Nursing Process Paper of the Adults

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I.S. is a pleasant eighty-five year old female with no intrinsic pulmonary or cardiac disease that is known. She was admitted to Mercy Medical Center on September twenty-eighth two-thousand and ten with an admitting diagnosis of **pleural effusion.** She is widowed but has two sons and daughters, six grandkids, and eight grandkids. I.S. lives in Canton, Perry Township, in a one-floor apartment. Her children all live close in town, also in Perry Township. Her children are all able to help her and it is to the patient's advantage that her kids are so close by her side. She is a Caucasian female that weighs 131 pounds and is 5 feet tall. I.S. has no known drug allergies and is on a regular diet. The patient's status is a Full Code Status which means that all possible measures are taken to revive a person and sustain life if something were to happen.

The patient's admission medical diagnosis is pleural effusion. Pleural effusion is an accumulation of fluid in the pleural space. It's in the thoracic cavity between the visceral and the parietal pleura. Pleural fluid normally seeps continually into the pleural space from the capillaries lining the parietal pleura and is reabsorbed by the visceral pleural capillaries and lymphatic system. Any condition that interferes with either secretion or drainage of this fluid leads to pleural effusion. Clinical manifestations depend on the amount of fluid present and the severity

of lung compression. If the effusion is small, its presence may be discovered only on a chest radiograph. With larger effusions, lung expansion may be restricted, and the client may experience dyspnea, primary on exertion, and a dry, nonproductive cough caused by bronchial irritation or mediastinal shift. (Black & Hawks, 2009) My patient was experiencing shortness of breath for several weeks before being admitted and had to sleep sitting up. She was also experiencing a nonproductive cough. These were great clues that lead to her diagnosis of pleural effusion. Diagnostic tests include ultrasonography, chest CT, chest x-ray, and thoracentesis. (Antony & Tolm, 2007) Thoracentesis is very common and is used to remove excess pleural fluid. After the thoracentesis, closed-chest drainage with suction is used to reexpand the lung rapidly and fill the pleural space. If the fibrous material has restricted the lung for some time, the lung may not reexpand effectively and further intervention may be needed. When I.S. arrived in the emergency room they performed a chest x-ray which revealed evidence of an elevated hemidiaphragm on the right, but also significant pleural effusion. The elevated hemidiaphragm can be due to the fluid buildup force. After they found out about the pleural effusion and since no old x-rays were available for comparison, the patient underwent an ultrasound-guided thoracentesis by radiology in which one liter of fluid was

removed.(Black & Hawks, 2009) Next, a CT of the chest showed a large right pleural effusion with adjacent atelectasis (a collapsed or airless condition of the lung) and consolidation and a ting left pleural effusion. An echocardiogram was done on April 23, 2010 which showed normal LV chamber sizes in systole and diastole but no pericardial effusion was seen.

There was question as to where the fluid was coming from but since the patient has a history of cirrhosis, this explains that it might be due to the liver. I.S. was diagnosed with cirrhosis cryptogenic secondary to her cirrhosis about three years ago. She has had this condition but with NO symptoms at all, so nothing was done about it. Cirrhosis of the liver is a chronic, progressive disease characterized by widespread fibrosis (scarring) and nodule formation. Cirrhosis occurs when the normal blood flow of blood, bile, and hepatic metabolites is altered by fibrosis and changes in the hepatocytes, bile ductules, vascular channels, and reticular cells. Causes of cirrhosis range from genetic to alcoholic problems, all leading to some form of the disease. However, there is one variation of it that has no known or so far explained cause: cryptogenic cirrhosis. The rate of diagnosed cryptogenic cirrhosis is 7:10000, smaller than of iatrogenic cancer or unexplained coronary attacks. Cryptogenic cirrhosis is an abstract

disease, according to physicians. It means that it has no palpable cause, nothing real and it just appears out of nowhere, installing itself fully in a matter of weeks. The symptoms of this form of cirrhosis are identical to those of classical cirrhosis: jaundice, fatigue and general weakness, weight loss and lack of muscle control, the presence of blood in your stool and vomit, high temperature and swelling in your abdominal cavity and your joints. The treatment of cryptogenic cirrhosis follows the same patterns than that of any kind of cirrhosis: it tries to stop further damage to the liver cells. Therefore, it makes use of a balanced diet and multivitamins to turn the patients' life around. I.S., the patient is also taking multivitamins for her health every day. (Black & Hawks, 2009)

The patient also has a past medical history of hypertension, hypothyroidism, left calf DVT about six years ago following a left knee replacement, benign bilateral breast biopsies, cholecystectomy, tonsillectomy, macular degeneration, CHF, bilateral cataract extractions, total abdomen hysterectomy, and appendectomy at the time of the hysterectomy.

Hypertension is high blood pressure that is a common condition in which the force of the blood against your artery walls is high enough that it may eventually cause health problems. Blood pressure is determined by the

amount of blood your heart pumps and the amount of resistance to blood flow in your arteries. You can have high blood pressure (hypertension) for years without any symptoms. Uncontrolled high blood pressure increases your risk of serious health problems, including heart attack and stroke. Most people with high blood pressure have no signs or symptoms, even if blood pressure readings reach dangerously high levels. Although a few people with early-stage high blood pressure may have dull headaches, dizzy spells or a few more nosebleeds than normal, these signs and symptoms typically don't occur until high blood pressure has reached a severe — even life-threatening — stage. There are two types of high blood pressure:

Primary hypertension: For most adults, there's no identifiable cause of high blood pressure. This type of high blood pressure, called essential hypertension or primary hypertension, tends to develop gradually over many years.

Secondary hypertension: Some people have high blood pressure caused by an underlying condition. This type of high blood pressure, called secondary hypertension, tends to appear suddenly and cause higher blood pressure than does primary hypertension.

High blood pressure has many risk factors, including age, race, family history, being overweight or obese, not being physically active, using tobacco, too much salt in your diet, etc. My patient, I.S. is managing her hypertension with medications such as Atenelol, Benicar, and Aldactone every day. (Cunha, 2010)

Hypothyroidism is a condition in which the body lacks sufficient thyroid hormone. Since the main purpose of thyroid hormone is to "run the body's metabolism," it is understandable that people with this condition will have symptoms associated with a slow metabolism. There are two fairly common causes of hypothyroidism. The first is a result of previous (or currently ongoing) inflammation of the thyroid gland, which leaves a large percentage of the cells of the thyroid damaged (or dead) and incapable of producing sufficient hormone. The second major cause is the broad category of "medical treatments." The treatment of many thyroid conditions warrants surgical removal of a portion or all of the thyroid gland. If the total mass of thyroid producing cells left within the body is not enough to meet the needs of the body, the patient will develop hypothyroidism. There are several other rare causes of hypothyroidism, one of them being a completely "normal" thyroid gland that is not making enough hormones because of a problem in the pituitary gland. If the pituitary does not produce enough thyroid stimulating hormones

(TSH) then the thyroid simply does not have the "signal" to make hormone. So it doesn't. Symptoms of hypothyroidism include fatigue, weakness, weight gain or increased difficulty losing weight, dry rough pale skin, hair loss, cold intolerance and muscle cramps. The patient is currently taking Synthroid PO as a supplementation to endogenous thyroid hormones.(Black & Hawks, 2009)

I.S. had a cholecystectomy in the past which impacted her a lot in the long run. A cholecystectomy is removal of the gallbladder by laparoscopic or abdominal surgery. Your gallbladder collects and stores bile — a digestive fluid produced in your liver. But since the patient has cirrhosis, the liver is probably not producing bile as effective. Surgical complications, including wound infections, adverse reactions to anesthetics, and injury to the liver or neighboring organs. Cholecystectomy is performed using general anesthesia, so you won't be aware during the procedure. Cholecystectomy can relieve the pain and discomfort of gallstones. Conservative treatments, such as dietary modifications, usually can't stop gallstones from recurring. Some people experience mild diarrhea after cholecystectomy, though this usually goes away with time. Most people won't experience digestive problems after cholecystectomy. Your gallbladder isn't essential to healthy digestion. How quickly you can return to normal

activities after cholecystectomy depends on which procedure your surgeon uses and your overall health. My patient is currently experiencing chronic diarrhea due to this procedure for years now, so the fact that mild diarrhea usually goes away with time is not so “usual.” She has to take medications for this condition and must always be near a restroom because she has to go about five times a day.(Cunha, 2010)

NPR Medication Sheet

Drug Name (generic/trade name)	Drug Action	Drug Classification	Dose / Route	Is the dose reasonable/safe?	Occurring side Effects	Why is patient taking it?
Tenormin/Atenolol	Blocks stimulation of beta1 (myocardial) – adrenergic receptors. Does not usually affect beta2 (pulmonary, vascular, uterine)-receptor sites.	Antianginals, antihypertensives Beta blockers	50 mg PO qday	Yes; recommended dose as antihypertensive is 25-50 mg	BP 108/62	Pt. taking As an antihypertensive for hypertension
Benicar/Olmesartan Medoxomil	Blocks vasoconstrictor and aldosterone-secreting effects of angiotensin II at various receptor sites including vascular smooth muscle and the adrenal glands.	Antihypertensives Angiotensin II receptor antagonists	40 mg PO qday	Yes; recommended dose can be increased up to 40 mg.	N/A	Pt. taking as an antihypertensive for hypertension
Multivitamin	Contains fat-soluble vitamins	Vitamins	1 TAB PO	Yes; recommended	N/A	Pt. taking for prevention of

	and most water soluble vitamins. These are necessary for normal growth and development. Prevention of deficiency or replacement.		qday	dose is 1 dosage unit (tablet)		vitamin deficiencies.
Calcium Carbonate	Essential for nervous, muscular, and skeletal systems Maintain cell membrane and capillary permeability. Act as an activator in the transmission of nerve impulses and contraction of cardiac, skeletal, and smooth muscle. Essential for	Mineral and electrolyte replacements/supplements	1 TAB PO qday	Yes	N/A	Pt. taking for

	bone formation and blood coagulation. Replacement of calcium in deficiency states.					
Aldactone/Spironolactone	Causes loss of sodium bicarbonate and calcium while saving potassium and hydrogen ions by antagonizing aldosterone. Weak diuretic and antihypertensive response when compared with other diuretics. Conservative of potassium.	Diuretics, potassium-sparing diuretics	25 mg PO qday	Yes the dose is safe range.	N/A	Pt. taking for hx of CHF & for hypertension control (↓BP)
Synthroid/Levothyroxine	Replacement of or supplementation to endogenous	-Hormones -Thyroid preparations	25 mcg qday PO	Yes the dose is in safe range; recommended usual	Diarrhea, arrhythmia	Pt. taking for hx. Of hypothyroidism

	thyroid hormones. Principal effect is increasing metabolic rate of body tissues. -Promote gluconeogenesis -Increase utilization & mobilization of glycogen stores. -Stimulate protein synthesis -Promote cell growth and differentiation -Aid in the development of the brain & CNS.			maintenance for Geriatric Pts is 12.5-25 mcg/day		
Preserved vision			1 TAB 2xday PO	Yes the dose is in the safe range.	N/A	Pt. is taking this for macular degeneration
Bismuth Subsalicylate/Bismatrol	-Promotes intestinal adsorption of fluids and electrolytes.	Antidiarrheals, antiulcer agents; adsorbents	2 TABS as needed PO	Yes the dose is the safe range.	N/A	Pt. is taking for hx. of chronic diarrhea, management.

	-Decreases synthesis of intestinal prostaglandins -Relief of diarrhea.					

**** All information taken from Skyscape-Davis' Drug Guide medical information copyright 1998-2010**

Adults Course
Lab Interpretation and Other Diagnostic Tests

Lab Test	Result	Normal Range	Interpretation
NA	**138**	135-145 mEq/L	
K	**4.1**	**3.5-5.0 mEq/L**	
CL	**104**	**100-110 mmol/L**	
CO2	**23**	**22-32 mEq/L**	
GLU	**128↑**	**70-110 mg/dL**	**May be d/t thyroid hormones(Synthroid med)** **May be d/t severe liver disease->hx of cirrhosis**
BUN	**9**	**8-20 mg/dl**	

CREAT	**0.80**	**0.6-1.2 mg/dl**	
BUN/CREAT	**11↓**		**May be d/t cirrhosis cryptogenic**
TP	**5.2↓**		
ALBUMIN	**3.1↓**	**3.5-5.0 g/dL**	**May be d/t hx of cirrhosis**
GLOBULIN	**2.1↓**		**May be d/t hx of cirrhosis**
CHOLESTEROL	**209↑**		
INR	**1.1**	**2.0-2.5(~3.0)**	
PT	**11.9↑**	**9.5-11.3 sec**	**Pt. was on Coumadin for 3 months.**
PTT	**27.6**	**25-38 sec**	
WBC	**5.9**	**5-10/mm3**	
RBC	**4.86**		
HcT	**41.3**	**35-47%**	
PLT	**79↓**	**130,000-400,000/mm3**	**May be d/t cirrhosis**
Hgb	**14.4**	**12-16 gm/dl**	
Ultrasound-guided thoracentesis			
Echocardiogram			
Chest x-ray/ Repeat chest x-ray			

Kent State University N30040
FUNCTIONAL HEALTH PATTERNS DATA BASE

Student Name: Julia S. Apostolescu **Date: October 20, 2010**

Include client's admission date, occupation, diet, religion, activity, allergies, current meds, treatments, surgery, and diagnostic tests results under the appropriate health pattern.

Client Profile (summarize events leading to the day you cared for client): I.S. was at home, in her own apartment, when she started feeling like she couldn't breathe and she began to panic. I.S. had experienced and noticed being short of breath for over the past couple of weeks before she was admitted to the hospital, but she did not think much of it. To solve her issues she was sleeping sitting up, and for this reason, she came into the emergency department. When I.S. felt as if she could not breathe even sitting up, she called 9-1-1 and came into the emergency room at Mercy Medical Center on 9-28-2010. In the emergency department paroxysmal nocturnal dyspnea (PND) and orthopnea was noted. A chest x-ray revealed evidence of an elevated hemidiaphragm on the right, but also significant pleural effusion. It was felt that the pleural effusion was new, although there are no recent x-rays done. Patient was significantly symptomatic which was what lead to her admission on floor 8 main.

AREA OF HEALTH	SUBJECTIVE DATA	OBJECTIVE DATA	INDIRECT DATA *Identify source of indirect data	INTERPRETATION (effective patterns or barriers/potential barriers)
HEALTH/PERCEPTION HEALTH MANAGEMENT General Survey, perceived health	"I think at my age I do GREAT and also compared to my friends.."	BP-108/66 R-18 POX-92% RA T-98.0 P-96 Multivitamin PO	Chart medical history indicates that Pt.'s immunizations are all up to date. Chart medical history	Patient demonstrates effective patterns of function in this area. She seemed to know a lot about her health conditions, even cause & effect situations.

& well-being, self-management strategies, utilization of preventative health behaviors and/or services.	" I exercise 2x/wk b/c my apartment complex offers it and I also have a walking path by my house"	qday Preserved vision 1 TAB 2xday Aldactone 25mg qday Patient demonstrates a lot of confidence in herself and the way she takes care of herself. Patient seems well groomed and clean and is very pleasant.	states Pt. is NON-smoker/NON-drinker	
NUTRITIONAL/ METABOLIC Patterns of food and fluid consumption, Weight, skin turgor. (Skin, Hair, Nails; Head & Neck; Mouth, Nose, Sinus; swallowing, Ht., Wt)	"My appetite is pretty good, but I eat small portions closer together" "My taste buds aren't so good.."	Diet:Regular 131 lbs, 5' Skin slightly pink, dry & intact No dentures; trachea intact; JVD not present Good skin turgor When the patient's food arrived she looked eager to eat and asked me to excuse her. Pt ate most of her lunch, about 75% of it.	Labs from medical chart show: **Cholesterol 209 ↑ **Hx. Of hypertension **Glucose 128 ↑ **Hx. Of tonsillectomy	Patient demonstrates effective patterns of function in this area with little concern of barriers. Patient still seems to have a pretty good appetite keeping in mind her age. Potential barriers include high cholesterol/glucose results & history of hypertension. Lifestyle modifications should be enforced..Potential for prediabetes?

ELIMINATION Patterns of excretory function & Elimination of waste; relevant labs, Medications, impacting, etc. (Abdominal - bowel and bladder)	PT states: "I go to the bathroom everyday" "Yea, I have a bowl movement about 5 times a day because I have chronic diarrhea and because of this I have to be on the diarrhea's schedule and ALWAYS near a bathroom" "I take antidiarrhea medication" "I have no problems urinating like burning or such..it's always yellow and clear..like pee"	BSx4 hyperactive Flat, soft abdomen Last BM:09/29/10 Coincidently, right after asking Pt. about elimination habits, she told me to excuse her and she ran to the bathroom.(d/t diarrhea) Pt. demonstrates knowledge of the cause of her chronic diarrhea	Bismatrol 2 TABS prn. Chart medical history shows history of a cholecystectomy. Chronic diarrhea is most likely secondary to her known history of the cholecystectomy. Chart medical history also notes chronic diarrhea.	Patient demonstrates effective knowledge about her diarrhea and the cause of it. Patient also demonstrates knowledge & understanding of always having a restroom around to reduce accidents. Potential barriers regarding elimination = high possibility of dehydration/fluid loss d/t diarrhea.
ACTIVITY/EXERCISE Patterns of exercise & daily living, self-care activities include major body systems involved. (Thoracic & Lung; Cardiac; Peripheral vascular; Musculoskeletal, vital signs)	Pt. states, " I keep pretty busy every day, and I like that" "I belong to a support group called TOPS (Take Off Pounds Sensibly support group)	Lungs CTA, ↓breath sounds in R lower base P-96 Apical Pulse-110 BPM Patient was always moving around and was being active.	Nurse X gives report that Patient should be going home because she is up and running around doing great. Medical Record shows history of CHF & ADM DX of Pleural Effusion Family history indicates pt.'s two brothers died of	Patient demonstrates potential barriers for cardiac problems. The patient's Apical Pulse is high. In combination with a history of CHF, close family history of myocardial infarctions and irregular rate & rhythm makes potential heart failure problems for this patient.

			myocardial infaction Cardiac exam reveals a nondisplaced PMI, irregular rate &rhythm.	
SEXUALITY/ REPRODUCTION Satisfaction with present level of Interaction with sexual partners (Breast; Testes; Abdominal-Genitourinary-reproductive)	Patient is not currently sexually active.	Patient is not currently sexually active.	Chart medical history shows a hx. Of total abd. hysterectomy	Patient demonstrates effective function of pattern in this area. There is no area of concern for potential barriers.
SLEEP/REST Patterns of sleep, rest, relaxation, fatigue (Appearance, behavior)	"I sleep 8 hours a night, AND I take naps" "I'm so tired all the time, I used to walk in the morning, now I walk in the A.M.only through the house and I need to sit down and rest" "I walk up and down the hallway & I was getting short of breath"	Patient appeared in a very calm state of mood. Patient repeatedly verbalized how she used to get SOB at home. Patient sits up most of the time.	Patient medical chart shows: C/C: SOB	Patient demonstrates effective functions of pattern in this area. Patient receives plenty of sleep and has regular sleeping patterns. Potential barriers in this situation are SOB which causes the Pt. to sleep sitting up. Another potential barrier is her weakness. The weakness from being SOB might waste her energy which can be used for important tasks.

COGNITIVE/ PERCEPTUAL Patterns of thinking & ways of Perceiving environment, orientation Mentation, neuron status, glasses, Hearing aids, etc.	"what did you say?" "huh?"	-A&Ox3 -Pleasant mood -HOH, bilateral hearing aids -PERRLA -Wears glasses at all times	Patient Medical Chart states "Pt. is Hard of Hearing"	Potential barriers include: The patient is **H**ard **O**f **H**earing which sets up potential problems with safety. (Ex: Pt. not hearing a fire alarm in the house, etc)
ROLE/RELATIONSHIP Patterns of engagement with others, Ability to form & maintain meaningful Relationships, assumed roles; Family communication, response, Visitation, occupation, community involvement	"I have a lot of dear friends who help out. They drive me everywhere" "I belong to a support group called TOPS (Take Off Pounds Sensibly support group) & I am part of 2 card clubs" "I am so lucky my family lives close and they can help me" " I exercise 2x/wk b/c my apartment complex offers it"	Pt. goes to church every week with a friend. Patient has 2 sons & daughters, 6 grandkids, 8 grand-kids. She lives in Canton/Perry Township in an apartment by herself.	Patient's chart states that she lives alone and that her kids live close in town in the same township as her, Perry Township. Pt's chart indicates that she is widowed.	Patient seems fine in this area of focus. She seems to be VERY active in her community and participates in several activities. Patient has a lot of support from friends and family and I see no potential barriers except safety driving around with her friends who are also older.
SELF-PERCEPTION/ SELF-CONCEPT Patterns of viewing & valuing Self; body image &	"I think at my age I do GREAT and also compared to my	Patient's attitude is positive throughout the whole	N/A	Patient demonstrates no potential barriers in this area of concern.

psychological state	friends..”	interview. Patient portrays a strong psychological state.		
COPING/STRESS TOLERANCE Stress tolerance, behaviors, patterns of coping with stressful events & level of effectiveness, depression, anxiety.	“Religion is the best way to deal with stress”	Patient shows no signs of depression.	N/A	Patient demonstrates effective positive coping patterns with no concern.
VALUE/BELIEF Patterns of belief, values, Perception of meaning of life that guide choices or decision; includes but is not limited to religious beliefs	“ I got to church with a friend every week”	Patient became noticeably serious when I brought up this section. Patient was constantly holding eye contact.	Patients chart indicates that she is an active member of the Catholic community	Patient seems effective when it comes to her values and beliefs. Patient demonstrates confidence in her answers and practices.

Primary Nursing Diagnoses

Activity intolerance R/T fatigue, lack or energy, and altered respiratory function secondary to ascites AEB…

-Pt. states, “I’m so tired all the time, I used to walk in the morning, now I walk in the morning only through the house and I need to sit down”

-Pt. states, “When I couldn’t breathe I sat up in a chair but that didn’t help so I called 9-1-1”

-POX-92% RA

-Apical rate-105

-Pleural Effusion

-SOB

-Cirrhosis Cryptogenic

“Primary” Goal: The client will progress activity to basic ADLs/normal limits without fatigue or SOB during hospitalization.

“Goal 2”: The client will decrease complaints of SOB, weakness/fatigue, and respiratory problems within 24 hours.

Interventions:

-Take vital signs immediately after activity.

*Response to activity can be evaluated by comparing preactivity blood pressure, pulse, and respiration with postactivity results. Then, in turn, are compared with recovery time. (Lippincott Williams & Wilkins, 2008)

-Take rest periods during activites at intervals during the day, and one hour after meals.

*Rest relieves the symptoms of activity intolerance. The daily schedule is planned to allow for alternating periods of activity and rest and coordinated to reduce excess energy expenditure. (Pippincott Williams & Wilkins, 2008)

-Stop an activity if fatigue or signs of cardiac hypoxia are present (inc. pulse, dyspnea, chest pain) stat.

*Clinical responses that require discontinuation or reduction in the activity level are evidence of compromised cardiac or respiratory ability. (Pippincott Williams & Wilkins, 2008)

-Promote a sincere “can do” attitude to provide a positive atmosphere to encourage increased activity and help client identify progress. Acknowledge progress stat.

*Nursing interventions for activity intolerance promote participation in activities to achieve a level of activity desired by the client for the therapeutic regimen. Strategies that are individualized can increase motivation. (Pippincott Williams & Wilkins, 2008)

"Primary" Outcome: The patient maintained a balance between rest and activity as evidenced by the absence of fatigue and progressed activity to basic ADLs by discharge.

"2nd" Outcome: The client stopped complaints of difficulty breathing & SOB within hospital stay.

I chose this as my primary nursing diagnosis because my patient was significantly symptomatic. She was fatigued all of the time, even when just walking. She complained of being short of breath and this made my draw my conclusion to activity intolerance because she cannot get daily tasks done when her energy is wasted on just getting across the room. Activity intolerance is the state is which a person experiences a reduction in one's physiologic capacity to endure activities to the degree desired or required. (Magnan, 1987) If a person has trouble breathing doing easy tasks, they will have problems most likely in all other departments since breathing is used for

everything! All interventions listed above were effective and helped get the patient towards a positive outcome. Her SOB improved and complaints of breathing difficulties gradually decreased.

Second nursing diagnosis

Pleural Effusion

Publish date: Sep 15, 2007
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More than 1 million cases of pleural effusion occur in the United States each year. Pleural effusions are a common presentation of many pulmonary and systemic diseases, including congestive heart failure (CHF), malignancy, sarcoidosis, and infection. About 25% to 30% of patients seen by a pulmonary consultant have evidence of pleural disease.

In this article, we will describe the steps to follow when evaluating a patient who has suspected pleural effusion. Specifically, we will discuss the clinical presentation, chest film findings, and the role of thoracentesis and medical thoracoscopy.

CAUSES OF PLEURAL EFFUSION

The pleural space is 10 to 20 µm in width and normally contains about 0.1 mL/kg of fluid. A volume greater than 7 to 14 mL is abnormal. Many mechanisms can result in abnormal amounts of pleural fluid, including:

- Increased hydrostatic pressures in the microvascular circulation.
- Decreased oncotic pressures in the microvascular circulation.
- Decreased pleural space pressure (resulting from lung collapse).
- Increased permeability of the microvascular circulation.
- Obstruction of lymphatic drainage (**Figure 1**).

Generally, transudative effusions are formed in response to increased hydrostatic pressure, while exudative effusions form when pleural inflammation or disrupted lymphatic drainage results in increased protein leak or decreased protein removal from the pleural space. In CHF, pleural effusions are secondary to pulmonary venous hypertension. Neoplasms can cause pleural effusions by direct involvement of the pleura, by lymphatic obstruction, or in association with a post-obstructive pneumonia. Pleural effusions associated with pulmonary embolism are secondary to increased capillary permeability, pleuropulmonary hemorrhage, and increased hydrostatic pressure.

CLINICAL FEATURES

Many patients with pleural effusions are asymptomatic. However, when symptoms arise, they do so because of pleural inflammation or the effusion's effects on mechanics. The most common symptoms of pleural effusion are dyspnea, nonproductive cough, and pleuritic chest pain.

The mechanisms by which dyspnea occurs are not well understood, but they do not appear to correlate with blood oxygen levels or the size of the pleural effusion. Dyspnea is probably related to increased thoracic cage size, which affects respiratory muscle function. Nonproductive cough may occur secondary to lung compression and resultant bronchial irritation.

Pleuritic chest pain is associated with inflammation of the parietal pleura. Pain is occasionally referred to the abdomen. If the central portion of diaphragmatic pleura is involved, patients experience pain in the lower chest and ipsilateral shoulder simultaneously. Historical features, including underlying disease processes, drug use, and radiation therapy, can alert you to the possibility of pleural effusion in a patient with less common symptoms.

Several physical findings suggest the presence of pleural effusion. Tactile fremitus is lost over the area of effusion because voice-induced vibrations are attenuated by the fluid adjacent to aerated lung. This finding is more sensitive than the use of percussion for detecting pleural fluid collections.

Absent or diminished breath sounds over the area of effusion are characteristic. Pleural friction rubs are occasionally noted in the initial stages or as the effusion resolves and are caused by roughened pleural surfaces moving across one another.

IMAGING STUDIES

Radiography. Once you suspect a pleural effusion, obtain chest films to confirm its presence and to look for other abnormalities that can help identify the cause (**Table 1**). Small pleural effusions appear on plain films as blunting of the normally sharp costophrenic angles. These effusions usually represent more than 100 mL of fluid. If the effusion volume is greater than about 500 mL, chest films are 100% sensitive (**Figure 2**).[1]

Lateral decubitus films are essential to confirm that the effusion is not loculated. Loculated effusions may be misinterpreted as parenchymal infiltrates.

Cardiomegaly with bilateral pleural effusions is most consistent with a diagnosis of CHF. The differential diagnosis of a normal heart size with bilateral effusions includes malignancy (most common), rheumatoid pleurisy, systemic lupus erythematosus (SLE), esophageal rupture, nephrotic syndrome, and cirrhosis with ascites. Massive effusions are most commonly caused by malignancy.

Ultrasonography. An ultrasound scan can detect as little as 5 mL of pleural fluid. Ultrasonography is extremely sensitive in identifying septations within a pleural fluid collection. Small or loculated effusions are best tapped under ultrasonographic guidance.

CT. A CT scan of the chest is not appropriate for the initial confirmation of pleural effusion. It is most helpful after thoracentesis for detecting suspected parenchymal or pleural abnormalities. A CT scan is ideal if pleural abnormalities are seen on the chest radiograph, because it allows imaging of the entire pleural space and differentiates pleural fluid from pleural thickening or pleural-based masses.[2]

In empyema, a CT scan often shows loculation and pleural enhancement. Asbestos-related pleural effusion may exhibit pleural calcifications and evidence of interstitial lung disease. In malignancy, a CT scan may show pulmonary masses and/or mediastinal adenopathy.

THORACENTESIS

In most cases, the discovery of a pleural effusion warrants prompt thoracentesis to determine the cause as well as to direct initial therapy. If a layered effusion is 1 cm or greater in width, it is easily tapped at the bedside. Laboratory study of fluid removed by thoracentesis is diagnostic in about 75% of cases; relevant information for management is obtained in an additional 15% to 20%.[3] Definitive diagnoses can be made in patients with malignancy, empyema, tuberculosis, fungal infection, lupus pleuritis (if lupus erythematosus cells are seen), chylothorax, urinothorax, and esophageal rupture.

However, it is appropriate to forgo thoracentesis in patients who have bilateral pleural effusions and uncomplicated CHF without fever, pleuritic chest pain, or severe hypoxemia. These patients can be monitored during therapy for CHF. Following diuretic therapy, the transudative effusions associated with CHF sometimes appear exudative, with increased protein and lactate dehydrogenase (LDH) levels.[4,5]

While there are no absolute contraindications to thoracentesis, relative contraindications include bleeding diathesis, anticoagulation, and small pleural effusions. The complication rate is about 20%; complications associated with thoracentesis include pneumothorax (12%), cough (9%) and, rarely, bleeding, empyema, and spleen or liver puncture.[3]

Only half of all pneumothoraces are clinically important; about one third of them require chest tube placement. Anxiety and pain at the site of thoracentesis are reported by about 20% of patients.

Large-volume taps to relieve dyspnea can result in unilateral pulmonary edema or hypoxemia; the latter occurs in up to 50% of patients. Despite this resultant hypoxemia, the patient's dyspnea is often relieved by thoracentesis. If it is not relieved and the pleural effusion reaccumulates, repeated thoracenteses for dyspnea alone are not indicated.

Routine use of post-tap chest films to check for pneumothorax is not necessary. Aspiration of air during thoracentesis often correlates with occurrence of a pneumothorax.[6] However, obtaining a chest film following thoracentesis may help identify an underlying parenchymal abnormality.

The gross appearance of the fluid obtained often helps identify the cause of the effusion (**Table 2**). If the tap reveals a milky supernatant, lipid studies are indicated to confirm the diagnosis of chylothorax. The initial analysis of pleural fluid should include

measurements of protein, LDH, and glucose concentrations; a cellular differential; and pH. If you suspect infection, order Gram, acid-fast, and potassium hydroxide stains and cultures for bacteria, acid-fast bacilli, and fungi.

Distinguishing an effusion as exudative or transudative is an important initial step. Transudative effusions characteristically have low protein and LDH concentrations. Exudative effusions have elevated cell counts with higher protein and LDH concentrations.

The classic criteria defining an exudate were established by Light and colleagues.[7] An effusion is exudative if it meets 1 of the following criteria:

- Pleural fluid protein/serum protein ratio greater than 0.5.
- Pleural fluid LDH/serum LDH ratio greater than 0.6.
- Pleural fluid LDH level greater than two thirds the upper limit of normal serum LDH level.

Although subsequent investigators have studied the sensitivity and specificity of other discriminators, such as bilirubin, cholesterol, and albumin levels, these are not superior to the measurement of LDH and protein levels.

The differential diagnosis of a transudative pleural effusion is limited (**Table 3**). Once confirmed, therapy consists of managing the underlying disease. The differential diagnosis of an exudative pleural effusion is extensive and requires additional analysis (**Tables 4, 5, 6, and 7**).[8]

Cytologic analysis is critical in any patient who has suspected malignancy or an exudate of unknown origin. In addition to identifying malignant cells, cytologic analysis with differential cell count can help narrow the differential diagnosis (**Table 8**). As little as 10 mL of fluid is adequate for diagnosing malignant pleural effusion.[9] The diagnostic yield of thoracentesis for malignancy is approximately 60% and improves slightly with a repeated thoracentesis.

Obtain a fluid amylase level if you suspect esophageal rupture, pancreatitis, or pancreatic pseudocyst or if the patient has a left pleural effusion of unknown cause. The pleural fluid amylase level is always elevated in patients with chronic pancreatitis but can be normal in those with early, acute pancreatitis or in patients immediately after esophageal rupture.[8]

A glucose level of less than 60 mg/dL or a pleural fluid glucose/ serum glucose ratio of less than 0.5 is a classic finding in patients with rheumatoid lung disease. A rheumatoid factor that is greater than 1:320 and an antinuclear antibody titer that is greater than 1:160 suggest SLE or rheumatoid pleurisy; the presence of lupus erythematosus cells is diagnostic of SLE.[8]

Low glucose levels are common in the pleural fluid of patients with empyema, malignancy, or tuberculosis and are occasionally found in patients with SLE. In patients with rheumatoid lung disease or malignancy, low glucose levels are the result of abnormal glucose transport. Otherwise, the low levels are caused by increased use of glucose by inflammatory or malignant cells.

Normal pleural fluid pH is 7.6. Transudative effusions usually maintain a pH of 7.4 to 7.55; exudates have a lower pH--7.3 to 7.45. A low pleural fluid pH (less than 7.3) is caused by increased cellular acid production or decreased acid removal (resulting from pleural inflammation), or by the presence of tumor or fibrosis.

Low pleural fluid pH is common in patients who have esophageal rupture, empyema, rheumatoid lung disease, malignancy, or tuberculosis. Parapneumonic effusions that have a pH less than 7.1, glucose concentration less than 40 mg/dL, and LDH concentration greater than 1000 IU/L should be drained to promote resolution of infection.[10]

An elevated pleural fluid triglyceride level (greater than 110 mg/dL) confirms the diagnosis of chylothorax. However, if the triglyceride level is intermediate (50 to 110 mg/dL), lipoprotein electrophoresis is indicated to determine the presence of chylomicrons, which is diagnostic.[11]

Chylothorax occurs with disruption of the patient's thoracic duct, as in trauma; following thoracotomy; or with the presence of malignancy, tuberculosis, or pulmonary lymphangiomyomatosis.

Pleural fluid adenosine deaminase (ADA) can be a useful marker for diagnosis of tuberculosis, especially in the presence of a lymphocytic effusion. Its sensitivity varies from 78% to 99% and its specificity, from 85% to 97%.[12] Pleural fluid ADA can be elevated in mesothelioma and in rheumatoid, malignant, and parapneumonic effusions. Although not widely available, pleural fluid interferon gamma is highly sensitive and specific for tuberculosis if appropriate cutoff values are used.[13]

PERCUTANEOUS PLEURAL BIOPSY

An exudative effusion that remains unexplained following pleural fluid analysis is often caused by tuberculosis or malignancy. Percutaneous pleural biopsy has a sensitivity of 75% for tuberculosis. The combination of pleural biopsy and fluid culture has a diagnostic sensitivity of 90% for tuberculosis.[14]

While pleural fluid cytology has a sensitivity of 60% to 90% for diagnosing malignant pleural effusion, closed pleural biopsy has a sensitivity of 40% to 75%. Biopsy occasionally leads to a diagnosis of fungal or parasitic infection, sarcoidosis, or rheumatoid pleurisy.[8] Between one third and three fourths of all exudative effusions that are unexplained following thoracentesis and pleural biopsy eventually prove to be secondary to malignancy.[14,15]

Contraindications to pleural biopsy include an obliterated pleural space, an uncooperative patient, a bleeding diathesis, and anticoagulation. The most common complications include pneumothorax (3% to 15%), hemothorax (less than 2%), pain (1% to 15%), and vasovagal episodes (1% to 5%).[7]

About 20% to 25% of pleural effusions remain undiagnosed following thoracentesis and closed pleural biopsy; most of these effusions are exudative. Common causes include pleural tuberculosis, pulmonary embolism, and malignancy.

MEDICAL THORACOSCOPY

Medical thoracoscopy has a diagnostic yield of more than 90% in the diagnosis of malignant pleural effusion. Compared with video-assisted thoracic surgery (VATS), it is less invasive and can be performed in the bronchoscopy suite under conscious sedation. The advantage of thoracoscopy over closed pleural biopsy is the ability to visualize the entire pleural surface and to perform biopsy of any abnormal pleura under direct vision.[16] In addition, talc poudrage, which has an effectiveness of greater than 90% in achieving pleurodesis in malignant pleural effusion, can be performed in the same setting. Medical thoracoscopy is the procedure of choice in undiagnosed exudative pleural effusions. Fewer than 10% of pleural effusions remain undiagnosed after medical thoracoscopy.

An absolute contraindication to thoracoscopy is an obliterated pleural space resulting from adhesions; relative contraindications include coagulopathy, severe hypoxemia, and cardiac disease. The most common complications are post-procedure fever (15%) and persistent air leak (2%).

OTHER PROCEDURES

Fiberoptic bronchoscopy has no role in evaluating unexplained exudative effusions unless the patient has hemoptysis, radiographic evidence of lung mass, or mediastinal shift toward the side of the effusion, which would indicate possible endobronchial obstruction.

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