

Topic of the lesson: PATHOPHYSIOLOGY OF EXTERNAL RESPIRATION

Aim: To learn main regular and specific mechanisms of gas exchange lung function; to be able to recognize typical disturbances of external respiration on the basics of pathophysiological analyze of respiratory system changes and changes of gas composition of blood.

Main questions to the topic of the lesson:

1. Comparison characteristics of alveolar hyperventilation obstructive and restrictive character.
2. Causes and pathogenesis of central respiratory regulation disorders: causes and mechanisms of development.
3. Alveolar hyperventilation: causes, mechanisms, manifestation.
4. Disorder of alveolar diffusion: main causes and consequences.
5. Disorder of ventilation and perfusion: types, mechanisms of development, manifestations.
6. Disorders of lung perfusion: types, causes, consequences.
7. Characteristic of “respiratory failure”.
8. Pathological types of breathe: types, etiology and pathogenesis.

Literature:

1. General and clinical pathophysiology/Gozhenko A.I. - Odessa National Medical University. - 2002. - p. 158-169
2. Pathophysiology/Gozhenko A.I., Gurkalova I.P. - Odessa National Medical University. - 2003. - p. 223-232

CONTROL QUESTIONS

№	Instructions to the execution of the task	Answers of the students with additions at the lessons
1.	External respiratory failure- is	

2.	Enumerate extrapulmonary causes of ventilating respiratory failure: a, b, c, d, e	
3.	Name pathogenetic variants of ventilating respiratory failure? a, b, c	
4.	Periodic respiration- is What types of it do you know? a, b	
5.	Obstructive respiratory failure- is Causes of it : a, b, c, d, e	
6.	Restrictive respiratory failure- is Causes of it : a, b, c, d, e	
7.	Enumerate types of terminal breathe	
8.	Ventilation-perfusion relation is- In norm:	
9.	Name clinical signs of external respiratory failure: a, b, c, d	

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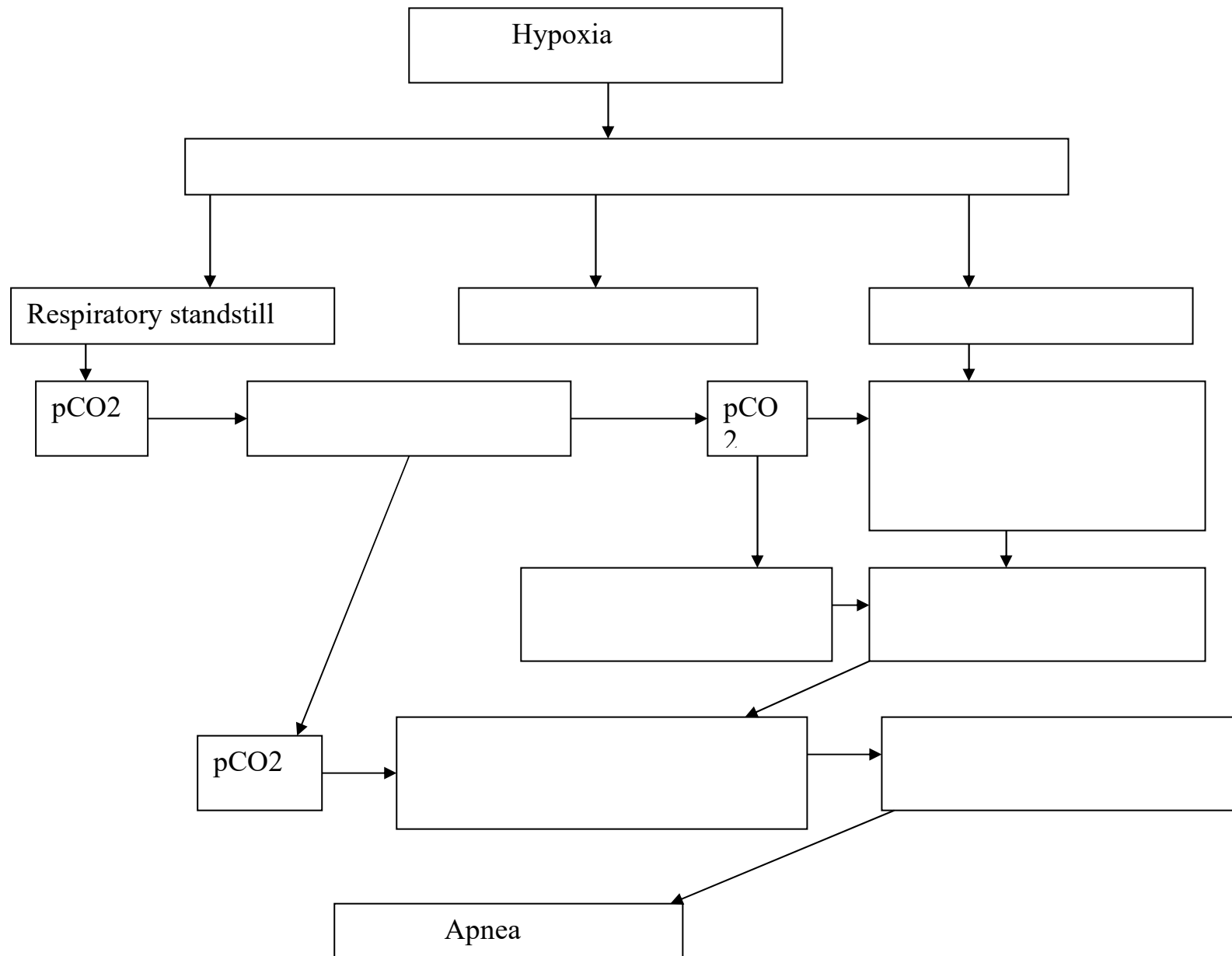
TASK 1. Fill in a table, marking a sign «+» reasons, causing the obstructive and restrictive external respiratory failure.

Causes	Obstructive respiratory failure	Restrictive respiratory failure
compression of alveoles as a result of inflammation and congested processes in lungs		
hitting of foreign bodies, vomit masses, water, pus in the respiratory tracts		
afflux of phlegm in bronchial tubes		
atelectasis		
thickening of respiratory tracts walls in connection with inflammation edema or with tumor growth		
pulmonary fibrosis		
laryngospasm		
spasm of bronchus muscles		
disorder of the surfactant lung system		
decrease of elastic qualities of lungs		
external compression of respiratory tracts walls		

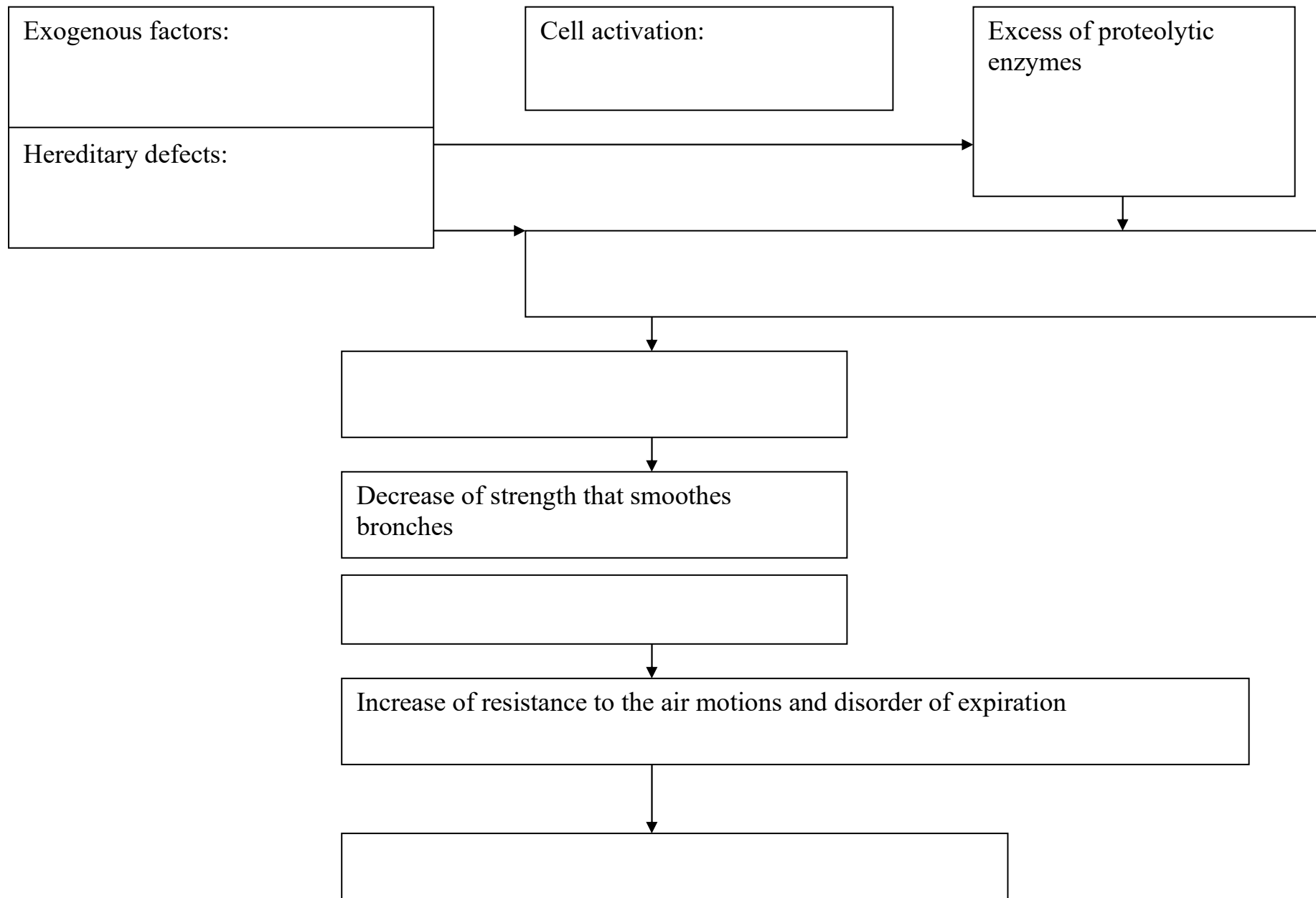
TASK 2. Compare the characteristic with type of external respiration

Kussmaul's respiration		A. Infrequent respiration
Cheyne-Stokes respiration		B. Deep breath, tachypnoe, with active work of expiratory muscles by expiration
Gasping-respiration		C. Temporary respiratory standstill
Polypnea		D. Frequent hypopnoe
Stenotic respiration		E. Deep frequent respiratory
Hyperpnoea		F. Deep bradypnea
Biot's respiration		G. Respiratory comfort
Bradypnea		H. Gradual increasing of the respiration amplitude up to hyperpnoea, then decreasing to apnea
Apnea		I. Spastic permanent effort to take a breath, occasionally interrupted with expiration
Apneustic respiration		J. Solitary rare breathings after temporary respiratory standstill
Eupnoea		K. Sudden apnea after respiratory movements with permanent amplitude, then repeating of such cycles
		L. Sensation of scarcity of air with necessity of overbreathing
		M. Reflectory action in answer to irritation of trigeminal endings in the mucous membrane of the nose

TASK 3. Fill free places in the pathogenetic scheme of the Cheyne-Stokes respiration



TASK 4. Fill free places in the pathogenetic scheme of the lungs emphysema



TASK 5-8. To solve clinicopathophysiological problems.

Task 1. By examination of the patient, who was delivered to clinic with presumptive diagnose “bronchial asthma”, was not revealed characters of this disease. In anamnesis: rare but typical for bronchial asthma asthmatic fits with cough. Results of external respiration examination:

Lung vital capacity, % from due value	- 87
Minute pulmonary ventilation, % from due value	- 95
Maximal expiratory flow volume	- 2,3
Lung vital capacity	- 3,5

Pulmonary residual volume, % from due value – 108
After the introduction of bronchial spasmolytic
salbutamol – increase of Tiffeneau's index to 15%
Tiffeneau's index before probe – to calculate

1. What indices are functional tests of the obstructive respiratory failure revelation? Make the conclusion of the bronchial patency.
2. What changes of maximal expiratory flow volume can we see after the introduction of bronchial spasmolytic?
3. Explain the mechanism of phenomenon of expiratory compression of bronches, mark the spirometric indices of this patient that indirectly argue to possibility of this phenomenon development.
4. Explain mechanisms of changes of main parameters, pneumogramm (the deep of breath, frequency of breathe, inspiration/expiration ratio) during the period of bronchial asthma attack.

Task 2.

A 36 year -old -patient, who works in the metal mining industry, was delivered to clinic with suspicion of silicosis. He complains of short breath, especially by walking and physical activity, straight cough (dry, sometimes with few phlegm), and pains in the chest. Gas composition of blood:

p_aO_2	
Initial:	90 millimeters of mercury
After the probe with forced ventilation:	92 millimeters of mercury
p_aCO_2	40 millimeters of mercury
Oxygen capacity	19,2 millimeters of mercury
S_aO_2	94,3 %

Spirometry

Lung vital capacity	4,2 l
Maximal expiratory flow volume	2,6 l
Lung vital capacity, % from due value	92
Tiffeneau's index	calculate ?
Minute volume of breath	124

Extra data

Frequency of breath	19 per minute
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1. Has the patient signs of gas exchange lung capacity?

Mark them and give the characteristic.

2. Has the patient disorders of alveolar ventilation?

Definite its type.

3. How can you assess the diffusing lung capacity, if you know that he has possibility of pneumoconiosis development?

4. Make the conclusion about the possible mechanisms of gas exchange disorders.

Task 3. A 33 year old patient after the sulphur trioxide gas poisoning in the mine has signs of lung emphysema and high-grade short breathe.

p_{aO_2}	86 millimeters of mercury
p_{aCO_2}	48 millimeters of mercury
Oxygen capacity	19,6 millimeters of mercury
S_{aO_2}	95,4 %

Spirometry

Total lung capacity	enlarged
Lung vital capacity	reduced
Inspiratory reserve volume	decreased
Expiratory reserve volume	decreased
Functional residual capacity of lungs	enlarged
Pulmonary residual volume	enlarged
Tiffeneau's index	reduced

Extra data

Frequency of breath	19 per minute
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1. Has the patient signs of lung compliance and elasticity?

Mark them and give the characteristic.

2. Define character of changes (increase/decrease)

maximal expiratory flow volume, explain possible mechanisms of such changes.

3. With help of which elementary functional probe can we evaluate diffusing lung capacity?

4. Make the conclusion about the possible mechanisms of gas exchange disorders.

Task 4. A 24 year old patient was delivered to clinic with complaining of short breathe, tachycardia by physical activity, nagging pain in the heart region. During the pronounced short breathe he has few mucoid sputum with impure of blood. On the basic of complainings of patient and other examinations was made conclusion that this is the disorder of lung blood circulation as a result of mitral stenosis. Results of respiratory system examination:

Frequency of breath	20 per minute
Minute volume of breath % from due value	133
Lung vital capacity, % from due value	81
Total lung capacity % from due value	76
Maximal expiratory flow volume	80

1. What types of disorders of lung perfusion are possible in this situation?

2. Give mechanisms of possible mechanisms of lung vital capacity and total lung capacity decrease?

3. Has the patient disorder of obstructive alveolar ventilation?

TASK 10. *Solve the tests for self-control.*

1. A 23 year old patient was hospitalized to the clinic with craniocerebral trauma in the grave condition. The breathe characterized with spastic permanent effort to take a breath, occasionally interrupted with expiration. What type of breathe is it?
A. Kussmaul's respiration
B. Gasping-respiration
C. Apneustic respiration
D. Cheyne-Stokes respiration
E. Biot's respiration
2. During the experiment was cut both animals' vaguses. How will change the breathing animal?
A. frequent and shallow breathing
B. frequent and deep breathing
C. rare and shallow breathing
D. rare and deep breathing
E. periodic breathing
3. It was introduced 5 ml of air to the pleural cavity of the rat. What type of

breath insufficiency appears in this case?

- A. restrictive disorder of alveolar ventilation
- B. obstructive disorder of alveolar ventilation
- C. perfussive
- D. diffusive
- E. disegulative disorder of alveolar ventilation

4. A patient was delivered to the clinic with symptoms of diabetic coma. The breath is noisy, frequent, after the deep inspiration- strong expiration. What type of breathe is it?

- A. Biot's respiration
- B. Kussmaul's respiration
- C. Cheyne-Stokes respiration
- D. Stenotic respiration
- E. Gasping-respiration

5. A patient with diphtheria has edema of larynx. He has rare deep breath with difficulty of inspiration. What type of breathe is it?

- A. Apneustic respiration
- B. Kussmaul's respiration

- C. Cheyne-Stokes respiration
- D. Stenotic respiration
- E. Gasping-respiration

6. The insensible man was delivered to the clinic after the carbon monoxide gas poisoning. Appearing of what compound stipulates hypoxia?

- A. carboxyhemoglobin
- B. methemoglobin
- C. carbhemoglobin
- D. oxyhemoglobin
- E. desoxyhemoglobin

7. A man complains of short breath, heaviness in the right part oh the chest, general weakness. Temperature is 38,9°C. On examination: right part of thorax during the breathing drop behind the left part. During the pleurocentesis was detected the exudate. What is the main factor of exudation in this case?

- A. decrease of resorption of pleural liquid
- B. increase of blood pressure
- C. hyperproteinemia
- D. erythrocyte aggregation

E. increase of vascular permeability

8. A 45 year old woman who suffers from bronchial asthma for a long time has the attack of asphyxia. What is the pathogenetic mechanism of this phenomenon?

- A. decrease of respiratory center sensitiveness
- B. loss of lung elasticity
- C. spasm of bronchial tubes
- D. disorder of chest movements
- E. disorder of lung perfusion

9. A patient has decrease of erythrocytes, hemoglobin, color index, concentration of serum iron level, microanisocytosis, poikilocytosis. He has hypoxia too. What type of hypoxia he has?

- A. exogenous
- B. hypoxic
- C. circulatory
- D. hemic
- E. respiratory

10. A miner has pneumofibrosis with disorder of alveolar ventilation. What

is main mechanism of alveolar ventilation disorder?

- A. disorder of neuroregulation of respiration
- B. constriction of upper airways
- C. decrease of lung compliance
- D. restriction of chest movements
- E. spasm of bronchus'

11. A 60 year old man who suffers from diabetes mellitus was delivered to clinic with diabetic coma. He has noisy, frequent breath. Deep inspirations alternate with intensified expirations. What type of breathe is it?

- A. Kussmaul's respiration
- B. Stenotic respiration
- C. tachypnea
- D. Cheyne-Stokes respiration
- E. Biot's respiration

12. A patient after activating of lipid peroxidation has pathology of lungs connected with deficit of surfactant. What changes take place in lungs with surfactant deficit?

- A. emphysema
- B. atelectasis
- C. bronchospasm

D. edema

E. lymphostasis

13. A 50 year old man was carried out enclosed space that was full of smoke after the fire. What type of hypoxia has a patient?

- A. hypoxic
- B. respiratory
- C. hemic
- D. tissue
- E. circulatory

For notes
