Pathology of surgery-related infections

The following subjects are described.

1) History of surgical infections
2) Pathology of contaminated surgery
3) Gangrenous infections requiring emergency surgery
4) Nosocomial infection of MRSA after surgery
5) Biohazard in pathology practice and surgery-related biohazard
6) Biohazard of tuberculosis

History of appendicitis

In 19th century, the lethality rate of acute appendicitis reached 60%. Dr. James Parkinson in London, UK, first described it as perityphlitis **in 1812**.

In 1886, Prof. Reginald Fitz at Harvard University, Boston, USA, analyzed a total of 5 autopsy cases of appendicitis, and proposed the possibility of early surgery based on early diagnosis.

In 1887, Dr. Thomas George Morton succeeded the very first surgery for appendicitis.

In 1888, Dr. Charles McBurney reported 7 cases of successful appendectomy.

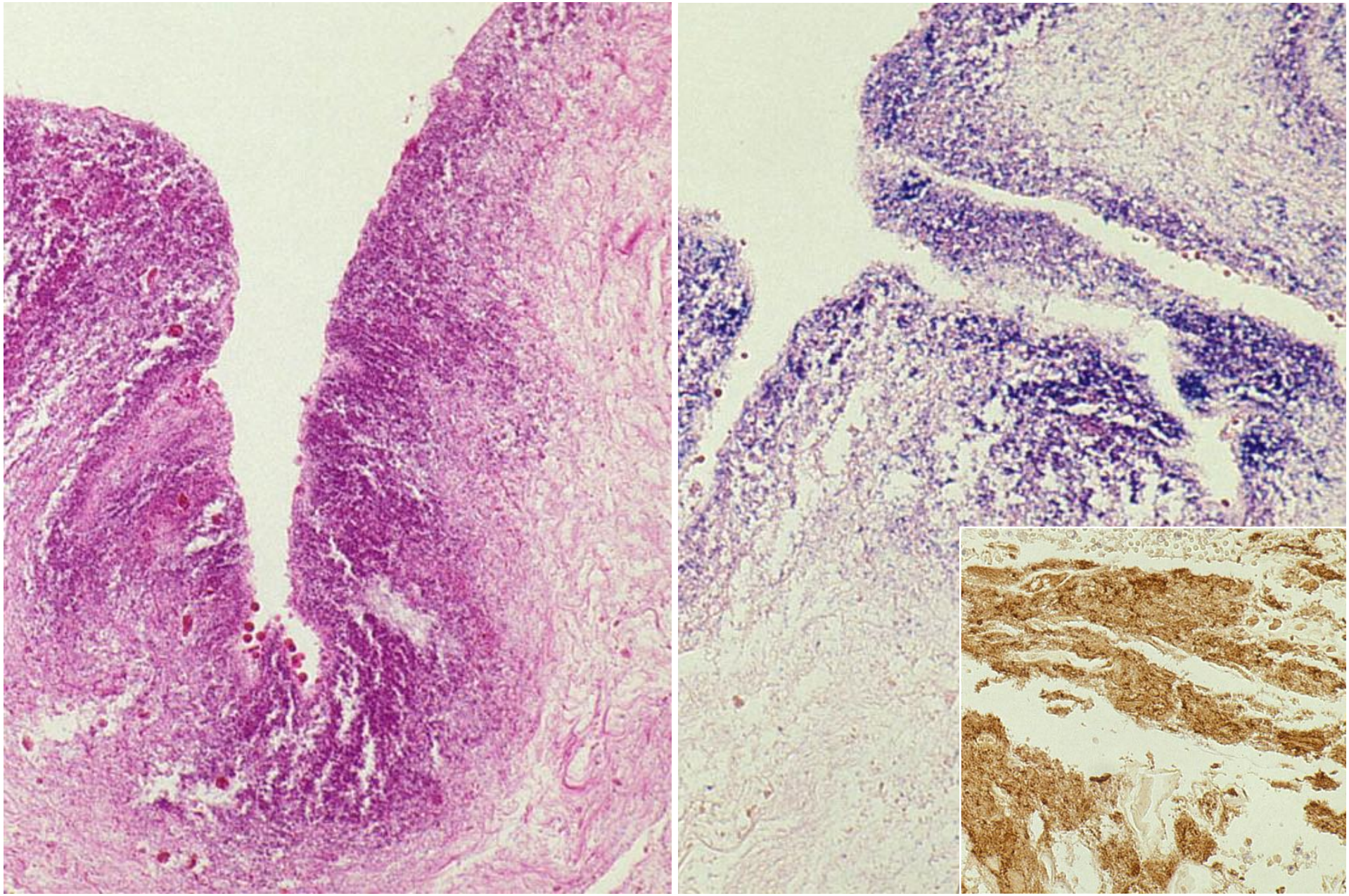
In 1889, John Benjamin Murphy performed earl-stage appendectomy for more than 100 cases, establishing the surgical treatment of acute appendicitis in USA.

In 1902, preventive appendectomy was proposed.

Until 1911, appendectomy was common in European countries.

In 1931, The significance of appendectomy was established in Japan, 45 years after Fitz' proposal.

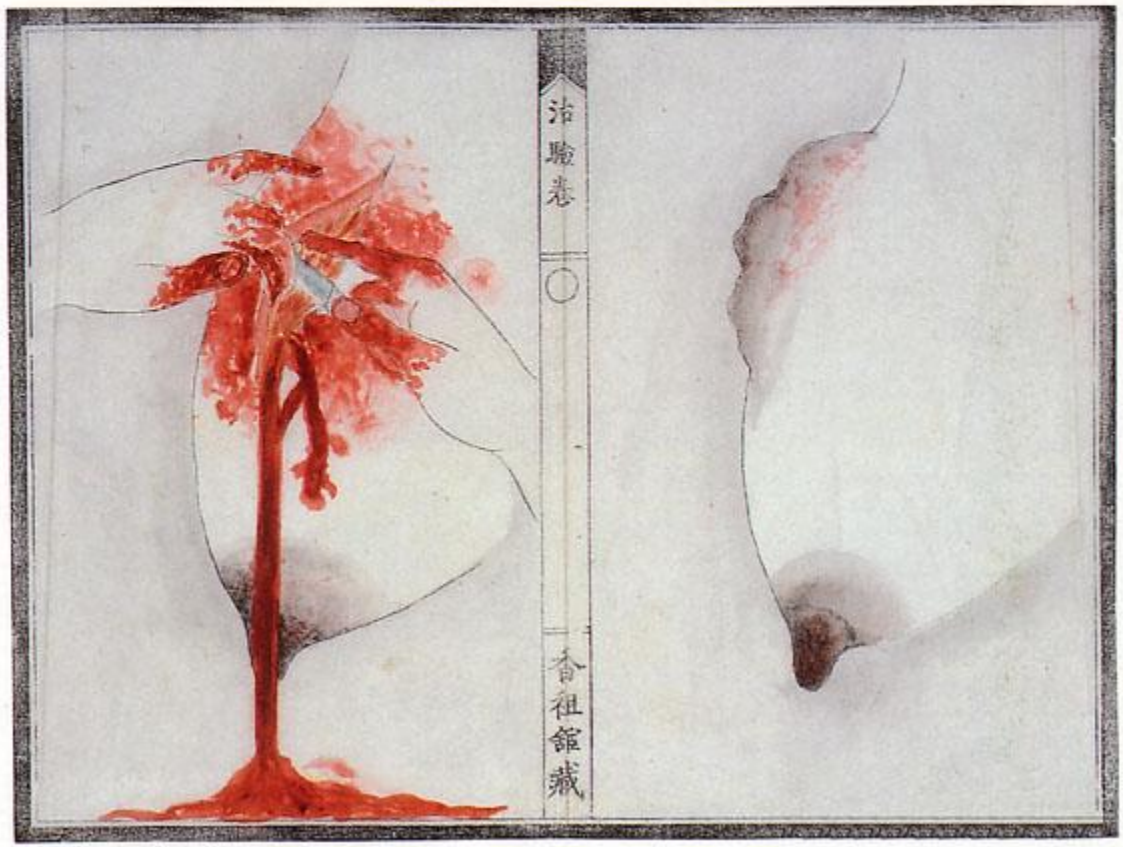
appendectomy specimen with a fecalith



Gangrenous appendicitis. Left: H&E, right: Gram, inset: immunostaining for *E. coli* antigens

Dr. Seishu Hanaoka (1760-1835)

Dr. Seishu Hanaoka succeeded the world-first surgery for breast cancer in October 13, 1804.

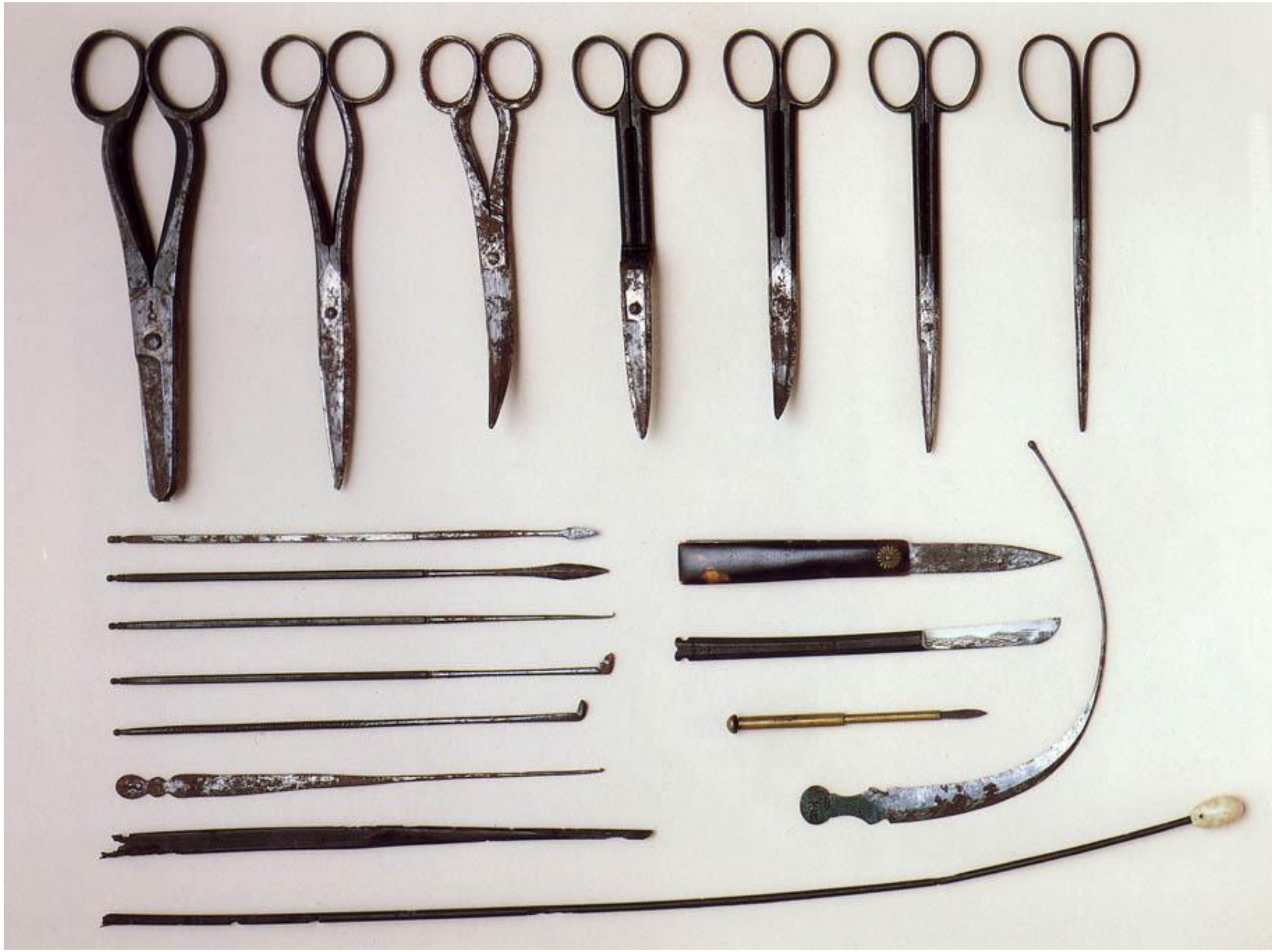


A scheme of breast cancer surgery (tumorectomy) by Dr. Seishu Hanaoka (1804)

General anesthetics: Tsusensan (通仙散)

No globes available.

Tsusensan is a mixture of 10 kinds of extracts including *Datura metel* and *Aconitum*. Principal ingredients are atropine, scopolamine and aconitin



Surgical instruments for Dr. Seishu Hanaoka

Disinfection procedures by Dr. Seishu Hanaoka

When he was 44 years old, surgical removal of breast cancer was performed for a 60 y-o woman, under general anesthesia with Tsusensan. He described that the tumor appeared as a rock.

It was 38 years preceded to the ethylether anesthesia by William Thomas Green Morton, Mass General Hospital, Boston, USA.

He investigated the anesthetics in Hirayama, Wakayama (Kii), Japan. They say no dogs survived in Hirayama. By human experiments, Otsugi (his mother) and Kae (his wife) lost their vision.

For 30 years until death at 76 years of age, he performed a total of 153 surgical resections of breast cancer.

At that time, no globes or antibiotics were available, disinfection was Shochu (a traditional Japanese distilled spirit) with a high concentration of ethanol for the skin and boiling for the instruments.

A sketch of a woman with a breast rock (breast cancer) described by Seishu Hanaoka

The very first Caesarian section in Japan

In April, 1852, at Shomaru-tohge, Chichibu, Japan:

The obsterticians Jundo Ikoda (50 years old) and Kimpei Okabe (38 years old) performed the very first Caeserian section in Japan.

The surgery was done without anesthesia, in reference with a Japanese translation version of Dutch textbook, Handleiding tot de verloskunde (1845).

The patient was a 32 y-o pregnant woman with transverse presentation.

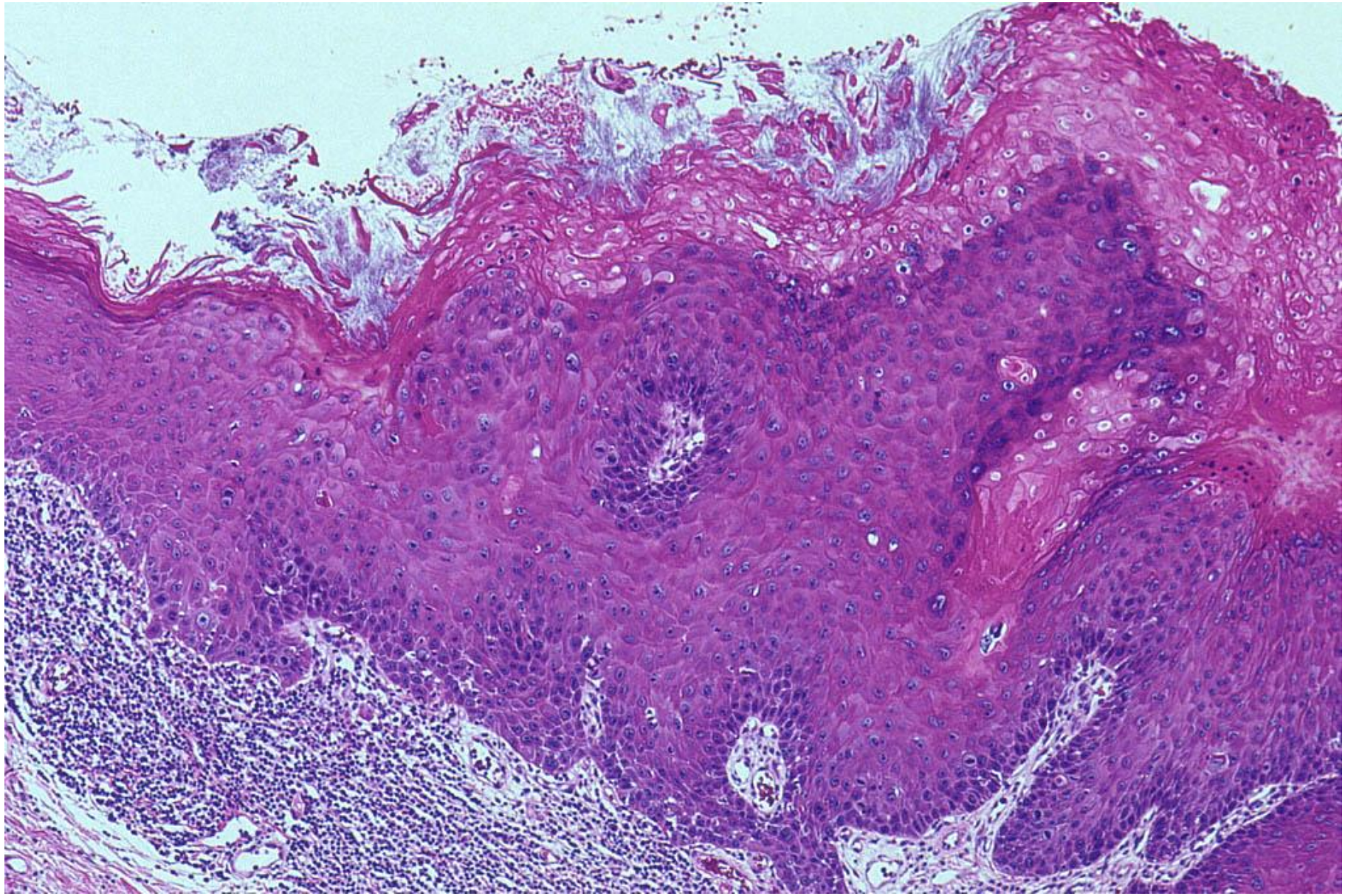
The fetal extremities were amputated, and the patient survived until 1908 at the age of 88 years.

A monument for the first Casaerian section at Shomaru Tohge, Chichibu, Japan

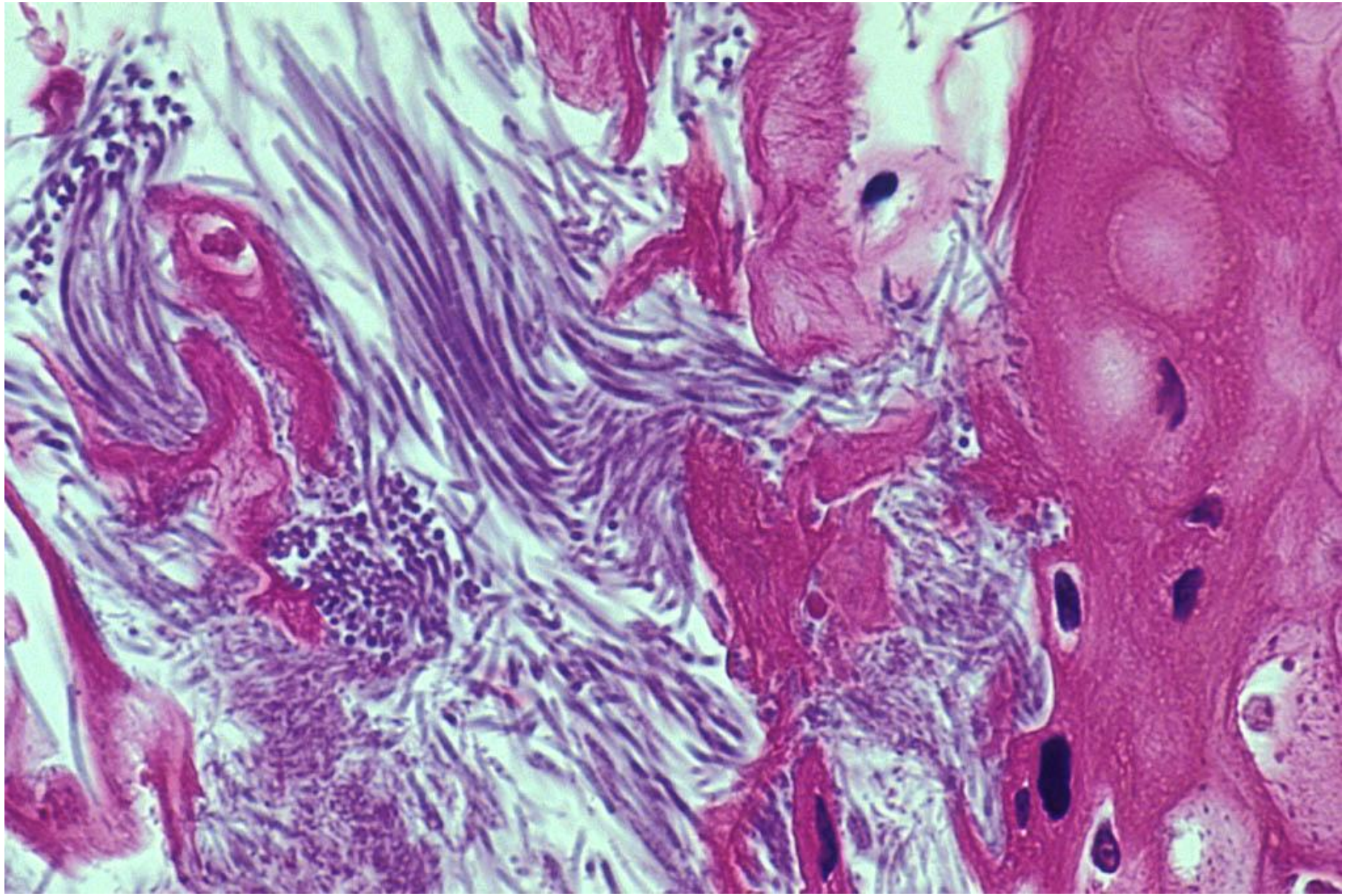
A stone monument for memoring the accomplishment by Jundo and Kimpei at Shomaru Tohge, Chichibu, Japan

Surgery with microscopically visible infection

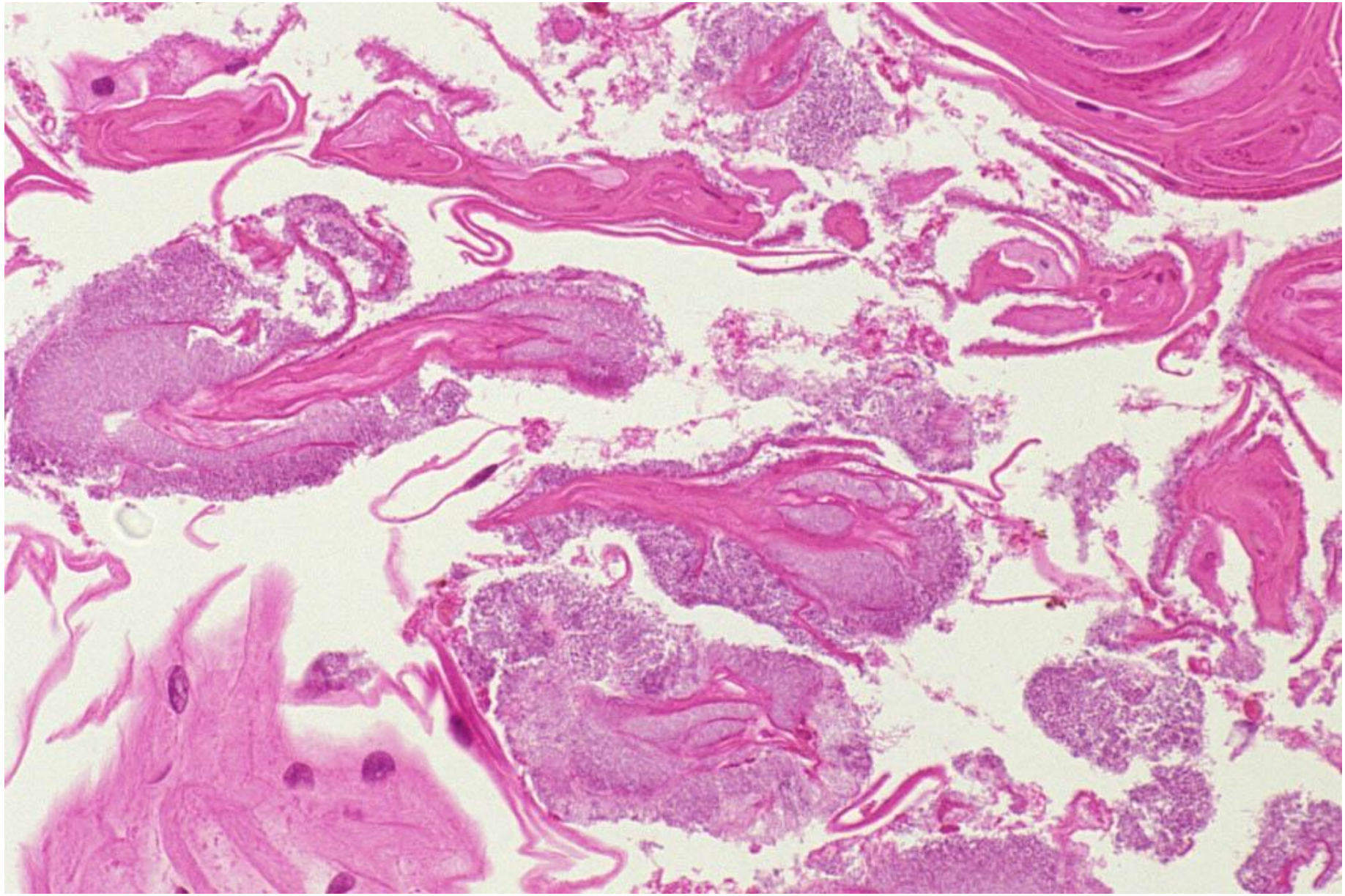
1) Tongue cancer
2) Pharyngeal cancer
3) Ileus



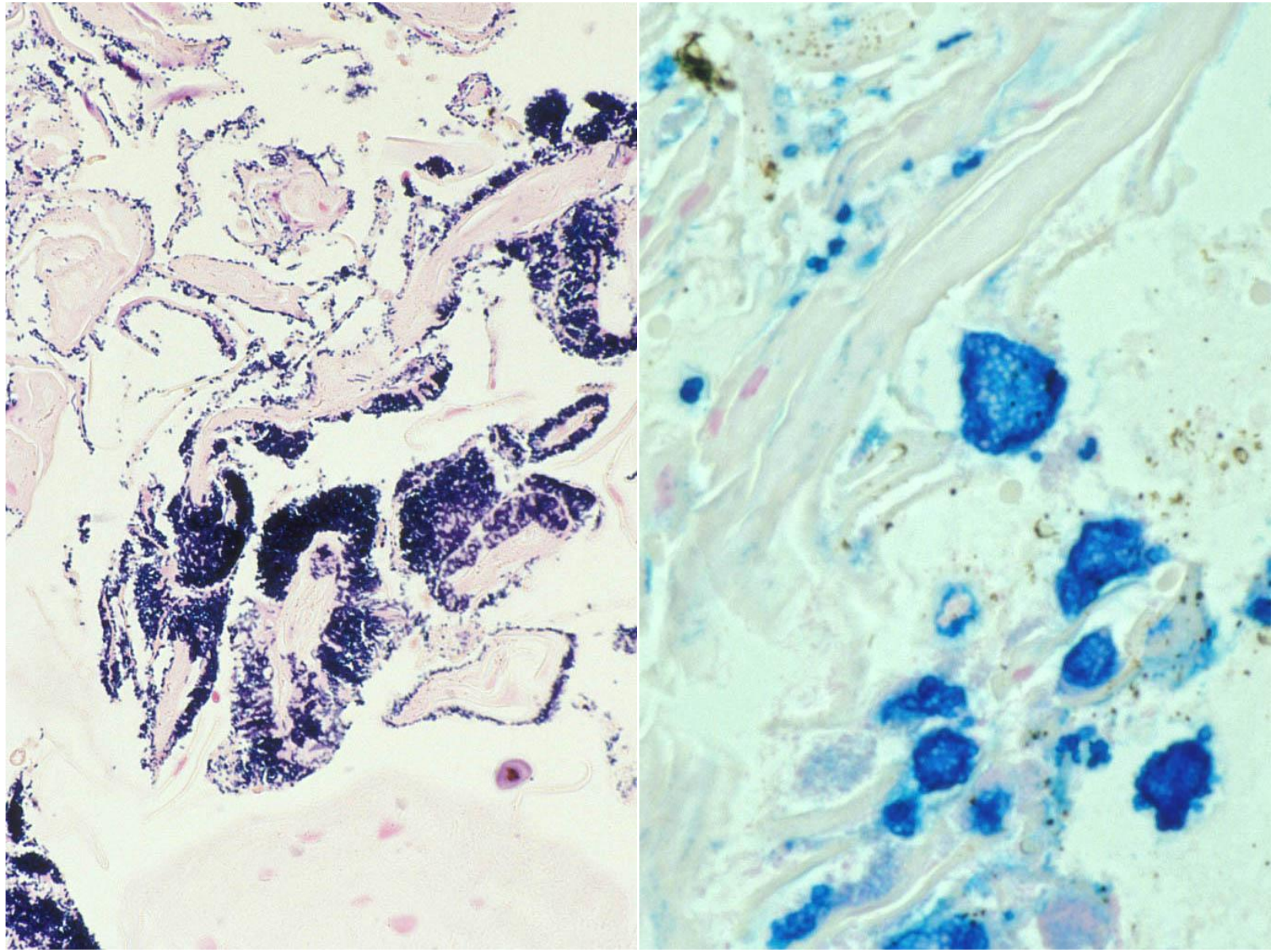
Furred tongue with bacterial infection adjacent to tongue cancer (H&E)



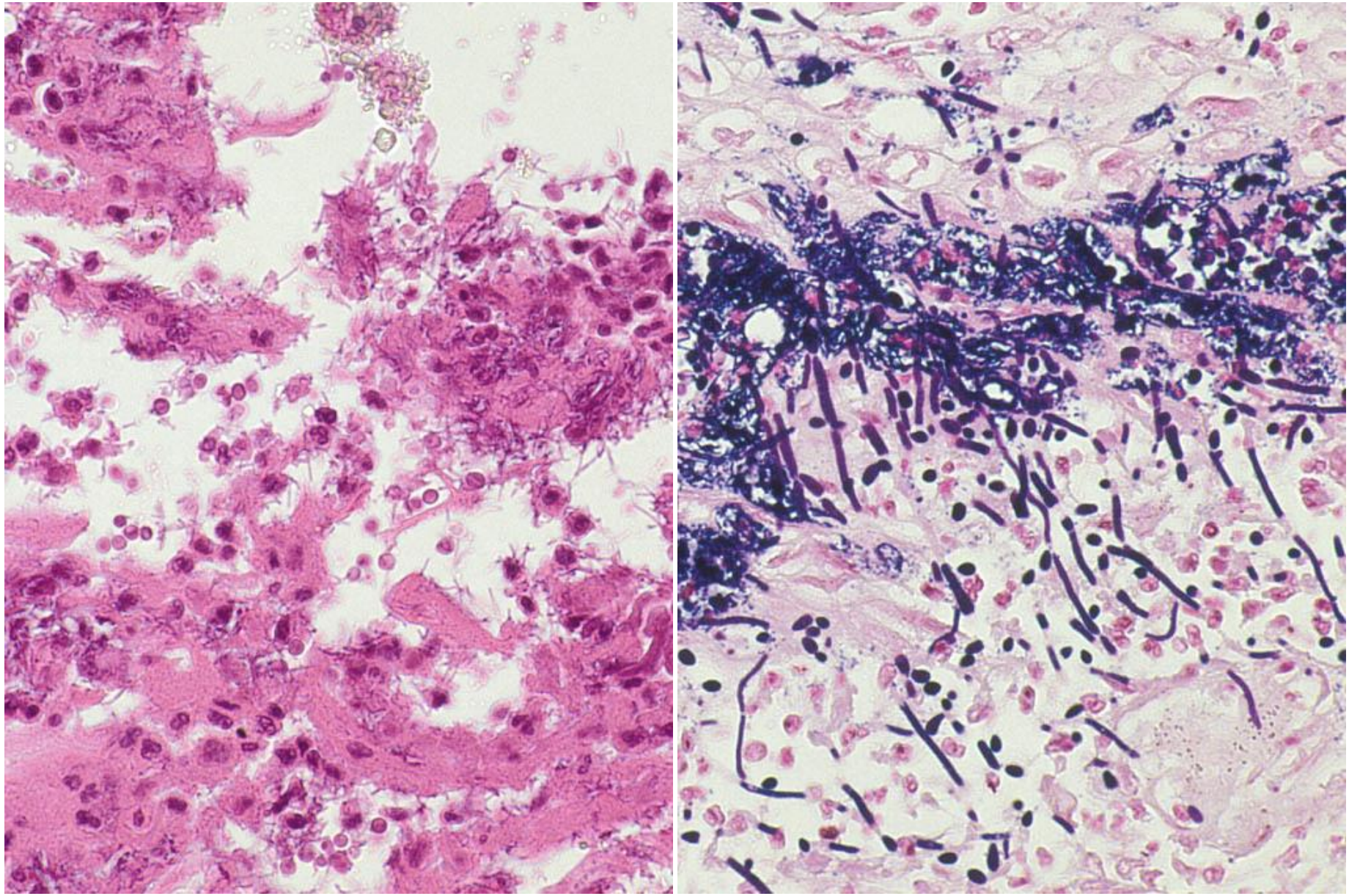
Furred tongue with bacterial infection adjacent to tongue cancer (H&E). Infection of long bacilli is evident on the tongue mucosa.



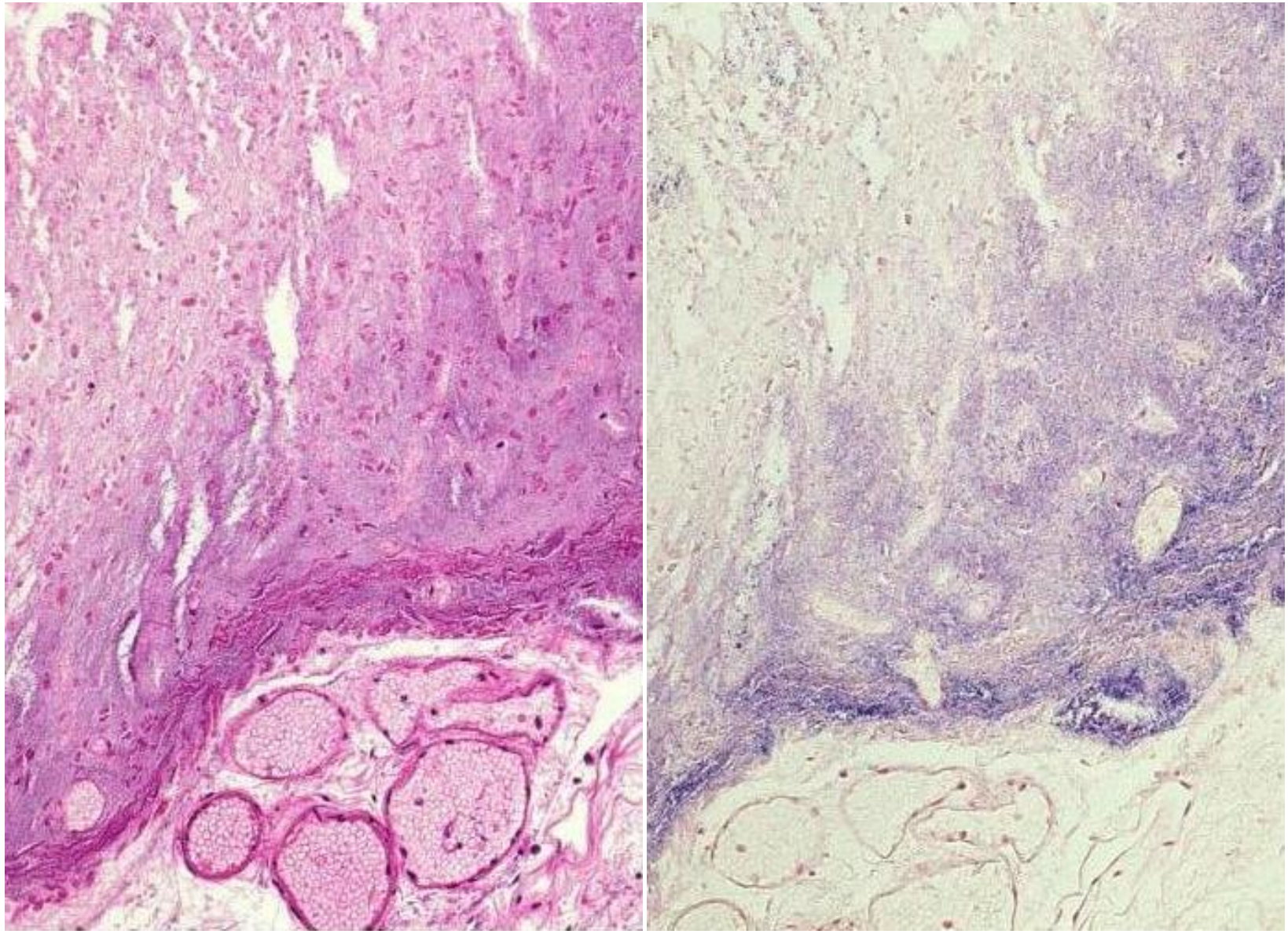
Furred tongue with streptococcal infection adjacent to tongue cancer (H&E). Colonization of commensal streptococci is evident on the tongue mucosa.



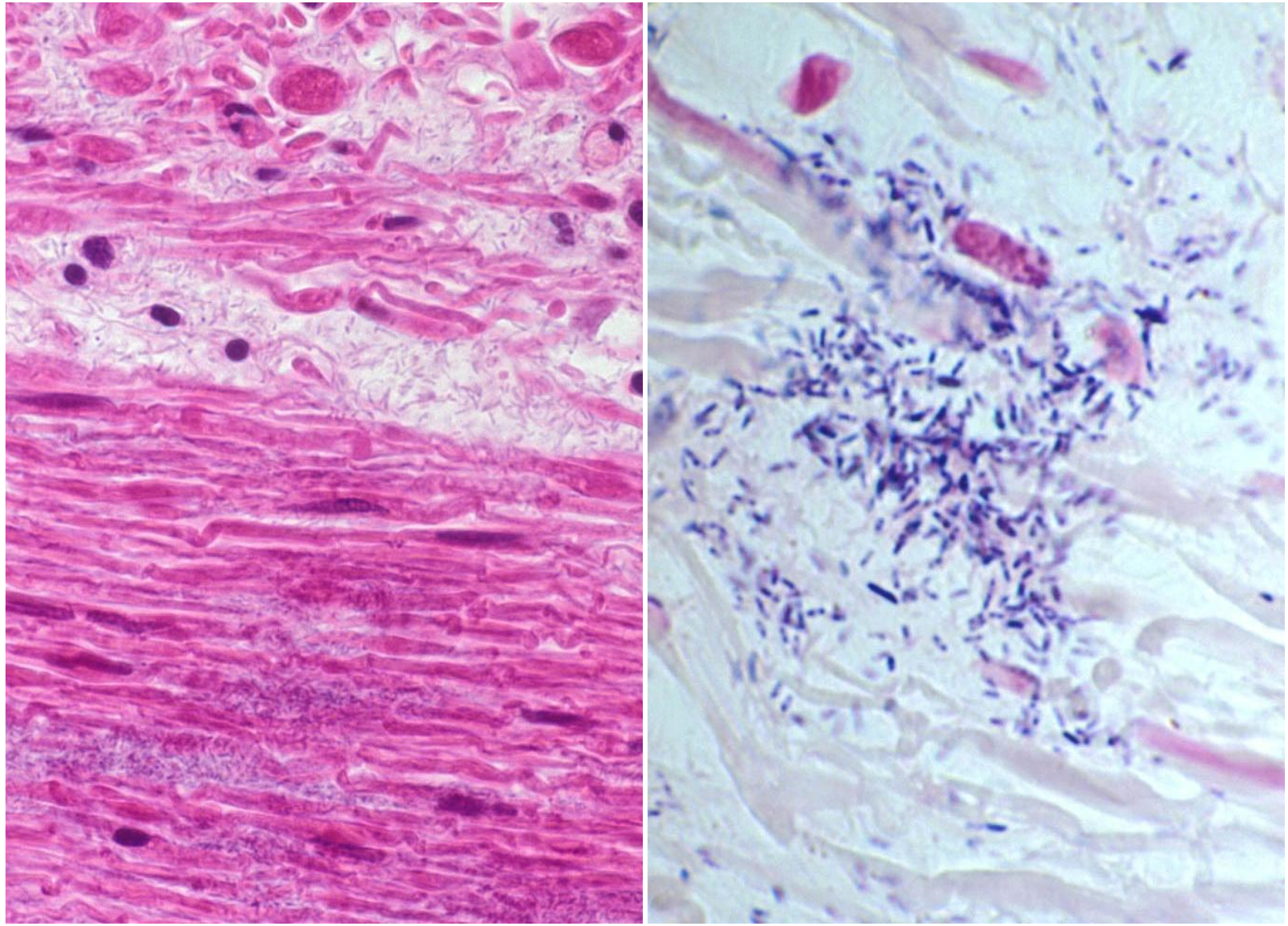
Furred tongue with streptococcal infection, adjacent to tongue cancer. Colonized commensal cocci are Gram-positive (left, Gram). Colloidal iron stain reveals biofilm formation (right).



The ulcer base of pharyngeal squamous cell carcinoma shows mixed infection of Gram-positive cocci (streptococci) and Candida (left: H&E, right: Gram)



Surgical specimen of mechanical ileus. The necrotic small bowel mucosa is densely infected with Gram-positive cocci (left: H&E, right: Gram)



Another surgical case of mechanical ileus of the colon. Infection of Gram-positive cocci with spore formation, representing *Clostridium* spp., is evident in the proper muscle layer (left: H&E, right: Gram)

Gangrenous infections clinically requesting emergency surgery

1) Fulminant streptococcal infection

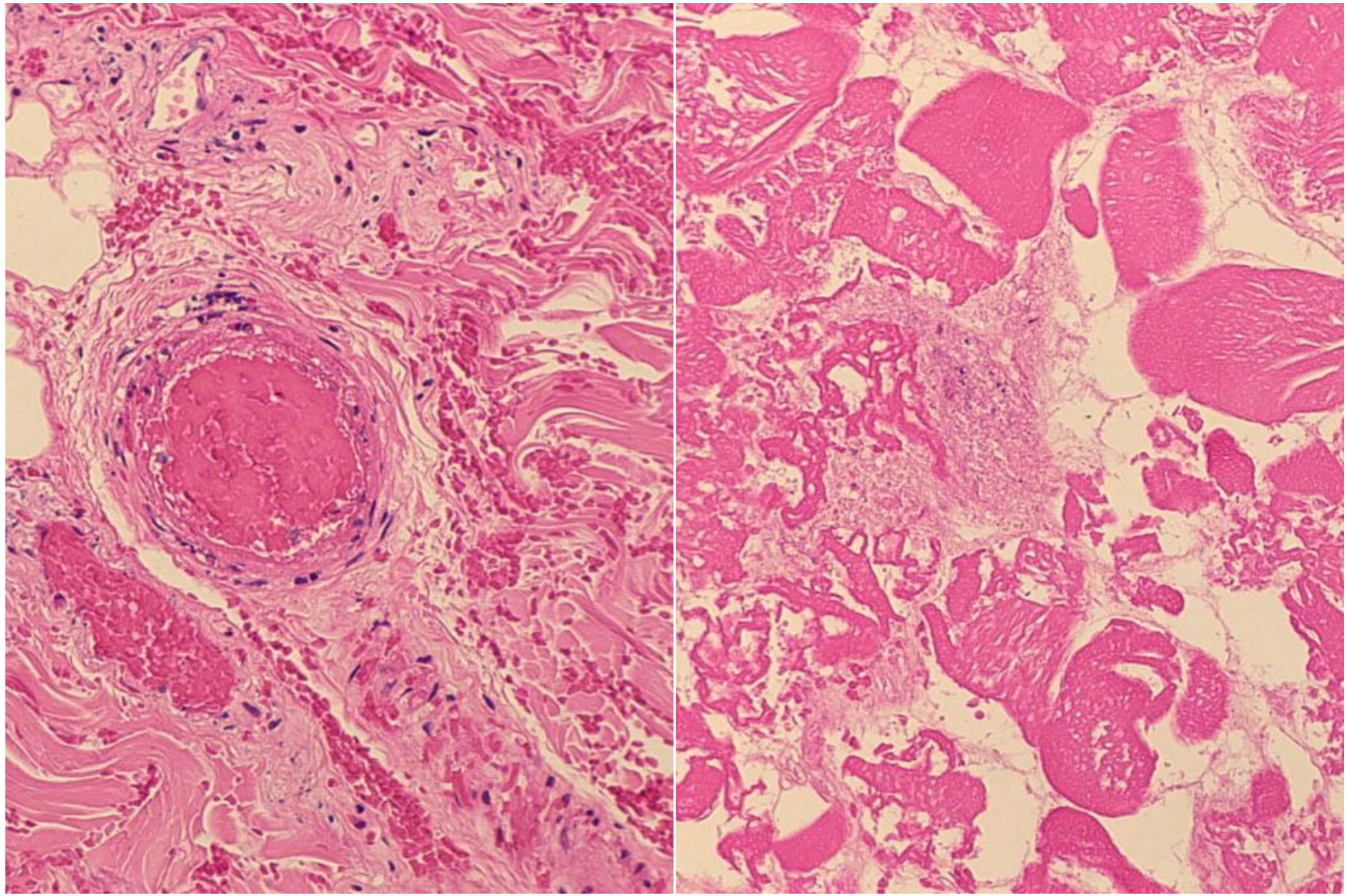
2) Pancreatic gas gangrene

3) Intestinal gas gangrene

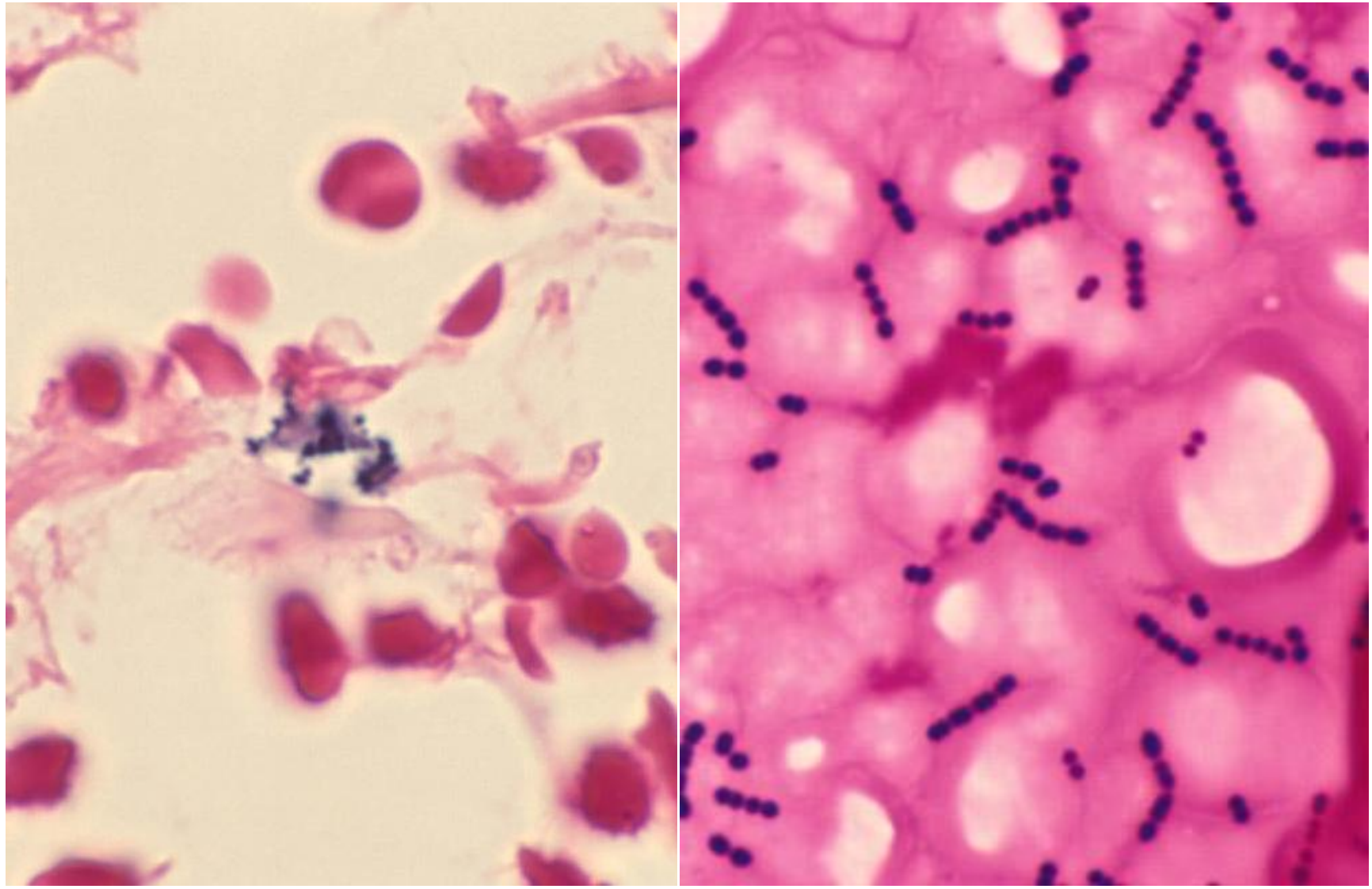
Fulminant β-hemolytic streptococcal infection of Fournier gangrene type seen in a male patient aged 30's. Progressive gangrenous necrosis with hemorrhage extends from the scrotum through the groin to the left thigh.

Fulminant β-hemolytic streptococcal infection of Fournier gangrene type seen in a male patient aged 30's. Progressive gangrenous necrosis with hemorrhage necessitated emergency amputation of the left leg, but the procedure could not save his life.

Fulminant β-hemolytic streptococcal infection of Fournier gangrene type seen in a male patient aged 30's. Progressive gangrenous necrosis with hemorrhage extends from the scrotum to the groin, where erosive change is associated.

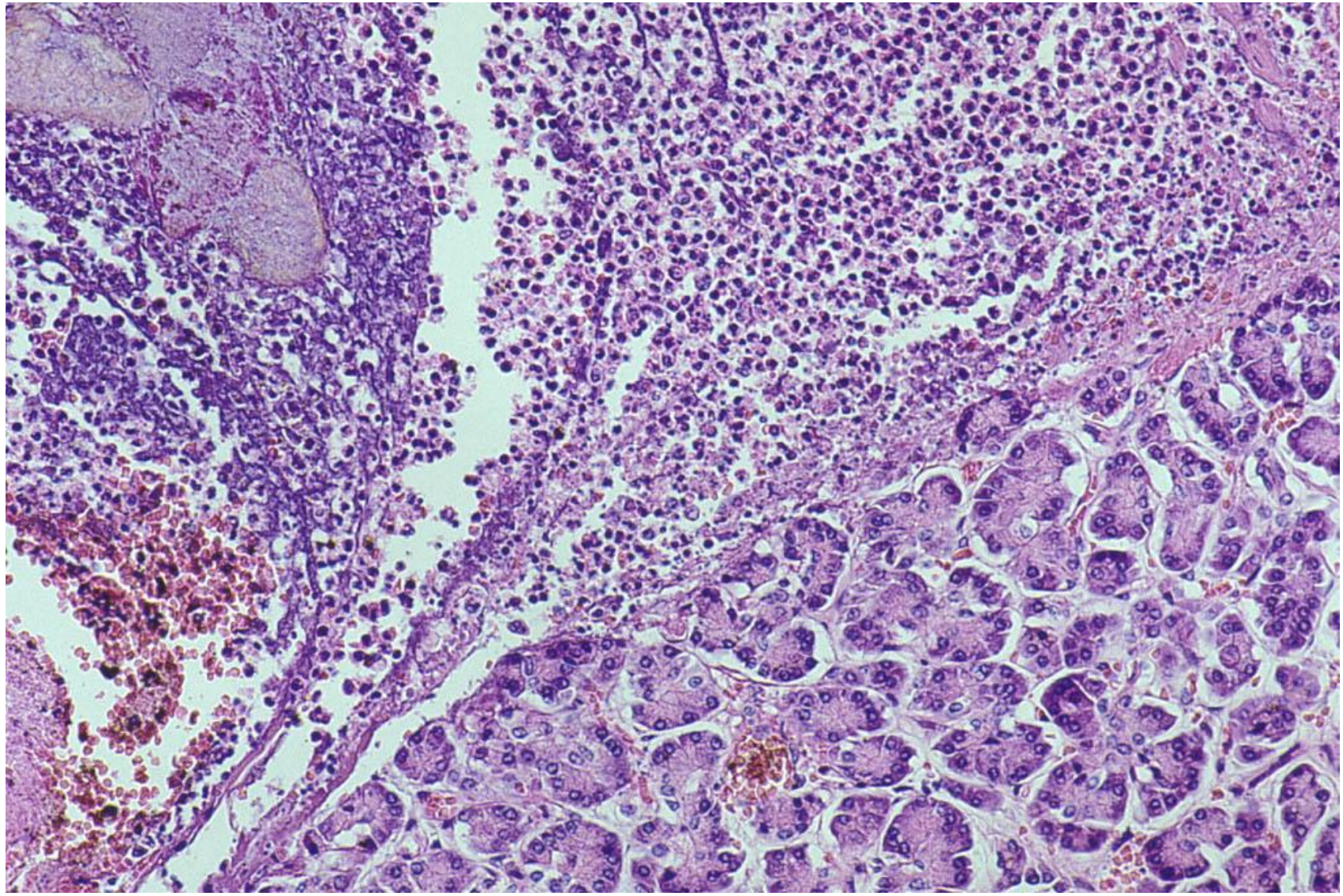


Fulminant β-hemolytic streptococcal infection of Fournier gangrene type seen in a male patient aged 30's. Emergency amputated left leg microscopically shows thrombosis (left) and massive myonecrosis (right) (H&E).

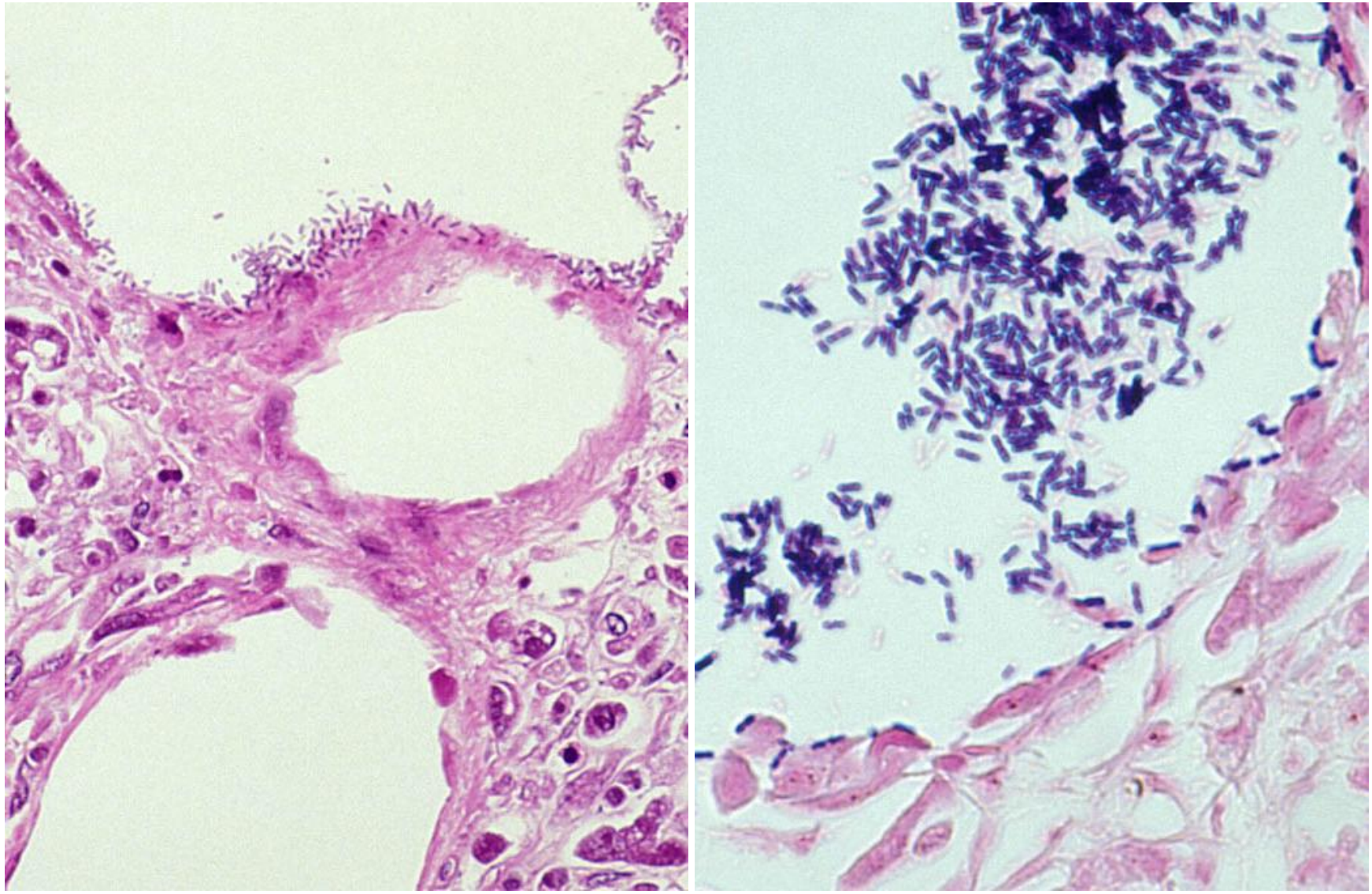


Fulminant β-hemolytic streptococcal infection of Fournier gangrene type seen in a male patient aged 30's. Gram-positive cocci grow in the necrotic striated muscle tissue (left). Cultured blood reveals the growth of chained Gram-positive cocci, representing streptococci (Gram).

Clostridial pancreatitis. A 66 y-o male businessman with diabetes mellitus complained of acute abdominal pain. Marked elevation of serum amylase level was confirmed. CT scan revealed gas formation in the pancreatic head. The patient died in 23 hours.

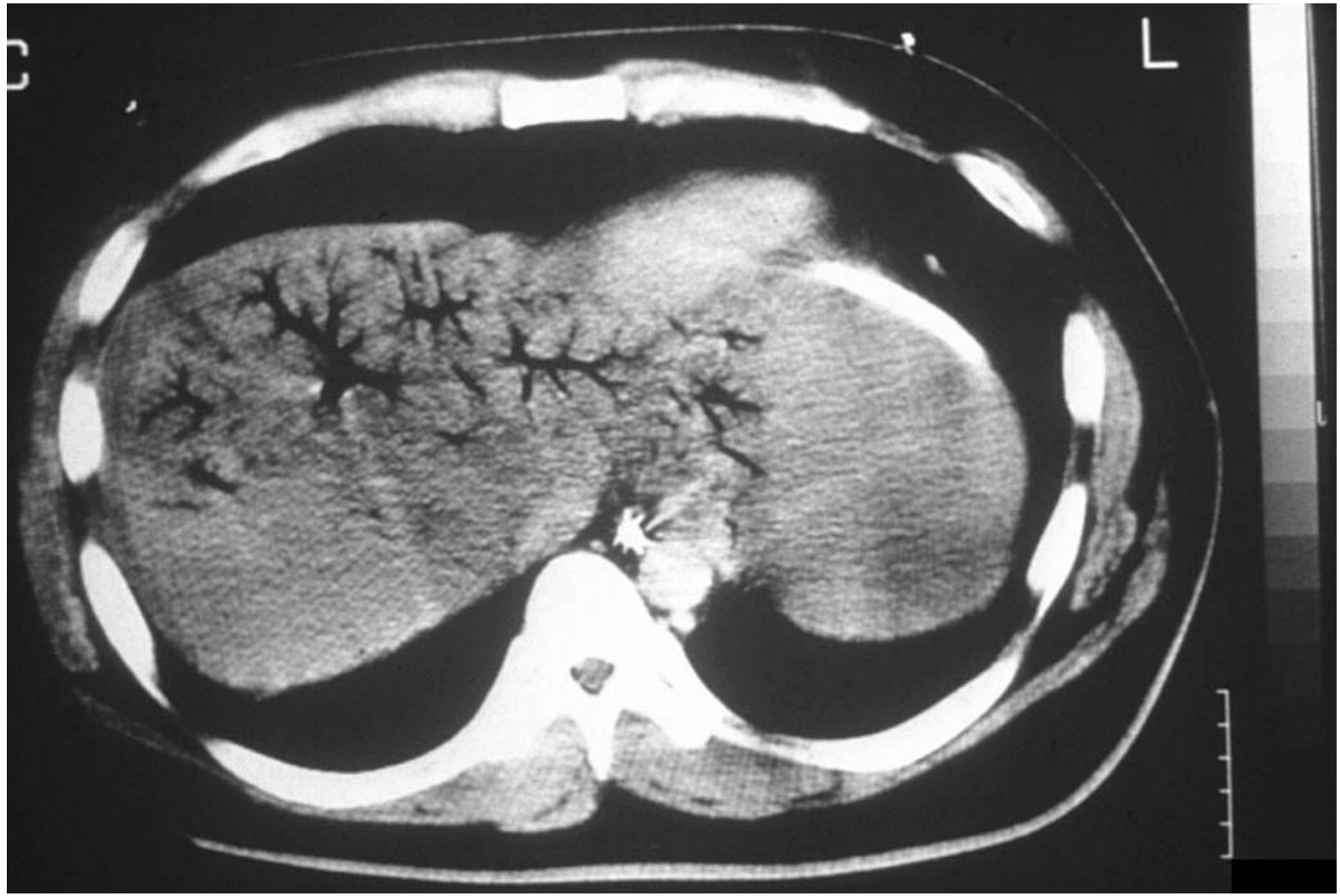


Clostridial pancreatitis seen in a 66 y-o male businessman with diabetes mellitus (H&E). At autopsy, neutrophilic infiltration is evident in the pancreas, confirming the diagnosis of acute pancreatitis.

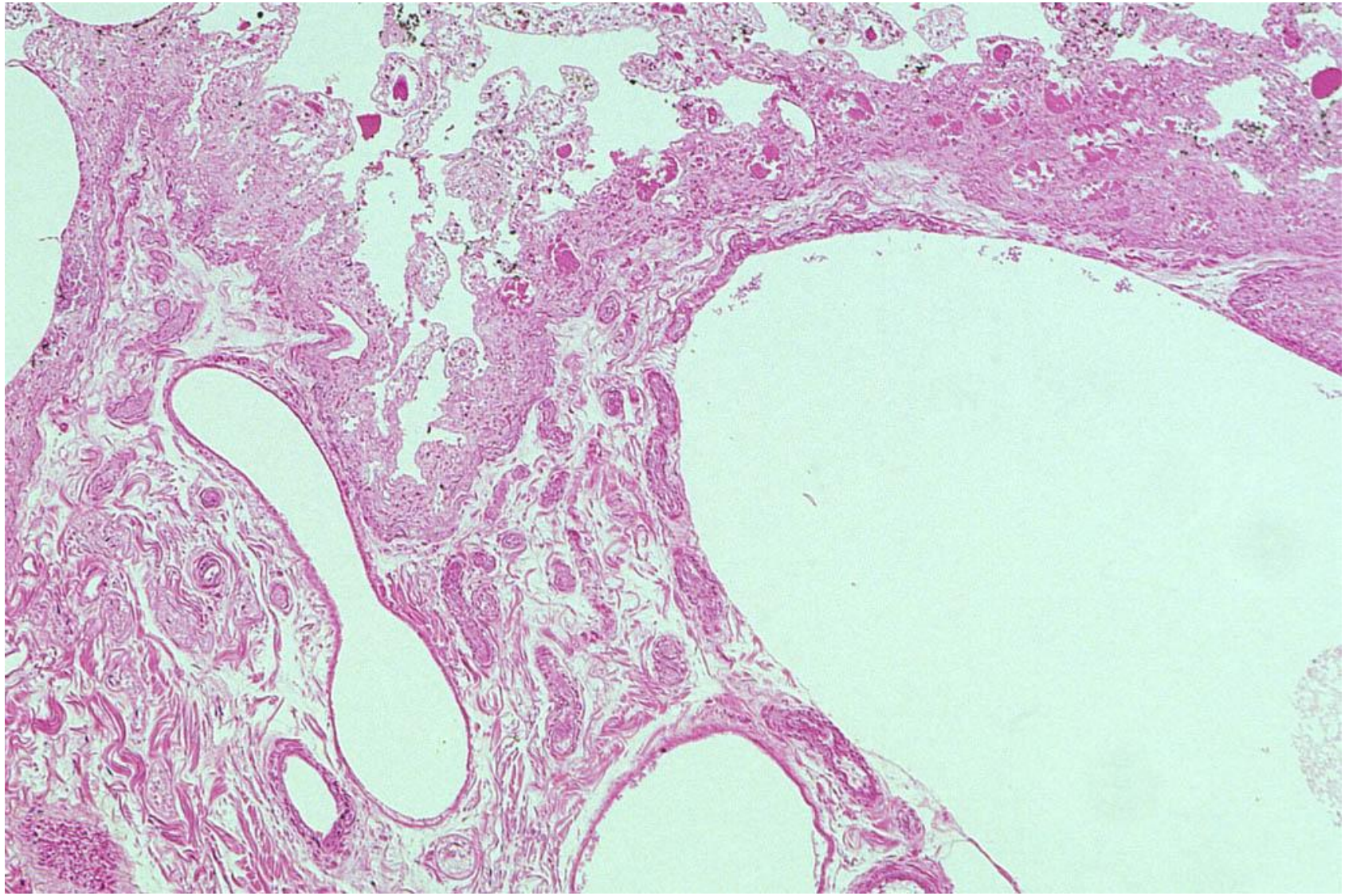


Clostridial pancreatitis seen in a 66 y-o male businessman with diabetes mellitus (left: H&E, right: Gram). At autopsy, gas bubble formation is seen in the pancreas, and growth of Gram-positive rods is evident in the gas bubble, confirming the diagnosis of clostridial pancreatitis (pancreatic gas gangrene).

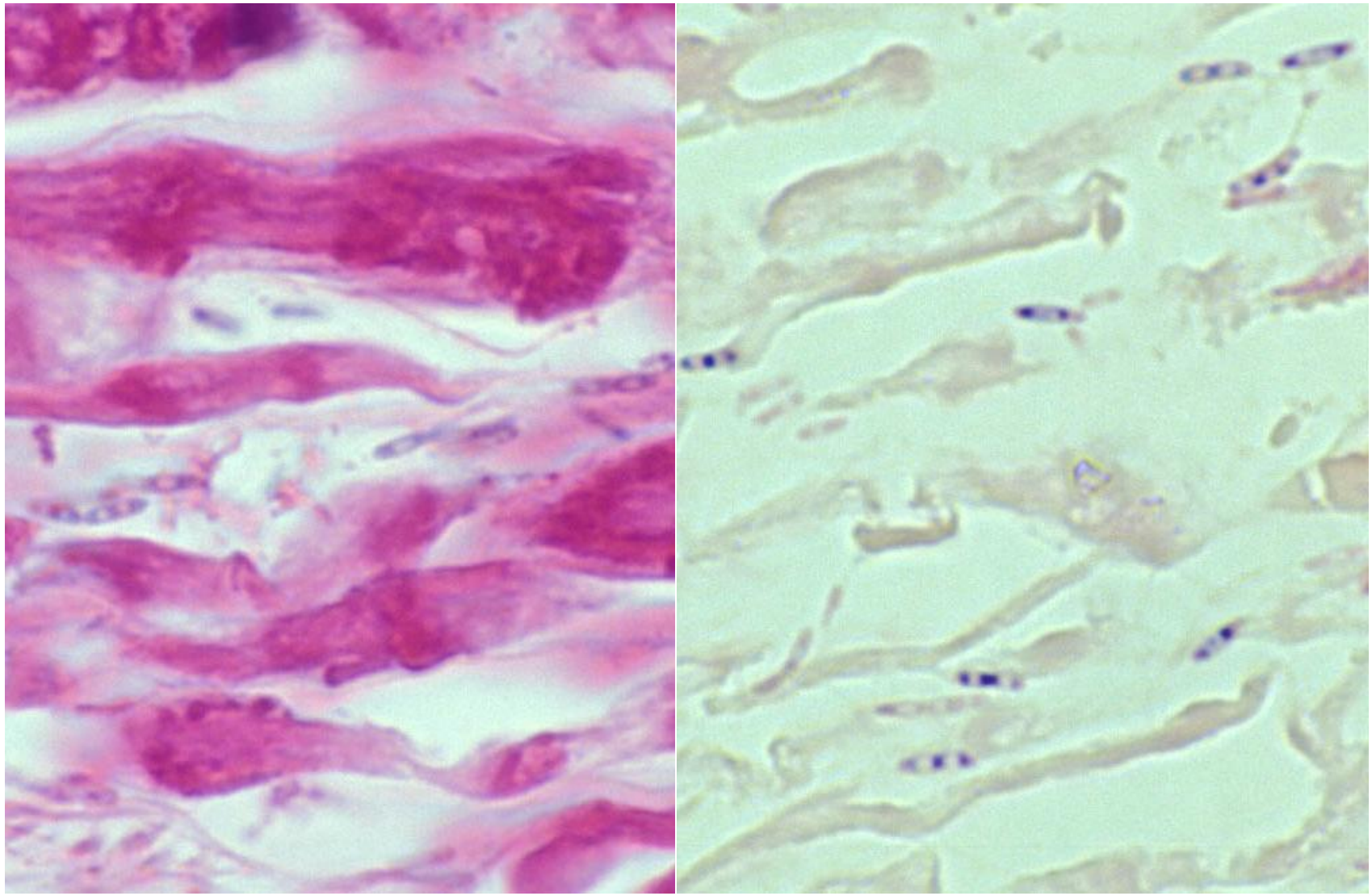
Clostridial pancreatitis seen in a 66 y-o male businessman with diabetes mellitus (left: H&E, right: Gram). The cut surface of the liver after formalin fixation reveals diffuse gas bubble formation (called "foamy liver"), confirming the transportal dissemination of *Clostridium perfringens* to the liver.



A 31 y-o man with severe type 1 diabetes mellitus manifested massive small bowel necrosis due to thrombosis of the superior mesenteric artery. The involved bowel wall showed pneumatosis, and portal vein gas embolism is seen in the CT scan. The small bowel, 2 m in length, was emergency resected. Microbial culture of the blood was positive for *Clostrisium butyricum*. He is alive 6 years after surgery.



A 31 y-o diabetic man received emergency small bowel resection (2 m in length). The involved bowel wall microscopically shows marked pneumatosis (pneumatosis cystoides intestinalis). Mucosal necrosis is evident (H&E).

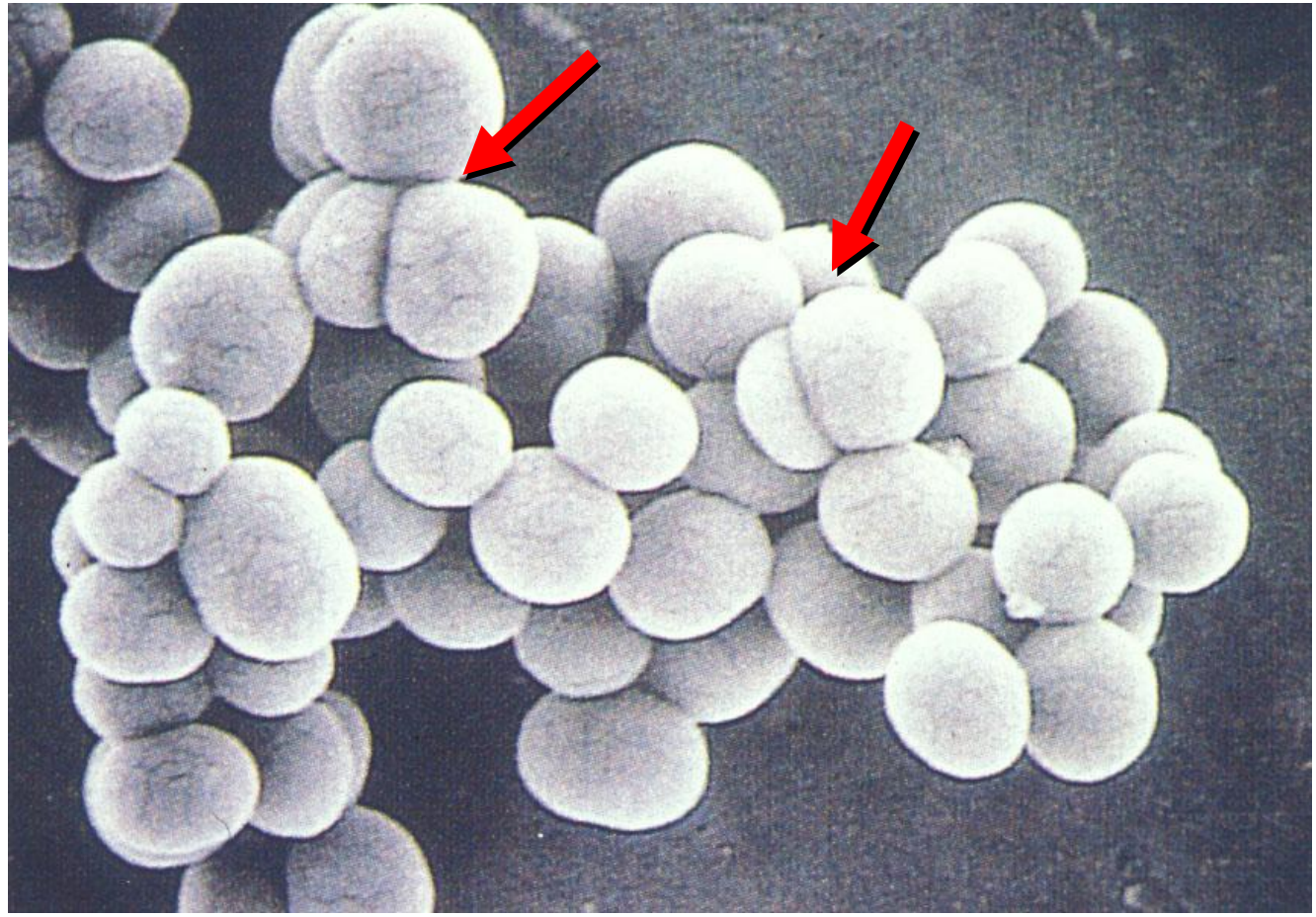


A 31 y-o diabetic man received emergency small bowel resection (2 m in length). The proper muscle layer of the involved bowel wall microscopically shows the growth of Gram-positive rods frequently with spore formation (left: H&E, right: Gram). The morphology is consistent with *Clostridium butyricum* infection.

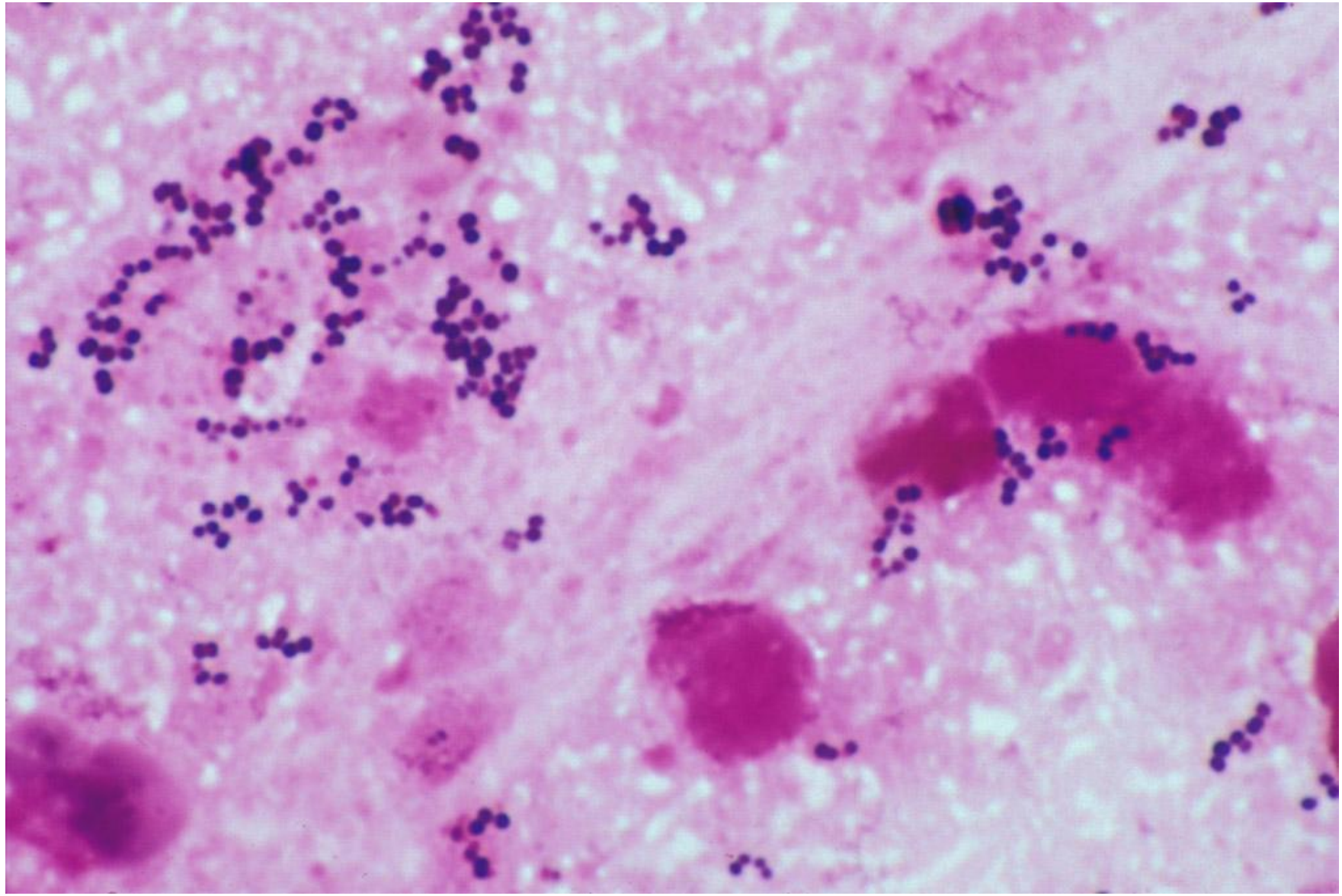
Hospital-acquired MRSA infection

MRSA: Methicillin-resistant *Staphylococcus aureus*

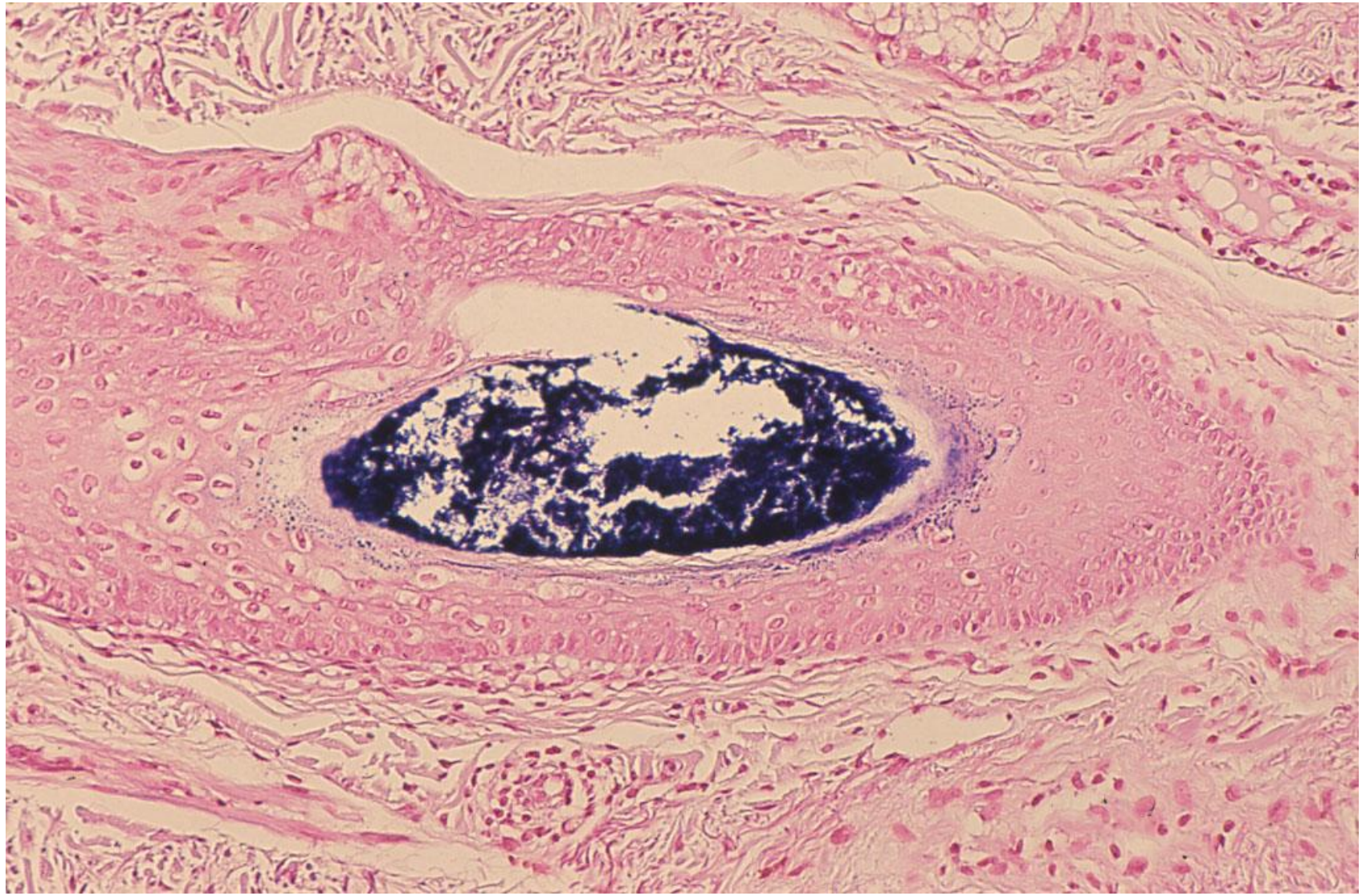
Post-operative patients are particularly susceptible to nosocomial infection of MRSA



Scanning EM features of MRSA growing with a binary divisions



MRSA seen in the sputum smear preparation: MRSA pneumonia (Gram)

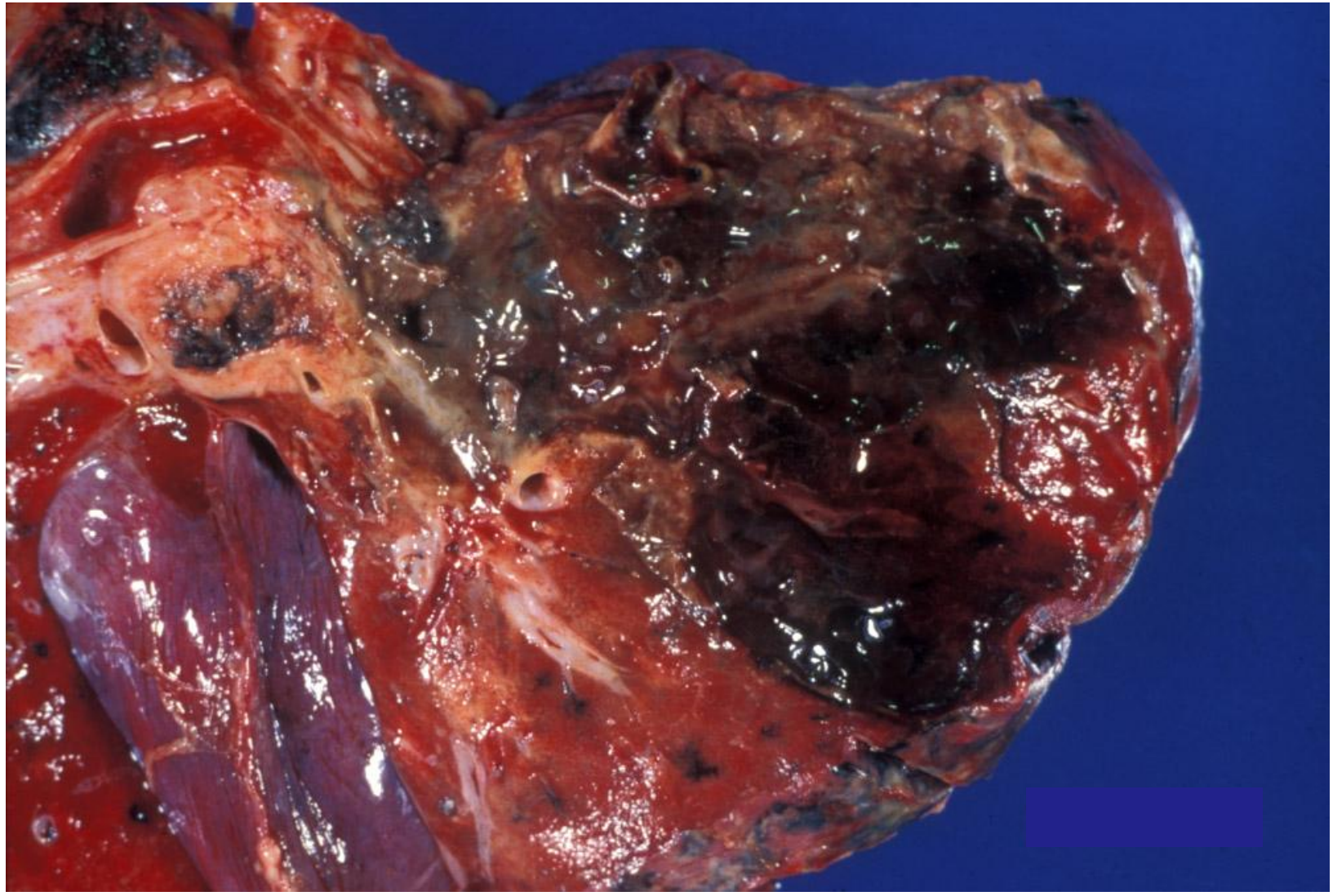


A normal hair follicle of the facial skin (Gram). Gram-positive cocci colonize the lumen of the hair follicle.

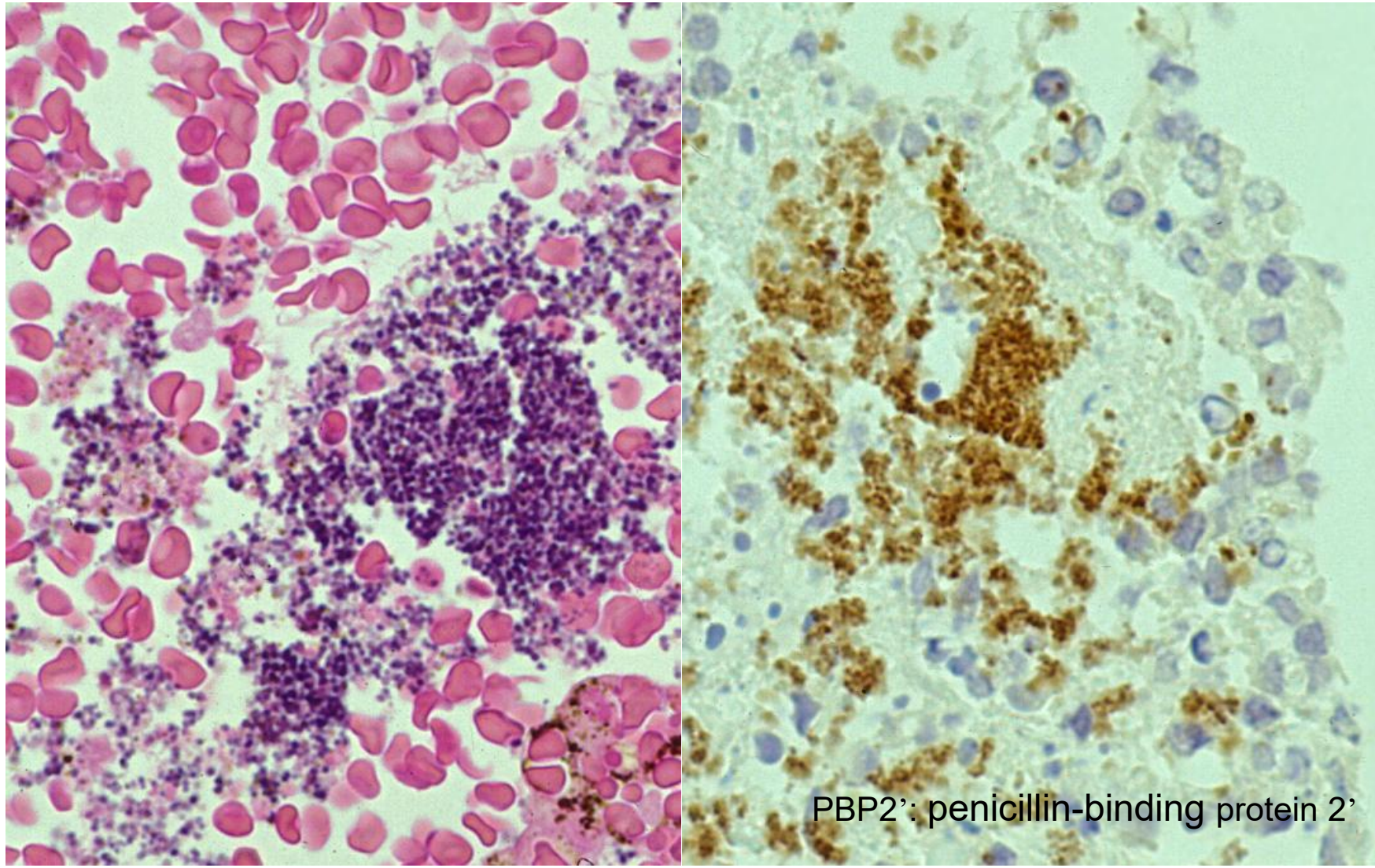
Nosocomial infection of MRSA Case 1 in 1997

Case: 76 y-o male patient
July, 1989: Y-graft replacement for abdominal aortic aneurysm
April, 1995: Artificial vessel replacement for aneurysm of distal aortic arch, with reconstruction of the left subclavian artery
Post-operative days: MRSA pneumonia. Tracheostomy performed
January, 1997: Closure of tracheostomy. Compression fracture of lumbar spine complicated. MRSA pneumonia recurred
May, 1997: Death with massive hemoptysis

Autopsy findings
1) MRSA-induced left lung abscess with left hemothorax
2) Suppurative myelitis of the spine
3) MRSA septicemia with acute splenitis



Gross appearance of MRSA pneumonia: a hemorrhagic lung abscess

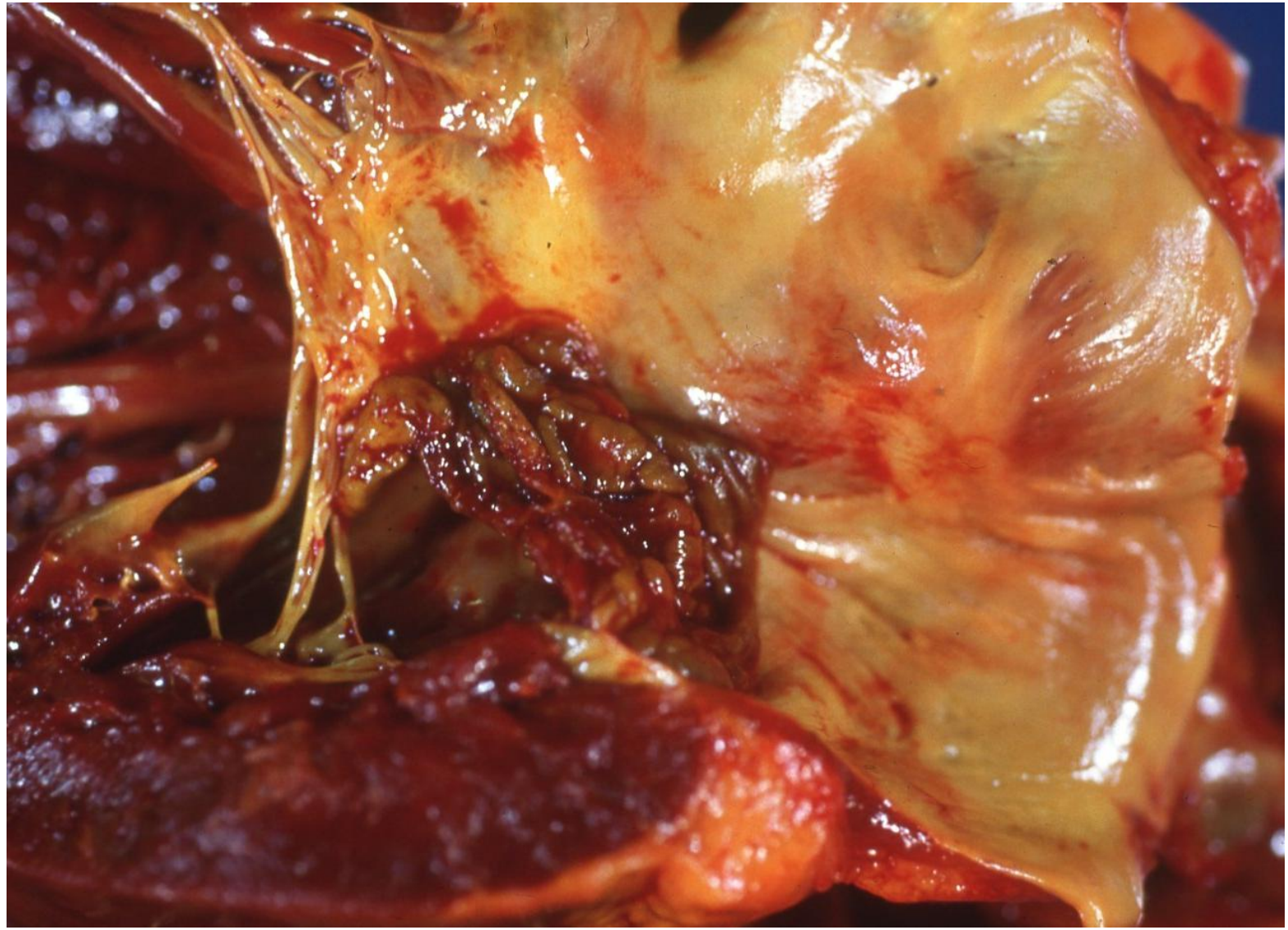


Microscopic features of MRSA pneumonia. The cocci colonized in the abscess cavity (left: H&E) are immunoreactive for PBP2' (penicillin-binding protein-2'), giving the Methicillin resistance to the cocci (right).

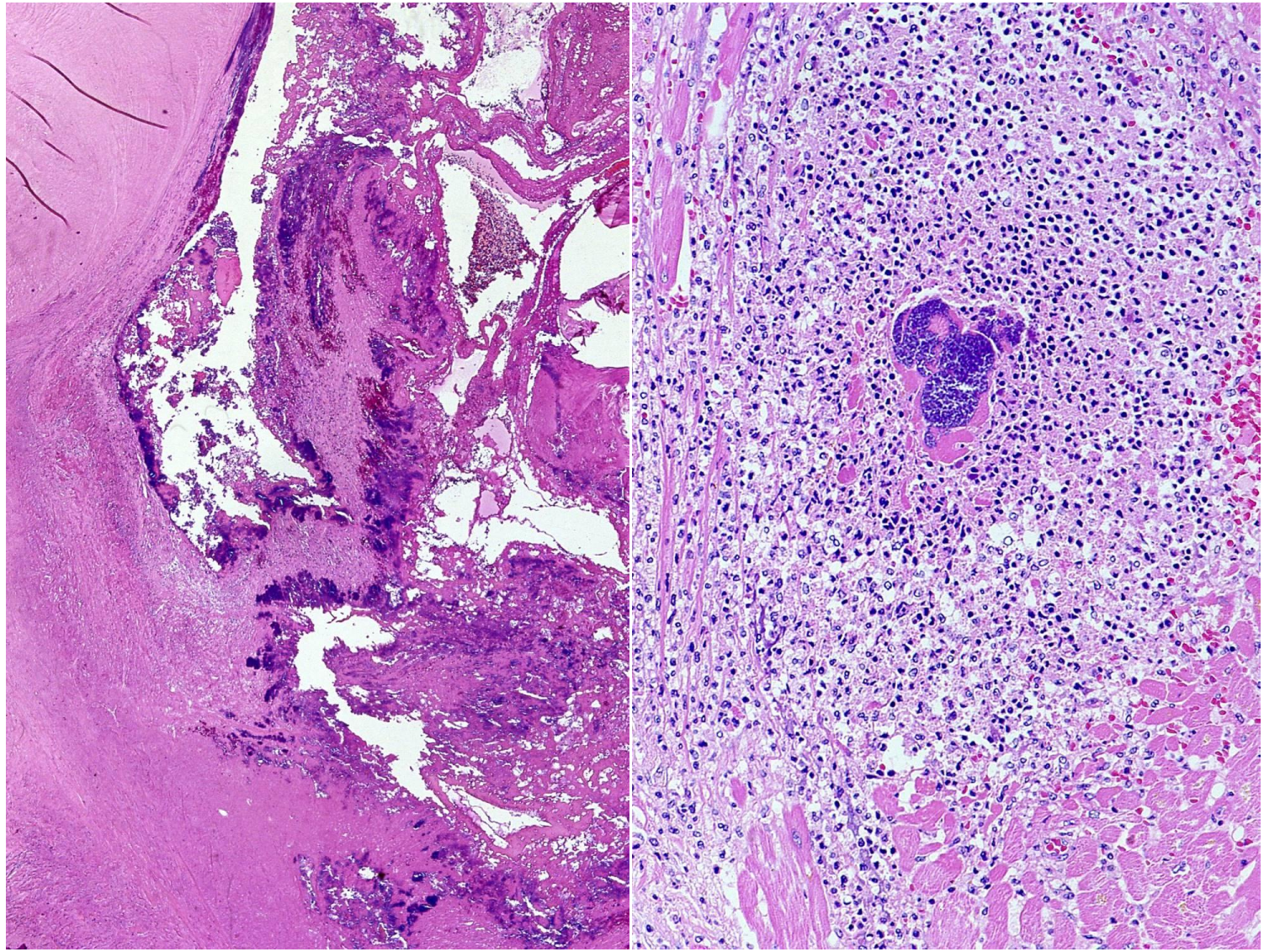
Nosocomial infection of MRSA, Case 2 in 1997

Case: 59 y-o male patient
October, 1997: Accidental trauma (the left leg pinched by a constructive roller)
Open fracture of the left leg with injury of left popliteal artery.
Emergency reconstruction surgery for the artery done.
Post-operative days: Local MRSA infection with an unstable circulatory status
POD-18: Fever appeared. The blood culture: positive for MRSA.
POD-27: Amputation of the left lower leg
POD-37: Acute renal failure
POD-59: Death by pneumonia with pulmonary edema

Autopsy findings:
1) MRSA endocarditis of the mitral valve
2) Mycotic embolism of the mesenteric artery with small bowel infarction
3) Purulent peritonitis
4) Secondary multifocal infarctions in the kidney, heart and spleen



Gross appearance of MRSA endocarditis of the mitral valve, causing lethal MRSA septicemia.



MRSA endocarditis of the mitral valve, causing lethal MRSA septicemia (left: H&E). Microabscess is formed in the myocardium (right: H&E).

Nosocomial MRSA infection in autopsy cases (1997-1998)

Autopsy cases analyzed: n=208

Microbial culture performed, n=153 (74%)

Heart blood, n=132 (63%)

Tissue/body fluid, n=43 (21%)

MRSA infection detected	pneumonia	enteritis	septicemia
Definite cases: n=20 (9.6%)	7	1	20
Probable cases: n=9 (4.3%)	9	2	1
Suspicious cases: n=3 (1.4%)	0	0	3
Local colonization: n=3 (1.4%)	2	1	0

MRSA infection (definite and probable cases), n=29

Main lesions: malignant lesions n=11, non-malignant lesions n=18

Sex: male n=23, female n=6

Age: 47-87 years (mean: 68.5)

Hospitalization days: 2-650 days (mean 101, median 59)

≤7 days n=3, 8-30 days n=5, 31-90 days n=12, 91 days-1 year n=7, ≥1 year n=2

Biohazards in pathology practice

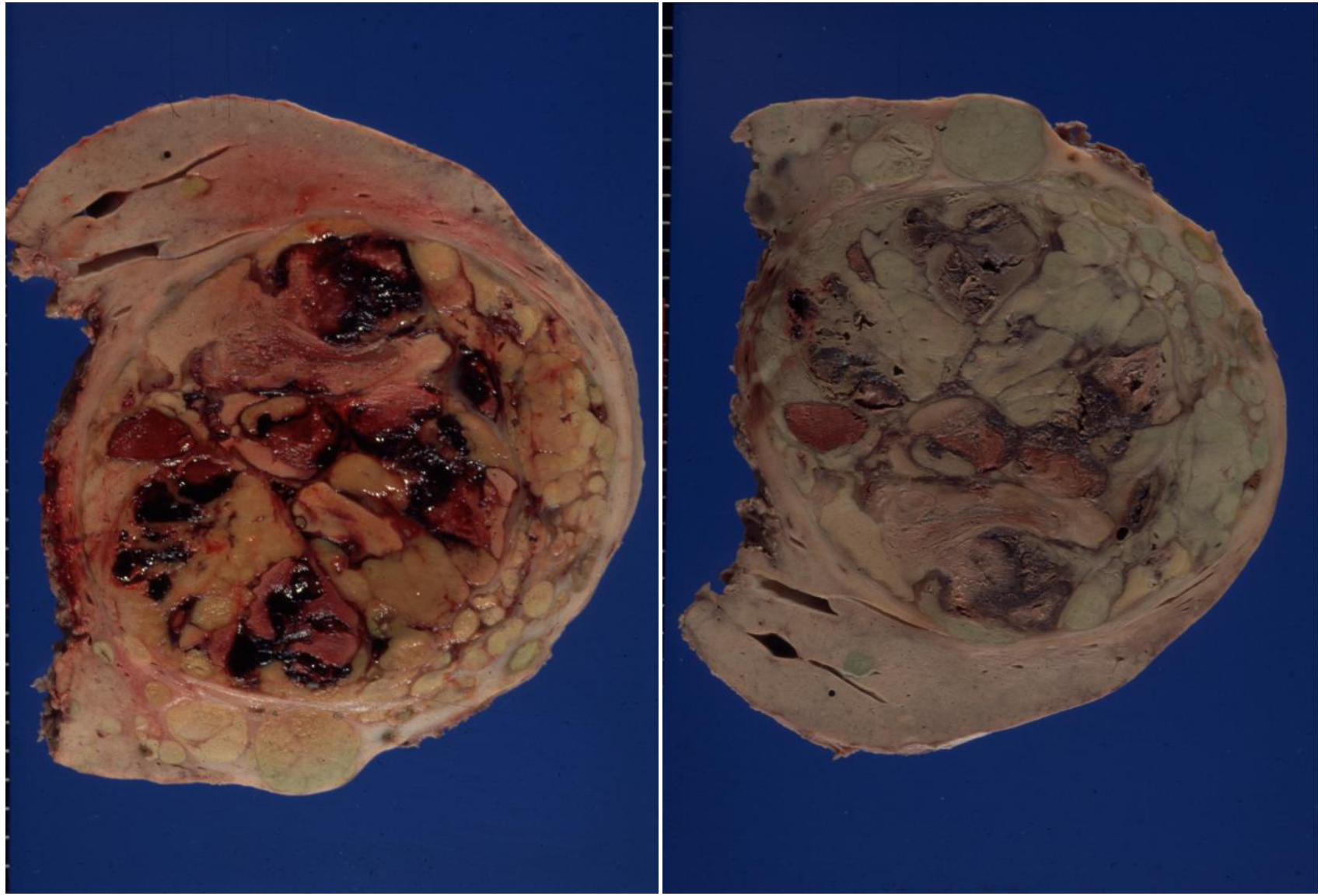
1) Autopsy of active tuberculosis

2) Intraoperative consultation for tuberculous nodular lung lesions

3) Cytology evaluation for the sputum and bronchial scraping

4) Cut wound (stab incision) during autopsy or tissue sampling

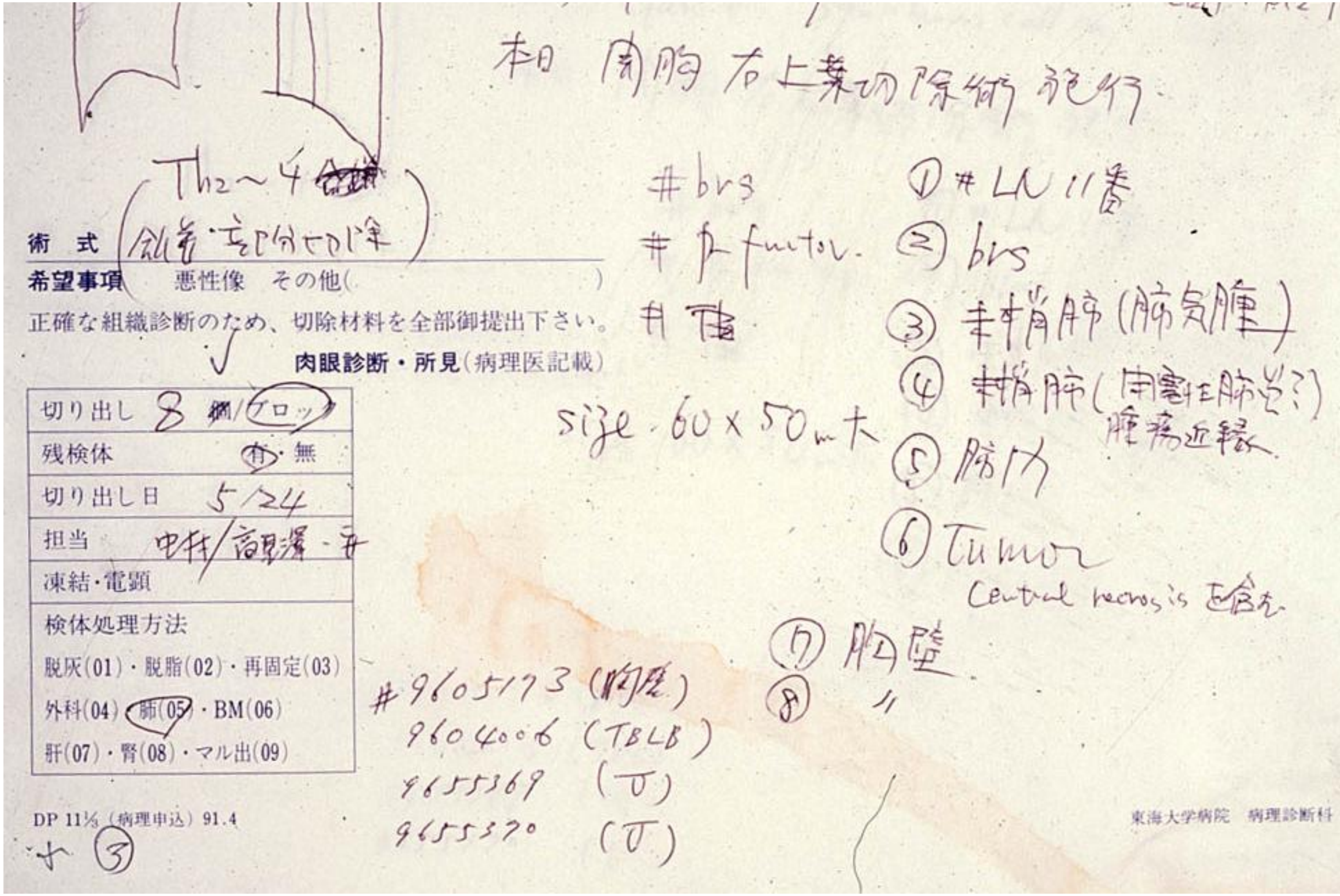
(Mycobacteria and hepatitis viruses may not be inactivated in poorly fixed liver tissue)



Cut surface of hepatocellular carcinoma with HCV-induced liver cirrhosis. The surgical material was soaked without cutting in formalin overnight, and then sliced for tissue sampling. The fixation was poor (left). Further fixation for 1 more day completed fixation (right).

Incidence rates of infection by needle stick accident

Hepatitis B virus (HBV) (in HBe antigen-positive case)	30%
Hepatitis C virus (HCV)	3%
Human immunodeficiency virus (HIV)	0.3%



本日 開胸 右上葉切除術 施行

術 式 (Th2~4 … 部分切除)

希望事項 悪性像 その他( )

正確な組織診断のため、切除材料を全部御提出下さい。

肉眼診断・所見（病理医記載）

切り出し	8 個/ブロック
残検体	有・無
切り出し日	5/24
担当	
凍結・電顕	
検体処理方法 脱灰(01)・脱脂(02)・再固定(03) 外科(04)・肺(05)・BM(06) 肝(07)・腎(08)・マル出(09)	

#brs
… factor
size 60 x 50 mm 大

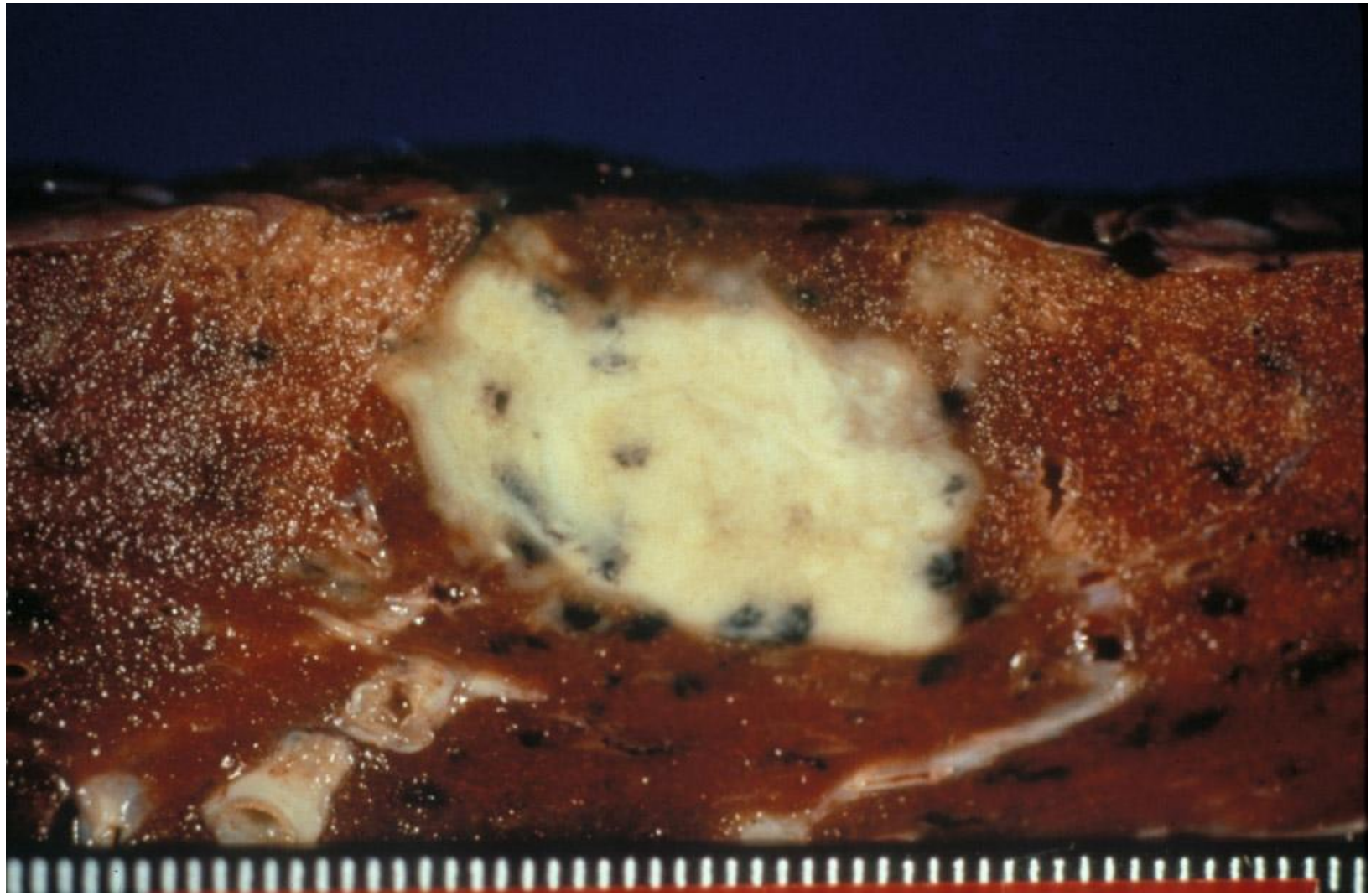
① #LN 11番
② brs
③ 末梢肺(肺気腫)
④ 末梢肺(閉塞性肺炎?) 腫瘍近縁
⑤ 肺門
⑥ Tumor central necrosis 含む
⑦ 胸壁
⑧ 〃

#9605173
9604006 (TBLB)
9655369 (T)
9655370 (T)

DP 11⅓ (病理申込) 91.4

東海大学病院 病理診断科

No thanks for such a form for the histopathology diagnosis as stained with blood! HBV will resist against the dryness.



Gross appearance of the cut surface of lung tuberculosis after formalin fixation. A localized subpleural nodule with caseous necrosis is shown. Caseous necrosis is a type of coagulation necrosis, and therefore the pre-existing lung structures are preserved. Black-pigmented (anthracotic) bronchioles are observed within the lesion. No pleural indentation is seen. In contrast, lung cancer (particularly adenocarcinoma) often shows central scarring and pleural indentation.

To avoid biohazard of tuberculosis during intraoperative pathology diagnosis services

A coin lesion of the lung may be submitted to the pathology division for intraoperative frozen section diagnosis, in order for distinguishing from lung cancer.

Frozen sections should not be prepared, when the pathologist judge grossly that the lesion is tuberculous in nature.

Mycobacterium tuberculosis will survive in the cryochamber of the cryostat kept at −20℃.