with computers allows students to construct knowledge rather than merely reflect the instructor’s presentation (Jonassen, 2000).
- Group and active learning processes that allow interactions within communities of learners are preferable to those dependent on the instructor (Jonassen et. al., 1995)

### **4. What question or hypothesis does this case raise that might be further investigated in a classroom research project?**

*Does a series of directed “mini” case studies on edema, which involve computer-assisted instruction and group activities, improve student learning and perception of learning?*

### **5. What classroom assessment data could be collected to test these hypotheses?**

Student learning was measured by performance on multiple choice test items (included after references section) which were also used in 2004 when content was covered by lecture only. Lecture-only student performance was compared to lecture/directed case study student performance. Student perception of learning was assessed by asking the students to respond to the following question:

*The edema case study activities enhanced my understanding of capillary dynamics.*

- (a) *strongly agree*
- (b) *agree*
- (c) *disagree*
- (d) *strongly disagree*

Students were also asked to write a sentence or two describing their reaction to the case study approach.

## Results of Cognitive Assessment:

### Student Performance on Multiple Choice Questions

| Question # | % correct Lecture Only<br>(n=54) | % correct Lecture +<br>Directed Case Study (n=57) |
|------------|----------------------------------|---|
| 38         | 87                               | 74  |
| 39         | 80                               | 74  |
| 40         | 59                               | 70  |
| 41         | 46                               | 46  |
| 42         | 59                               | 60  |

Based on the literature discussed in question 3, my expectation was that the lecture + directed case study students would have a higher percentage of correct answers on multiple choice questions than the lecture only group. In actuality, the case-study based intervention did not improve test performance on the topic across the board. Case-study students scored lower on 2 questions, higher on 1 question, and about the same on 2 questions. However, it should be noted that on questions 40-42, which dealt directly with edema, the case study students answered as well or better than their lecture only counterparts.

It should also be noted that the study dealt with 2 different groups of students. To address student ability between the 2 groups, student performance on a national exam covering a year's worth of A&P content was compared. In 2004 (lecture only), the median score was 7% higher on this exam than in 2006 (lecture plus directed case study). In light of the course-wide higher achievement level of the lecture-only group, it is possible that the lecture plus case study group did in fact exhibit enhanced learning by closely matching the performance of the lecture-only group.

### Results of Affective Assessment:

90% of students responding either strongly agreed or agreed that the edema case studies enhanced their understanding of capillary dynamics. 80% of students wrote comments that could be considered positive. 18% wrote comments that could be considered neutral. One student summed up the views expressed by the majority, "It was helpful for me to be able to see how what we are learning actually applies in the real world." Other positive comments cited the computer activity and having group input in analyzing the cases as benefits. Several said the activities were "more interesting" than lecture-only. It is interesting to note that student reaction was overwhelmingly positive in spite of the mixed results of the cognitive assessment. As described in CREOLE Chapter 1, Module 3, sometimes learners and the instructor do not have commonly shared expectations for learning. It is possible that I had higher expectations than the students; they may have seen their performance as "enhanced" regardless of the cognitive outcome.

## 6. Conclusion

Based on the literature cited in question 3 above, I chose to investigate a learning intervention that combined increased relevance, learning in a social context, and

computer assisted instruction. Although cognitive results may be considered somewhat inconclusive, the results of the affective assessment were positive enough to cause me to continue to make use of and refine the guided case study approach to teaching capillary dynamics and edema. In particular, I will review the parts of the case-study activities that concern increased blood hydrostatic pressure as a cause of edema (as is seen in congestive heart failure). This topic resulted in the lowest percent correct on the cognitive assessment in both the lecture-only and lecture plus case study groups.

The positive student response will prompt me to look for further opportunities to incorporate this learning intervention in the Human A&P classroom. I hope to work with nursing faculty (as I did in this case) to develop clinically based scenarios which incorporate physiological concepts. As I increase the use of these learning strategies and they become more familiar to students, it is possible that I can make them less instructor-directed and more student-directed—this may bring greater increases in the cognitive area.

As opportunities arise, I will share my case study approach with interested faculty.

### References

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## **Mini Case Studies—Introduction to Capillary Dynamics**

*Leonard W. is a 66 year old alcoholic who has been drinking for years. He has recently been admitted to the hospital. Currently, his plasma albumin levels are 1.6 g/dl and his blood pressure is 100/50. During the past month he has gained over 25 pounds due to water retention. He exhibits swelling in all areas of the body. Diagnosis: end stage liver disease*

*Gladys E. is an 85 year old suffering from congestive heart failure. She exhibits swelling in the extremities and is having difficulty breathing. Her physician tells her she has pulmonary edema.*

*Bonnie S. is a 19 year old gymnast. During practice, she falls from the uneven parallel bars and twists her ankle—it is markedly swollen.*

*Marilyn M. is a 45 year old woman who recently discovered a lump in her right breast. After mammography and biopsy, it was determined that she had breast cancer. A modified radical mastectomy (removal of breast tissue, nipple, and lymph nodes, leaving muscles intact) has been performed. Her right arm has become extremely swollen.*

*How are these cases related? They all have to do with disruption in the relationship between the capillary and the tissue it serves. In this unit of study, we will explore this relationship.*

## Computer Assisted Learning Activity

*MATERIALS NEEDED: Introduction to capillary dynamics cases, A&P Textbook, Interactive Physiology Fluid and Electrolytes Module*

*Refer to the cases presented in the introduction to the capillary dynamics unit to complete this activity. Access the Interactive Physiology (IP) Fluid and Electrolyte Module. Select "Electrolyte Homeostasis" from the Topic Menu. Click on the title bar and select page 9 to begin. We will be using pages 9-16 in this activity. Complete pages 9-12 before you begin to analyze the cases. These first few pages will review the pressures that affect fluid movement into the interstitial space and the causes of edema*

### **THE CASE OF LEONARD W.**

1. Leonard W.'s blood pressure is (circle one) normal/above normal/below normal.

2. Use your text book (Appendix E) to determine a normal range for plasma albumin levels.

Normal plasma albumin levels=

Leonard W.'s plasma albumin level=

2. IP Page 13 is pertinent to Leonard's case. Complete the following as you proceed through page 13:

Liver disease causes a \_\_\_\_\_ in the production of plasma proteins like albumin.

This, in turn leads to a (circle one) increase/decrease in blood colloid osmotic pressure.

In which direction will water move?

What happens to blood pressure as a result of this movement? Explain.

4. Write a several sentence summary describing the causes of Leonard W.'s edema and low blood pressure.

### **THE CASE OF GLADYS E.**

Read the description of congestive heart failure in your text book.

1. When the left side of the heart fails, blood pressure in the lungs (circle one) increases/decreases. This is known as pulmonary hypotension/hypertension

2. If the right side of the heart fails, where does blood accumulate and blood pressure increase?

3. Page 14 of the IP module is pertinent to Gladys' case. Complete the following as you proceed through page 14.

Increased/decreased (circle one) blood hydrostatic pressure (hypertension) in the capillaries is another cause of edema.

This change in pressure causes increased movement of fluid \_\_\_\_\_ the interstitial fluid compartment.

4. MULTIPLE CHOICE: Given Gladys E.'s symptoms, which side of the heart appears to be failing?      a. right side      b. left side      c. both sides

5. Write a several sentence summary describing the causes of Gladys E.'s edema.

#### **THE CASE OF BONNIE S.**

1. IP Page 15 is pertinent to Bonnie's case. Complete the following as you proceed through page 15.

As a result of inflammation or injury \_\_\_\_\_ leak from capillaries into the interstitial fluid compartment.

This causes water to move in which direction?

How are protein and fluid returned to the plasma once localized inflammation ends?

2. Write a several sentence summary that describes the cause of Bonnie S.'s edema.

#### **THE CASE OF MARILYN M.**

1. IP Page 16 is pertinent to Marilyn's case. Complete the following as you proceed through page 16.

MULTIPLE CHOICE: When lymph nodes are removed during surgery

- a. blood osmotic pressure is decreased
- b. blood hydrostatic pressure is increased
- c. fluid is trapped in the interstitial fluid compartment

2. Write a several sentence summary that describes the cause of Marilyn M.'s edema.

### Multiple Choice Test Questions

38. The pressure which tends to draw fluid into capillaries that is exerted due to the solute concentration of the blood is the

- (a) blood hydrostatic pressure
- (b) interstitial fluid hydrostatic pressure
- (c) blood osmotic pressure
- (d) interstitial fluid osmotic pressure

39. Which of the following statements is TRUE concerning blood hydrostatic pressure and capillary dynamics?

- (a) The blood hydrostatic pressure is normally the largest force causing movement out of the capillaries at the arterial end.
- (b) The blood hydrostatic pressure is normally the only pressure that changes significantly from the arterial to the venous end.
- (c) both of these are correct
- (d) neither of these is correct

40. Trauma (such as a sprained ankle) can cause localized edema because it increases the \_\_\_\_\_ in the area.

- (a) blood hydrostatic pressure
- (b) interstitial fluid osmotic pressure
- (c) blood osmotic pressure

41. Why does left side congestive heart failure cause pulmonary edema?

- (a) the blood osmotic pressure in pulmonary capillaries is decreased
- (b) the blood hydrostatic pressure in pulmonary capillaries is increased
- (c) the interstitial fluid osmotic pressure in pulmonary capillaries is increased

42. Liver disease or loss of proteins in the urine due to nephrosis may cause edema because

- (a) the blood osmotic pressure is reduced
- (b) the blood hydrostatic pressure is reduced
- (c) the interstitial fluid osmotic pressure is reduced