Morphological State Of The Gastric Mucosa In Patients In Severe Condition On Artificial Ventilation.

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ABSTRACT

The gastrointestinal (GI) condition of critically ill patients on prolonged mechanical ventilation (MV) is associated with a significantly elevated risk of serious complications. These complications include erosive and ulcerative lesions, gastrointestinal bleeding, pancreatitis, gastropathy, and ischemic damage to the mucosal lining. A variety of factors contribute to the onset of these conditions, including stress, ischemia, infections, and the side effects of medications used in treating the underlying illness. The prolonged use of MV further exacerbates these issues by disrupting normal tissue perfusion and compromising the protective barrier function of the mucosa.

Additionally, the combination of systemic inflammation, immune suppression, and reduced gastric motility in these patients creates an environment where gastrointestinal complications are more likely to occur. Stress-induced hypersecretion of gastric acid and reduced blood flow to the gastric mucosa can lead to acute gastric injury, increasing the risk of bleeding and ulcer formation. Moreover, mechanical ventilation itself can alter the dynamics of the GI tract, contributing to issues such as gastric stasis, regurgitation, and even aspiration pneumonia.

Effective management of critically ill patients on MV must therefore include vigilant monitoring of GI function, with a focus on early detection of mucosal injury and preventive strategies to mitigate complications. Interventions such as maintaining adequate tissue perfusion, optimizing enteral nutrition, and minimizing the use of medications that can aggravate mucosal damage are essential for improving outcomes in this vulnerable patient population. Recognizing and addressing the multifactorial nature of GI dysfunction in critically ill patients is crucial for reducing morbidity and mortality associated with these complications.

Keywords:	erosions, scars, ulcers, morphological examination, biopsy

Introduction. Morphological changes in the gastric mucosa in critically ill patients on artificial lung ventilation (ALV) are a key factor in the pathogenesis of gastrointestinal complications. These alterations are driven by a range of factors, including the systemic inflammatory response, tissue ischemia, stress, and the pharmacological agents used in intensive care. Prolonged ALV impairs microcirculation and weakens the protective functions of the gastric mucosa, fostering the development of erosions, ulcers, and other pathological conditions [1]. A comprehensive understanding of the morphological features of the gastric mucosa in this patient group is essential for improving the diagnosis and prevention of gastrointestinal complications,

which plays a vital role in optimizing treatment strategies and improving patient outcomes [2].

Damage to the gastroduodenal region has been extensively studied from morphological, clinical, and endoscopic perspectives. Among the key contributors to mucosal damage, stress-related effects and the use of drugs—particularly nonsteroidal anti-inflammatory drugs (NSAIDs) and glucocorticoids—stand out as significant factors. These medications are commonly used in critical care settings and, while essential, can exacerbate mucosal damage by reducing gastric protective mechanisms [3].

One of the common issues in critically ill patients is delayed gastric emptying, which is thought to be regulated by hormones such as cholecystokinin (CCK) and decreased concentrations of active ghrelin. Nutrient malabsorption, another concern, remains poorly understood but is thought to result from impaired blood flow to the small intestine and altered mucosal barrier function [4]. Critical illness and the associated treatments can affect the absorption of macronutrients in different ways, and optimal energy and protein requirements for these patients remain a topic of ongoing research. Nevertheless, it is widely accepted that enteral nutrition, even in small amounts, is crucial for supporting these patients nutritionally.

Gastrointestinal motility impairment in critically ill patients has several important clinical consequences, with the most significant being reduced nutrient delivery [5]. Certain patient groups, including those with multiple trauma (60%), traumatic brain injury (57%), and sepsis (42%), are at particularly high risk for food intolerance and delayed gastric emptying. In addition to delayed gastric emptying, GI dysfunction in critically ill patients is marked by impaired absorption in the small intestine and abnormal motility of both the small and large intestines, manifesting as either constipation or diarrhea [6].

Hormonal regulation of gastrointestinal motility, which is tightly controlled under normal conditions, is likely disrupted during critical illness [7]. Cholecystokinin (CCK) is one of the most well-studied hormones in this context, playing a crucial role in the enterogastric feedback mechanism. In critically ill patients, this feedback mechanism is impaired, contributing to delayed gastric emptying [8]. Elevated plasma concentrations of CCK, particularly in cases of enteral feeding intolerance, further underscore its role in the pathophysiology of gastrointestinal dysfunction in these patients.

Additionally, while small intestinal transit tends to remain relatively normal, distinguishing GI dysfunction from ileus, a nonmechanical obstruction that is less common in critically ill patients, remains critical [9]. This distinction is important for managing the gastrointestinal complications associated with critical illness and for tailoring therapeutic interventions to support optimal gut function. Early identification and intervention are crucial to mitigate the risks associated with impaired GI motility, such as nutrient malabsorption, regurgitation, aspiration, and subsequent respiratory complications [10].

Objective of the study: To improve treatment results by studying the clinical and morphological features of the stomach of patients in serious condition under artificial respiration.

Materials and methods. The work is based on the analysis of studies conducted in 50 patients who underwent inpatient treatment in the general intensive care unit of the Republican Scientific Center for Emergency Medical Care of the Navoi Region in the period from 2022 to 2024 in the general intensive care unit.

to examine these patients. According to the diagnostic algorithm, clinical and laboratory examination methods, ultrasound and endoscopic examination of the gastrointestinal tract were performed.

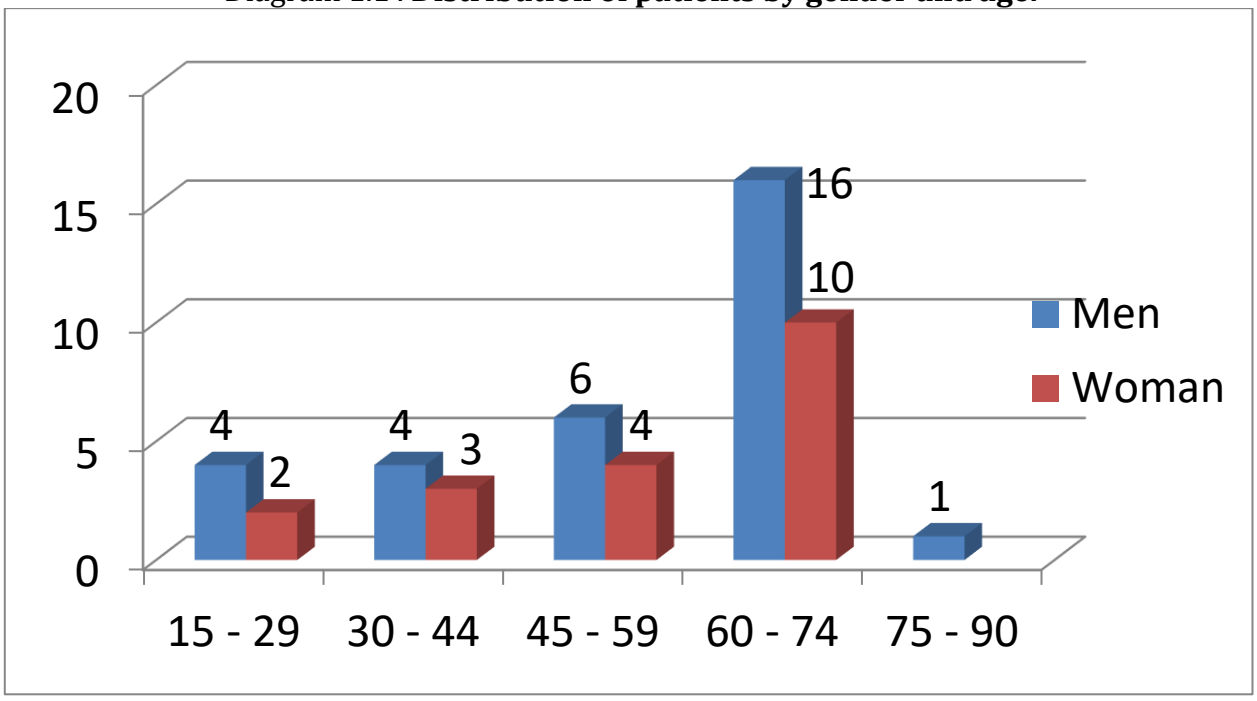
Results of the study . There were 0 pediatric patients (0%), 6 adolescents (12%), 7 young patients (14%), 10 middle-aged patients (20%), and 26 elderly patients (52%), and 1 elderly patient (2%) out of the total number of patients admitted in serious condition (50 patients) to the general intensive care units of the Republican Scientific Center for Emergency Medical Care in Navoi Region for the period from 2022 to 2024 (Table 1.1).

Table 1.1. **Distribution of patients by age and gender**

	15 - 29	30 - 44	45 - 59	60 - 74	75 - 90	**Total**
Men	4	4	6	16	1	31
Women	2	3	4	10	-	19
Total	6	7	10	26	1	50

From the analyzed age cohorts, it was noted that the majority of those hospitalized in serious condition were in the elderly group (60-74 years old) of patients, followed by 45-59 years old – the middle (mature) age group (diagram 1.1).

Diagram 1.1 . **Distribution of patients by gender and age.**



A distribution of 50 patients with various diagnostic criteria in serious condition on adequate artificial ventilation was carried out: 1 6 patients with a diagnosis of acute cerebrovascular accident (ACVA) of hemorrhagic type - 10 and ischemic type - 6; with recurrent ACVA made up - 7 of them: ischemic type - 3, and with hemorrhagic type - 4 patients; 6 patients were delivered with multiple injuries ; with acute pancreatitis, which was complicated by diffuse peritonitis - 2; with cholelithiasis, which was complicated by choledocholithiasis and cholangitis - 2; 2 patients arrived with peptic ulcer, 3 patients with closed craniocerebral injury.

1 patient with :

- acute exogenous poisoning with drugs (suicide),
- genitourinary infection;
- alimentary dystrophic cachexia;
- secondary meningoencephalitis ;
- epileptic disease;
- tumor of the colon of the rectosigmoid angle;
- IHD: myocardial infarction without ST segment elevation;
- segmental thrombosis of the ascending small intestine;
- persistent bronchitis , stage 3;
- burn disease;
- type 2 diabetes mellitus in the decompensation stage;

- bilateral bronchopneumonia severe course. In total 12 patients (hereinafter referred to as other diseases). Various cohorts of diseases were selected for conducting and studying the gastrointestinal tract in various critical pathologies under conditions of adequate ventilation of the lungs.

Of the total number of patients with acute cerebrovascular accident, 16 (75%) were patients. The patients were distributed by type and gender, which was 10 men and 6 women. Distribution by gender did not reveal any significant difference between men and women in the total number, but men had ± 1.5 times more acute cerebrovascular accidents than women. The number of men with repeated acute cerebrovascular accidents was 4, and women - 2. There were 5 men and 1 woman with polytrauma . From the conducted analysis, it was revealed that the male gender is ± 2.6 times more common than women.

42 patients were urgently hospitalized in the emergency room of the shock room with transfer to the intensive care unit with various etiologies of the disease. And 8 patients were transferred from various departments due to deterioration of the general condition to the general resuscitation and intensive care unit of the Republican Scientific Center for Emergency Medical Care of the Navoi branch for the period from 2022 to 2024 (Table 1.2).

Table 1.2 . **The order of admission of patients to the intensive care unit.**

Got sick.	ACVA	Reccurent ACVA	GU	CCCI	Multip. trauma	Acute pancreatitis	Cholelithiasis	Other problems
Hospital . in emergency . in order	14	5	1	3	6	1	1	10
Translated from other sections.	2	2	1			1	1	2
Total	16	7	2	3	6	2	2	12

Table 1.2 shows the distribution of patients admitted to the intensive care unit with various diagnoses, urgently and by transfer from other departments. Let us consider the data in the table in more detail: acute cerebrovascular accident (ACVA) is the most common reason for admission to the intensive care unit, both urgently (14 cases) and by transfer from other departments (2 cases). In total, this is 16 cases. Polytrauma also accounts for a significant share among those hospitalized urgently (6 and 10 cases, respectively). Repeated ACVAs account for a significant number both among emergency hospitalizations (5 cases) and transfers (2 cases), which in total is 7 cases. Gastric ulcer (PU), closed craniocerebral injury (CCI), acute pancreatitis and cholelithiasis (CSD) have a comparatively smaller number of cases, but are also present among the reasons for hospitalization to the intensive care unit. A general analysis shows that cerebrovascular accidents and multiple injuries are the key causes requiring intensive care and observation in intensive care.

Of the 50 patients examined, 34 patients were adequately ventilated, 1 patient was on the C PAP regimen, and 15 patients were breathing freely through nasal cannulas with humidified oxygen. The burdening of patients and their placement on the ventilator was associated with the underlying diagnosis and complication of the disease. Without constant ventilator support, the condition of patients would have worsened and the length of stay in the intensive care unit would have been increased.

In 34 patients who were adequately ventilated: an endotracheal tube was inserted in 26 patients, and a tracheostomy was inserted in 8 patients . All 34 patients were given different modes and configurations of inhalation and exhalation (Table 1.3). From the above diagram, it can be concluded that correctly calculated time of decision-making for the installation of artificial ventilation of the lungs of patients in critical situations improved the condition and prevented secondary complications.

Table 1.3 . Modes of the ventilator

Configurations / Modes	SIMV	ACV	PCV	With PAP
Tidal volume	500-550	Minute ventilation 100%	Inspiratory pressures +10+12+14	Support +14+12+10
Three g ger	5 liters	5 liters	5 liters	5 liters
PEEP	+3+5+7	+3+5	+3+5	+3+5
FiO_2	0,4-0,6	0,4-0,6	0 ,4	0 ,4
I : E (inhalation to exhalation ratio)	1:2	1:2	1:2	1:2
Freq (RR)	12-14-16		12-14-16	

All patients on adequate artificial ventilation had different modes and parameters established in accordance with the underlying disease and existing complications. The reasons for switching from spontaneous breathing to artificial ventilation varied from upper airway obstruction to apnea.

1 .2 Research methods.

In accordance with the set objectives, the following were determined during the clinical examination of patients:

1 .2.1 Traditional laboratory research methods

1. Number of red blood cells, white blood cells, platelets, hemoglobin content, ESR.
2. Total serum protein.
3. Protein fractions.
4. creatinine .
5. Blood bilirubin.
6. Blood diastase.
7. Aspartate aminotransferase and alanine aminotransferase .
8. Blood ammonia.
9. Blood urea.

Based on clinical and laboratory studies, pathological processes occurring in the gastrointestinal tract were identified.

1 .2. 2 Histological diagnostic method

Histological examination was performed on 20 patients. Histological examination of the stomach involves detailed tissue analysis using microscopy. This method allows obtaining information about the structure of cells, tissues and organs, as well as identifying pathological changes. Histological examination of the stomach is a procedure aimed at studying the structure of stomach tissues at the micro level using a microscope. This method is often used in medical diagnostics to identify pathologies, inflammatory processes, determine the type of cells and other changes that may be associated with stomach diseases.

The procedure for histological examination of the stomach includes several stages:

Biopsy: The first step involves taking a tissue sample from the stomach. This is done

using an endoscopic biopsy (using an endoscope). In an endoscopic biopsy, a thin tube (endoscope) is inserted through the mouth and a small sample of tissue is taken from the inside of the stomach.

Fixation: The obtained tissue sample is fixed in a special solution (formalin) to preserve the cell structure. This step is important to prevent changes in the tissues after their extraction. The sample is kept in 10% formalin for 1 hour. On the 2nd day, the biopsy is treated with 96% alcohol twice every hour. Then it is left in 96% alcohol for 24 hours.

Cleaning and embedding in paraffin is carried out on the 3rd day: The sample undergoes cleaning and embedding in paraffin to create a solid block of tissue, which will be easier to cut into thin sections. A solution of alcohol and chloroform is prepared (100 ml 96% alcohol + 100 ml chloroform) and the biopsy is left in this solution for 1 hour. Then a "porridge" is prepared (100 ml dissolved paraffin + 100 ml chloroform) in a 57 * C thermostat and the material is left for 1 hour. Later, the material is placed in 57 * C paraffin and cooled for 30 minutes, after which blocks begin to form.

Microtomy : A solid block of tissue is cut into thin sections (slices) using an instrument called a microtome. The slices are usually only a few micrometers thick.

Staining: The tissue sections are stained with special dyes to highlight the different structures and cells. This allows the microscope to see the details of the tissue structure more clearly. For histological analyses of the gastric mucosa tissue, hematoxylin and eosin (H&E) was used: this is one of the most widely used staining methods in histology . Hematoxylin stains the cell nuclei blue, and eosin stains the cytoplasm and other substances pink or red. This method provides an overall picture of the tissue and allows for the identification of different cell types. The block in step I is inserted into xylene solvent for 10 minutes. In step II and step III, the block is also placed in xylene solution for 10 minutes. Then there is a three-stage treatment of the blocks in a solution of 96% alcohol with a time interval of 10 minutes. After these treatments of the blocks, the staining process itself begins. First, it is stained with hematoxylin for 4 minutes in hot water. Then the block is washed in warm water for 1 minute. Afterwards, the block is placed in eosin dye for 5 mec and washed again with warm running water. Then, a three-stage treatment of the almost finished block is carried out in 96% alcohol for 10 minutes. Having taken out the block, it is placed in a xylene solution twice for 10 minutes and then a balm is applied and placed on a glass slide.

Microscopy: Stained tissue sections are placed under a microscope where the structure of cells and tissues is examined in detail.

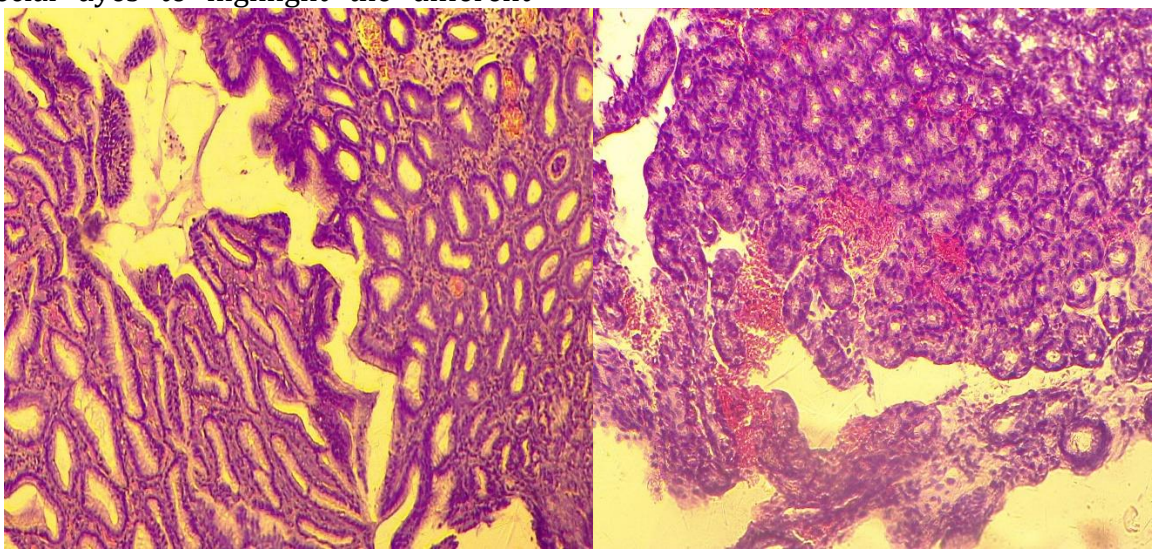


Fig. 1. Patient B.R., 40 years old. Diagnosis: type II diabetes . (Acute erosive-hemorrhagic gastritis. Blood overflow in blood vessels, bleeding areas, hyperplasia and defects of the mucous membranes.)

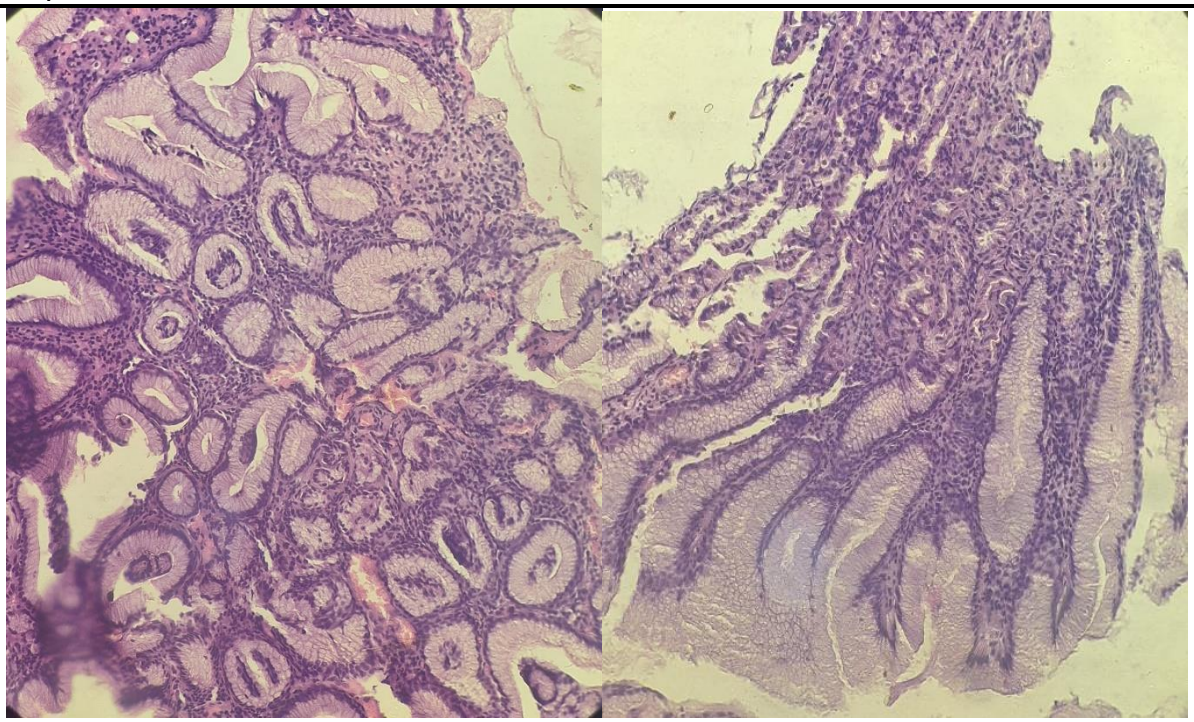


Fig. 2. Patient A.T., 40 years old. Diagnosis: type II diabetes . (Erosion of the gastric mucosa. Vessels overfilled with blood, hyperplasia of the mucous glands, a small amount of leukocyte infiltration.)

In 34 patients who underwent histological examination, various structural changes in the gastric mucosa were detected. Of these,

Instrumental examination methods

Ultrasound examination.

All 50 admitted patients underwent ultrasound examination of the chest and abdominal cavity using the **Midray DC-40 m6** 3.5 MHz device. convex and linear transducers. Ultrasound examination (US) of the thoracic and abdominal organs includes echocardiography to evaluate the morphological and functional parameters of the heart, as well as ultrasound imaging of the pleural cavities to detect pleural effusion or thickening. In the abdominal cavity, ultrasound is used for detailed visualization of the liver, gallbladder and ducts, pancreas, spleen, kidneys, ureters and bladder to detect pathologies such as neoplasms, cysts, abscesses, fatty hepatosis, cirrhosis, cholelithiasis, pancreatitis and hydronephrosis. Additionally, in women, the uterus and ovaries are assessed to diagnose cysts and fibroids, and in men, the prostate gland is assessed to detect hyperplasia and tumors.

Radiography.

Radiography was performed on 45 hospitalized patients. Radiography of the chest and abdominal organs is a diagnostic imaging technique that uses ionizing radiation to produce images of internal structures. In the chest, radiography allows evaluation of the lungs, cardiac shadow, bony structures of the chest, and pleural cavities, revealing pathological changes such as pneumonia, pleural effusion, cardiomegaly , pneumothorax, and tumors. In the abdominal cavity, radiography is used to visualize the gastrointestinal tract, detect free gas in case of perforation of hollow organs, intestinal obstruction, stones in the biliary tract and urinary system, and to evaluate the condition of bone structures and soft tissues.

Multislice computed tomography (MSCT)

Multislice computed tomography (MSCT) of the brain is an advanced neuroimaging technique that provides high spatial resolution for detailed examination of intracranial structures. MSCT allows to detect acute and chronic pathological processes, including intracranial hemorrhages, ischemic strokes, space-occupying lesions (tumors, cysts, abscesses), traumatic injuries (skull fractures,

hematomas), as well as degenerative and demyelinating diseases. The technique is used to assess the state of the vascular bed in case of suspected aneurysms or arteriovenous malformations and to plan neurosurgical interventions. MSCT of the brain plays a key role in emergency diagnostics and monitoring of therapy effectiveness in various neurological conditions. MSCT was performed on 36 patients hospitalized in the intensive care unit .

Esophagogastroduodenoscopy

Esophagogastroduodenoscopy – provides the ability to reliably assess the shape, size and location of the stomach, as well as changes in the gastrointestinal tract. The procedure provides unique anatomical features of the stomach, as well as such pathological changes as ulcers, the state of vascular architecture, malignancy processes, tumor-like neoplasms, structural changes in the mucosa, etc.

The procedure is performed with premedication : the patient is allowed to drink only cold drinks and water from 18:00 before the procedure. Anesthesia in the throat area is performed using a 10% lidocaine solution . If the study needs to be performed under general anesthesia, anesthetics such as propofol and dormicum are used .

The patient is examined in a supine left position. Video esophagogastroduodenoscopy and a video gastroscope are used to evaluate the mucous membranes of the esophagus, stomach and duodenum. A full assessment of the stomach sections is performed.

34 patients underwent EGD. The gastrointestinal tract of critically ill patients on mechanical ventilation is subject to numerous changes (Table 1.2.1 some examples).

Table 1.2.1 Changes in the **gastric mucosa in patients on artificial ventilation depending on the nosology**

Diseases	**Changes in the gastric mucosa (EGD)**	**Histology (biopsy)**	**Morphological changes**
Polytrauma. CCT. Disorders : Edema of the brain . Aspiration syndrome.	Erosive gastritis, superficial gastritis.	Congestion of blood vessels, areas of bleeding, hyperplasia and defects of the mucous membranes	Submucous vascular inflammatory hyperemia
Ischemic stroke	Esophagitis, erosive gastritis	Glandular hyperplasia and lymphocytic infiltration.	Leukocytes are located in the area of submucosal infiltration.
Closed craniocerebral injury. Moderate brain contusion. Epidural hematoma.	Erosive gastritis.	Erosion of the gastric mucosa.	Infiltration of leukocytes in aggregated and scattered form.
Segmental thrombosis of the ascending small intestine.	Superficial gastritis. Erosive esophagitis. Mallory-Weiss syndrome .	Glandular hyperplasia, inflammatory reaction. Blood overflow in blood vessels.	Inflammatory hyperemia of the vessels of the submucosal layer, leukocyte infiltration.

Tumor of the colon of the rectosigmoid angle. Tumor perforation.	Subatrophic gastritis	Glandular hyperplasia and lymphocytic infiltration.	Increased number of mast cells in the mucous and submucous layers. Inflammation.

Conclusion . The presented data demonstrate a correlation between various diseases and changes in the gastric mucosa revealed by EGD, histological features and morphological changes. In patients with polytrauma , CCT, cerebral edema and aspiration syndrome, erosive and superficial gastritis is observed, accompanied by vascular congestion and mucosal defects, which leads to submucosal vascular inflammatory hyperemia. In ischemic stroke, esophagitis and erosive gastritis are detected, characterized by glandular hyperplasia and lymphofollicular infiltration with leukocyte infiltration of the submucosal layer. Severe craniocerebral trauma and epidural hematomas also cause erosive gastritis and leukocyte infiltration. In segmental thrombosis of the ascending small intestine and Mallory-Weiss syndrome, inflammatory hyperemia of the vessels and leukocyte infiltration are recorded, and in patients with colon tumors , subatrophic gastritis, glandular hyperplasia, and inflammation in the mucous and submucous layers are observed. These data emphasize the importance of a comprehensive approach to the diagnosis and treatment of diseases, including endoscopic, histological, and morphological examination.

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