



In the US:

more than 50% of adults weigh
more than 20% above optimum

>30 kg m⁻² obesity

>40 kg m⁻² morbid obesity



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BMI = weight(kg) / height(m²)

Pounds X 2.2

Inches divided by 39, squared



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From 2000 to 2005:

obesity (self-reported BMI over 30) increased by 24%

morbid obesity (self-reported BMI over 40) increased by 50%
(about 100 pounds (45 kg) overweight)

super obesity (BMI over 50) increased by 75%

The heaviest BMI groups have been increasing at the fastest rates for 20 years.

RSturm, Public Health (2007) 121, 492–496

Self reporting underestimates by at least 10 to 15 percent.

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Risk **Assessment:**

airway

pulmonary

cardiovascular

metabolic

nervous system physiology variations



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metabolic syndrome :

The triad of

obesity

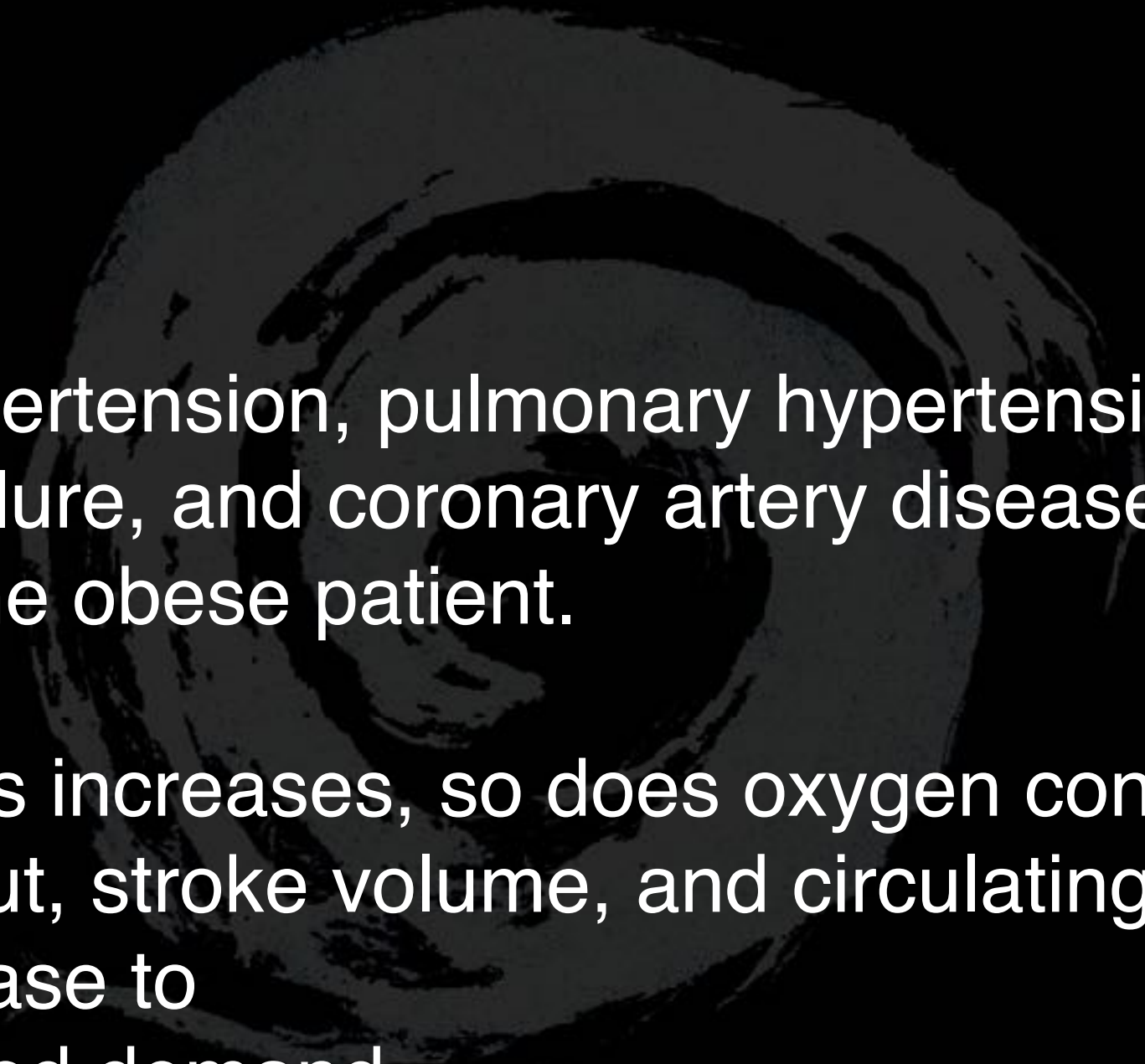
hypertension

type II diabetes mellitus



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Systemic hypertension, pulmonary hypertension, left and right heart failure, and coronary artery disease are all more common in the obese patient.

As body mass increases, so does oxygen consumption. Cardiac output, stroke volume, and circulating blood volume increase to meet increased demand.

Systemic hypertension in time results in left ventricular hypertrophy.



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Chronic hypoxemia:

leads to sympathetic
activation
hence hypertension



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30% overweight :

40% increased chance of dying of heart disease

50% increased chance of dying of stroke.

Higher resource utilization and higher perioperative mortality and morbidity.



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Increasing BMI by 2 units - Increases OSA by a factor of 4.



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Obstructive Sleep Apnea

F / M

general population is 2% / 4%

morbidly obese is 3 to 25% / 40 to 78%



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Obesity Hypoventilation Syndrome (OHS)

OHS associated with chronic daytime hypoxemia $PO_2 < 65$ mm Hg (normal 85+)

Sustained hypercapnia $PCO_2 > 45$ mm Hg without COPD is diagnostic (norm 40)

Usually $BMI > 40$

Leads to pulmonary hypertension
then rt ventricular hypertrophy
then rt ventricular failure

Called Pickwickian--

EKG--RV hypertrophy, right axis deviation,
RBBB

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Severely overweight people fail to breathe rapidly enough or deeply enough.

They have low blood oxygen levels and high blood carbon dioxide (CO₂) levels which leads to sympathetic activation.

They have obstructive sleep apnea with many partial awakenings during the night.

They have continual sleepiness during the day.

There is strain on the heart from pumping against pressure. That leads to left ventricular hypertrophy. That leads to right ventricular hypertrophy. That leads to pulmonary hypertension.

This leads to the symptoms such as heart failure, leg swelling, weight loss.

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Obesity Hypoventilation Syndrome Definition

- ★ body mass index above 30 kg/m²
- ★ hypoxemia (falling oxygen levels in blood) during sleep
- ★ hypercapnia (increased blood carbon dioxide levels)
- ★ hypoventilation (excessively slow or shallow breathing)



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obesity hypoventilation syndrome key symptoms

snoring

brief episodes of apnea

interrupted sleep

excessive daytime sleepiness

sleepiness may be worsened by elevated blood levels of carbon dioxide causes drowsiness ("CO₂ narcosis")

depression

hypertension (high blood pressure) that is difficult to control with medication
high carbon dioxide can also cause headaches, which tend to be worse in the morning



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Cor pulmonale

The low oxygen level leads to excessive strain on the right side of the heart, known as cor pulmonale.

Because the heart has difficulty pumping blood from the body through the lungs fluid accumulates

Symptoms

- skin of the legs in the form of edema (swelling)
- the abdominal cavity in the form of ascites
- decreased exercise tolerance and exertional chest pain

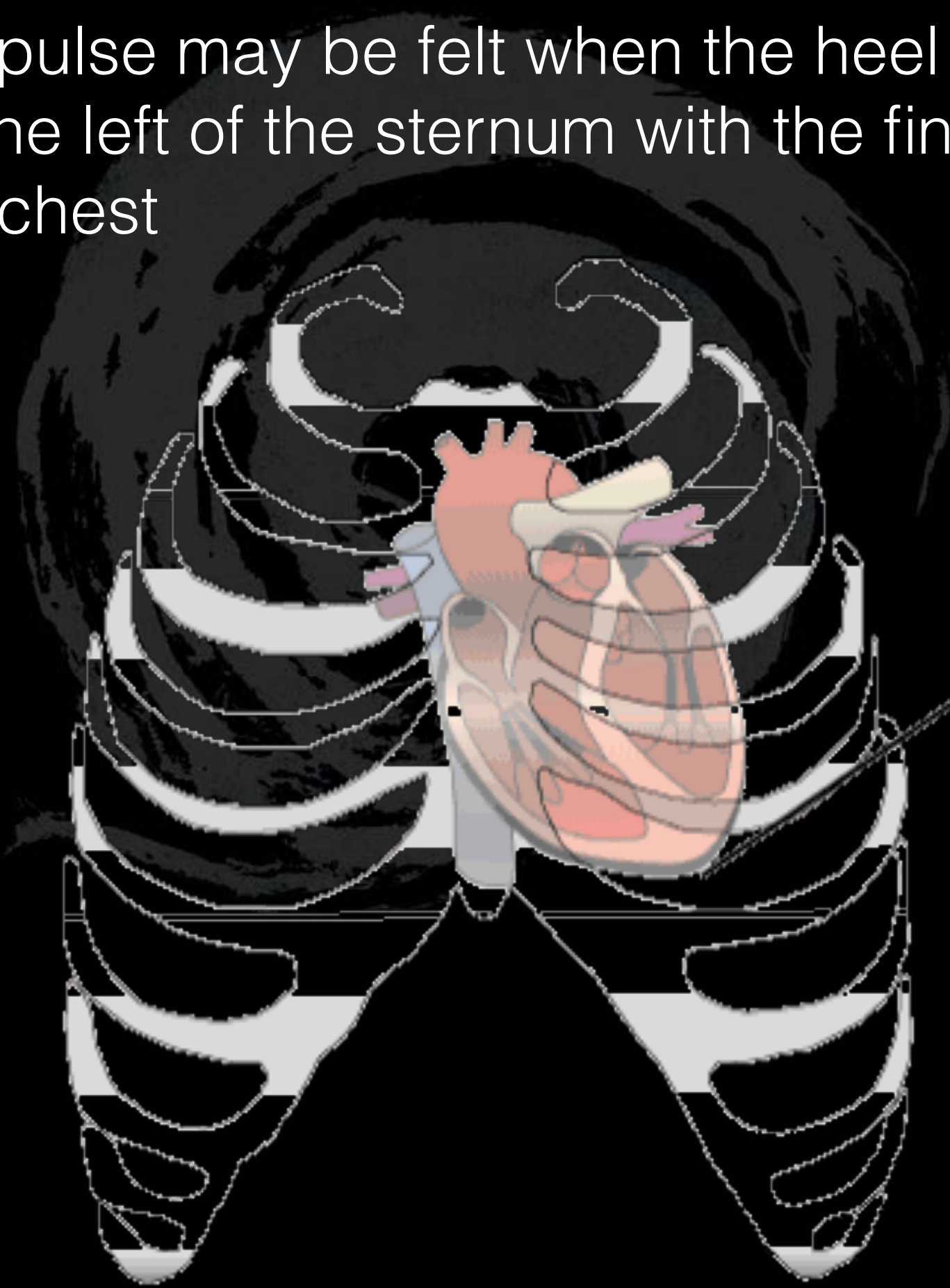
On physical examination

- raised jugular venous pressure
- a palpable parasternal heave
- a heart murmur due to blood leaking through the tricuspid valve
- hepatomegaly (an enlarged liver)

Cor pulmonale occurs in about a third of all people with OHS.

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parasternal impulse may be felt when the heel of the hand is rested just to the left of the sternum with the fingers lifted slightly off the chest



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Work of breathing is increased

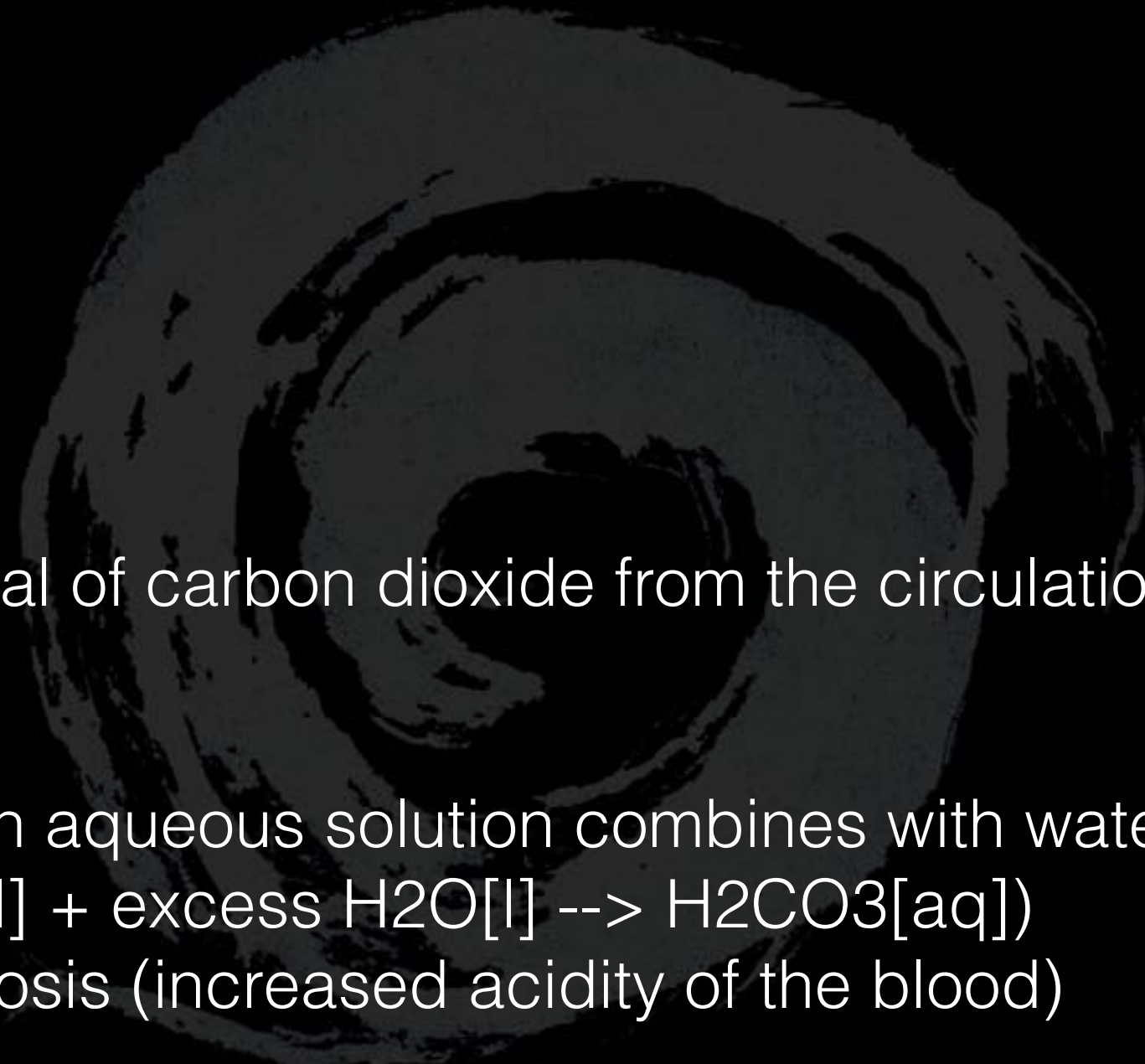
- adipose tissue restricts the normal movement of the chest muscles
- makes the chest wall less compliant
- the diaphragm moves less effectively,
- respiratory muscles are fatigued more easily, and
- airflow in and out of the lung is impaired by excessive tissue in the head and neck area.
- more energy to breathe effectively.

These factors together lead to sleep-disordered breathing



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Inadequate removal of carbon dioxide from the circulation leads to **hypercapnia**

- carbon dioxide in aqueous solution combines with water to form an acid
- $(\text{CO}_2[\text{g}] + \text{H}_2\text{O}[\text{l}] + \text{excess H}_2\text{O}[\text{l}] \rightarrow \text{H}_2\text{CO}_3[\text{aq}])$
- this causes acidosis (increased acidity of the blood)



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Under normal circumstances

- central chemoreceptors in the brain stem detect the acidity
- respond by increasing the respiratory rate
- in OHS, this "ventilatory response" is blunted

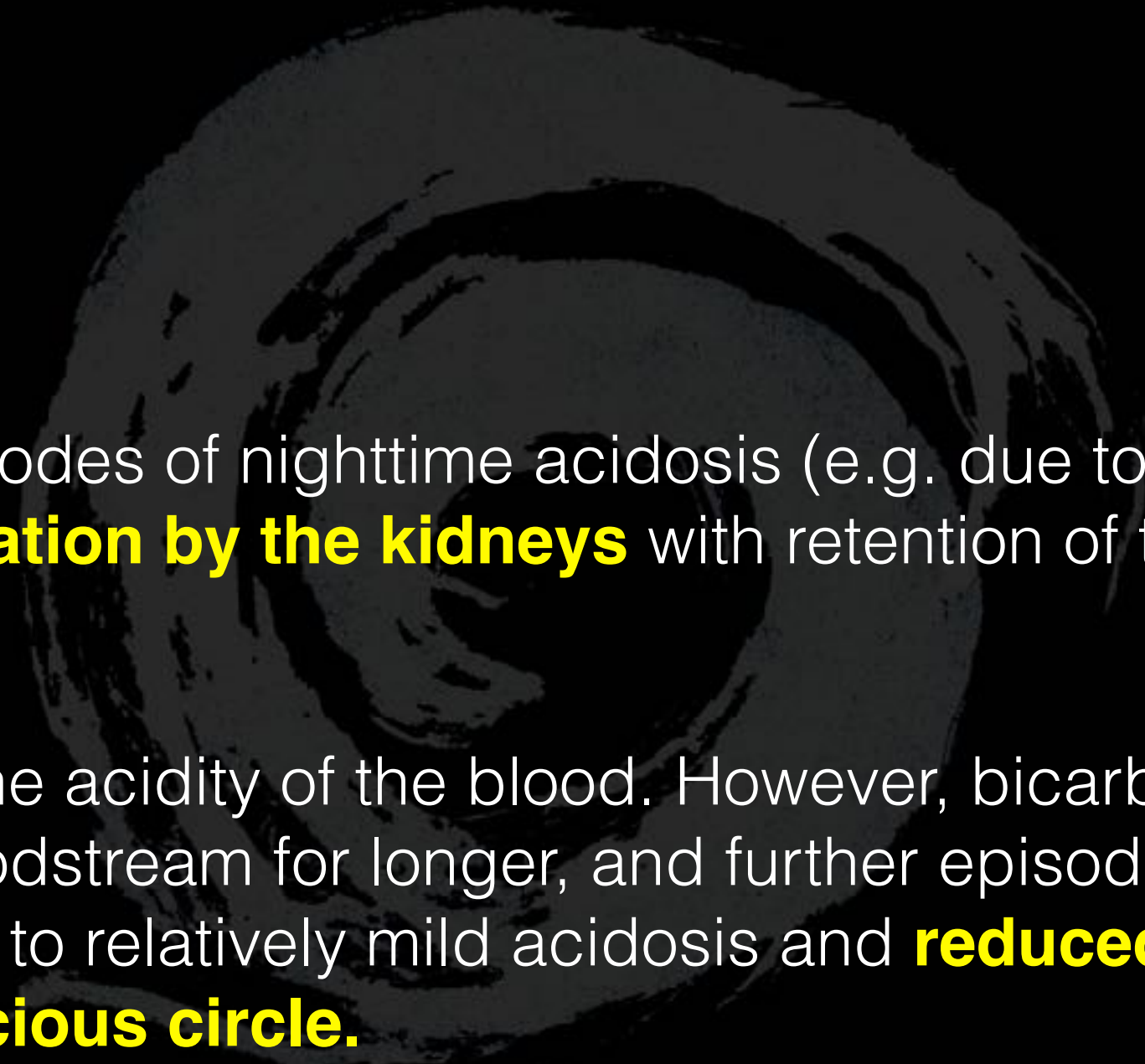
The blunted ventilatory response is attributed to several factors

- Obese people tend to have raised levels of the hormone leptin
- which is secreted by adipose tissue and increases ventilation
- In OHS, this effect is reduced.



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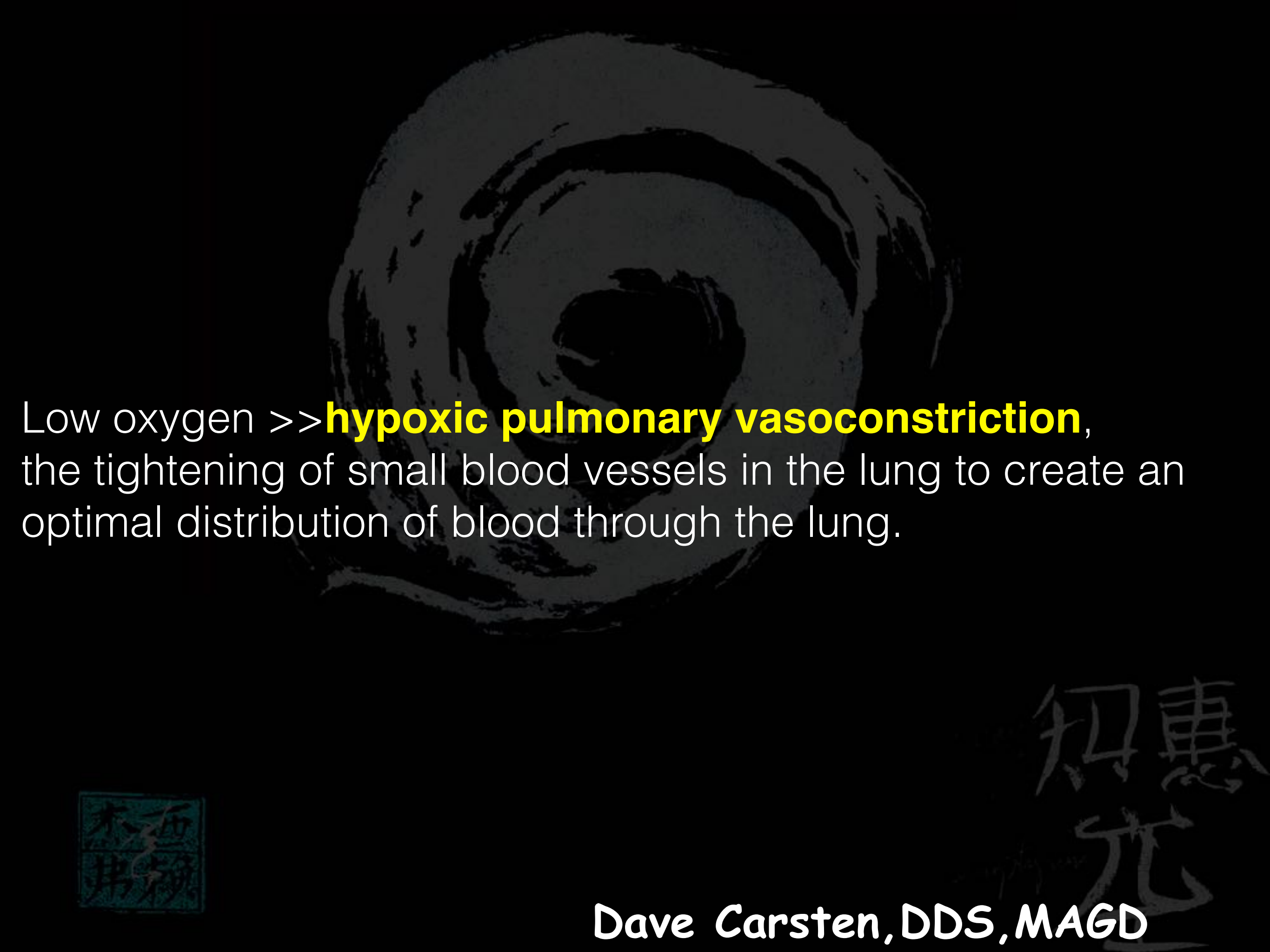
Furthermore, episodes of nighttime acidosis (e.g. due to sleep apnea) lead to **compensation by the kidneys** with retention of the alkali bicarbonate.

This normalizes the acidity of the blood. However, bicarbonate stays around in the bloodstream for longer, and further episodes of hypercapnia lead to relatively mild acidosis and **reduced ventilatory response in a vicious circle.**



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Low oxygen >> **hypoxic pulmonary vasoconstriction**,
the tightening of small blood vessels in the lung to create an
optimal distribution of blood through the lung.



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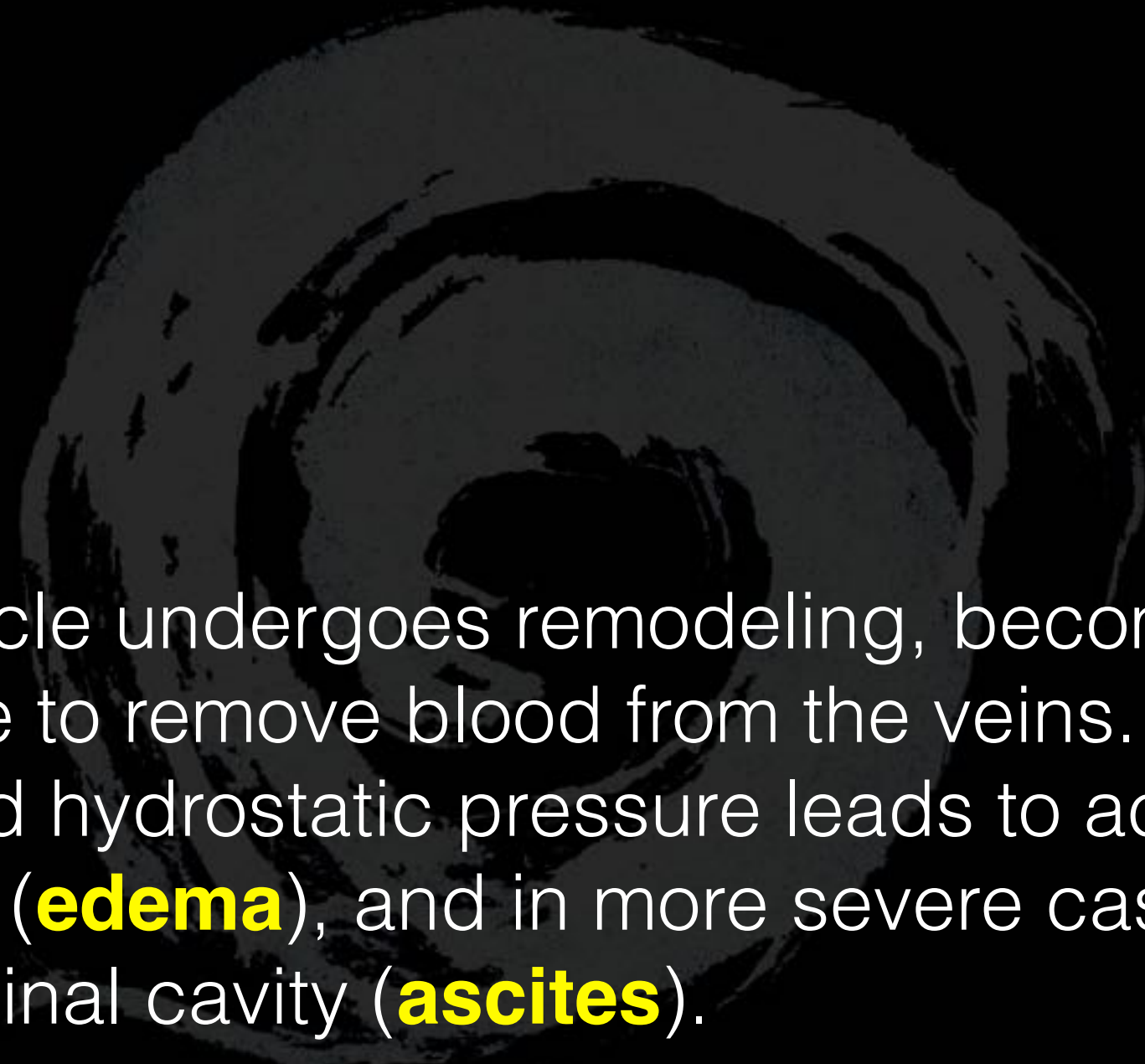
Persistently low oxygen levels causing chronic vasoconstriction leads to increased pressure on the pulmonary artery (**pulmonary hypertension**),

which in turn puts strain on the **right ventricle**, the part of the heart that pumps blood to the lungs.



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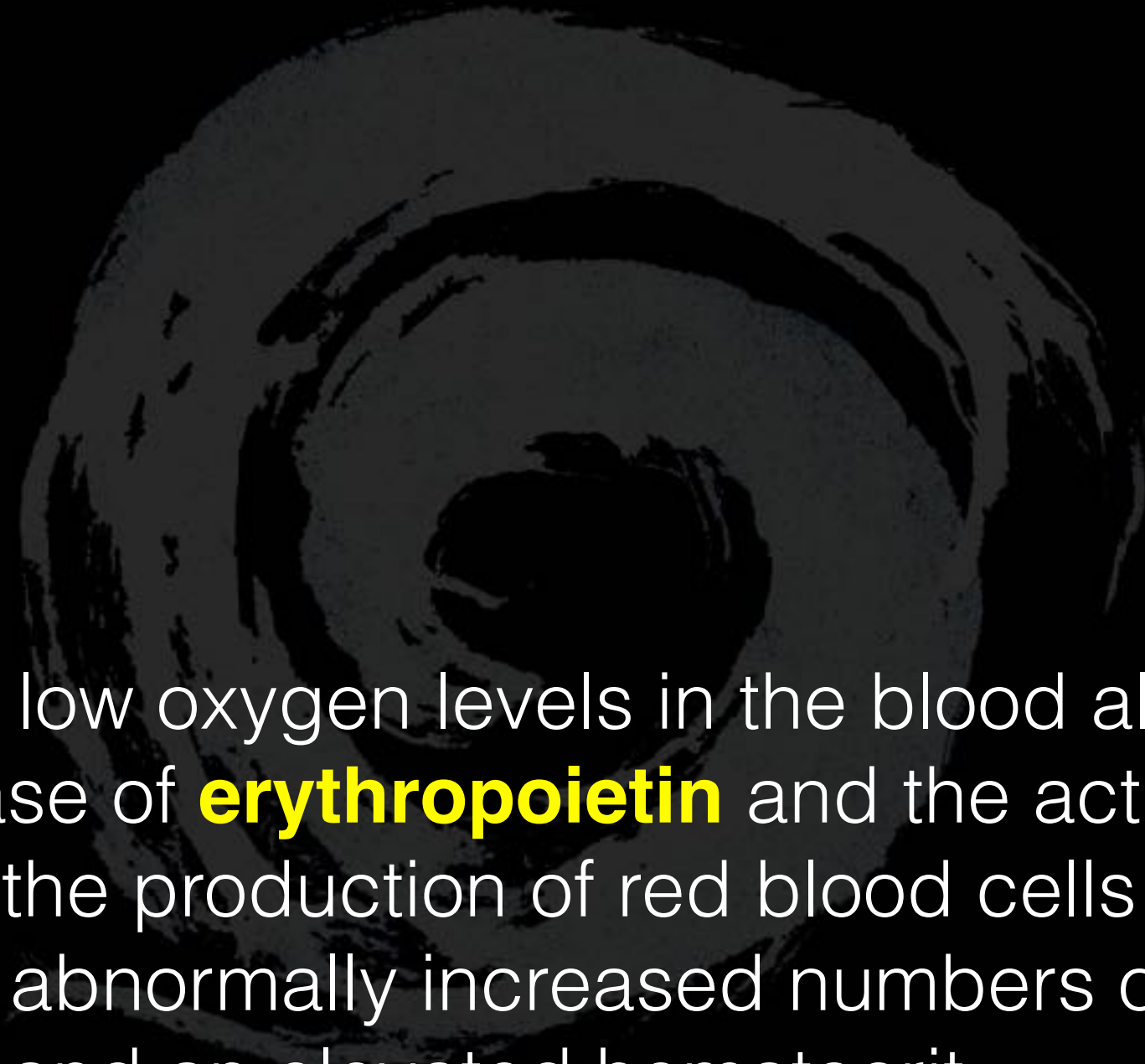


The right ventricle undergoes remodeling, becomes distended and is less able to remove blood from the veins. When this is the case, raised hydrostatic pressure leads to accumulation of fluid in the skin (**edema**), and in more severe cases the liver and the abdominal cavity (**ascites**).



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The chronically low oxygen levels in the blood also lead to increased release of **erythropoietin** and the activation of erythropoiesis, the production of red blood cells. This results in **polycythemia**, abnormally increased numbers of circulating red blood cells and an elevated hematocrit.



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Simple Obesity reduces Vital Capacity to 90%
OHS reduces Vital Capacity to 60%

Airway resistance
with Simple Obesity increased up to 133%
with OHS increased up to 650%



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Do we administer opioids?

Risky for respiratory misadventure
because of respiratory depression.

Any drug which causes respiratory or
cardiac depression may have its effect augmented
by cannabis.



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