Various features of tuberculosis and biohazard by *Mycobacterium tuberculosis*

Infectious diseases of healthcare workers contracted through healthcare practices are called occupational infections. *Mycobacterium tuberculosis*, transmitted by inhaling contaminated air; i.e. "airborne transmission“, is the most serious pathogen for pathologists who perform autopsy. It is important for the pathologists to recognize gross appearance of tuberculosis in order to avoid the biohazard. Various features of tuberculosis are presented herein.

Ref.: Tsutsumi Y. Occupational risk of tuberculosis in pathology. 2003; https://pathos223.com/en/review.htm#Occupational

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)

The risk of pathogens

1) Pathogenicity of the pathogen
   (potential for causing infection)
2) Resistance of the host (immunity)
3) Presence of absence of treatment

Resistance of pathogens against disinfectants

Common bacteria
Yeast-type fungus
< Hypha-forming fungus
< *M. Tuberculosis*
Enveloped virus
< Virus without envelop @
< Spore-forming bacteria
< Prion

@ Virus without envelop = hydrophilic virus

Examples: DNA virus excluding herpes viruses

Enteropathic RNA viruses such as rotavirus and enteroviruses

Among viruses, hepatitis B virus is most resistant.

Three principles of Countermeasures against infection

1) Source of infection	Isolation, in case of animal to human transmission
2) Route of infection	In case of human-to-human transmission
3) Susceptible host	Vaccination, preventive medicines

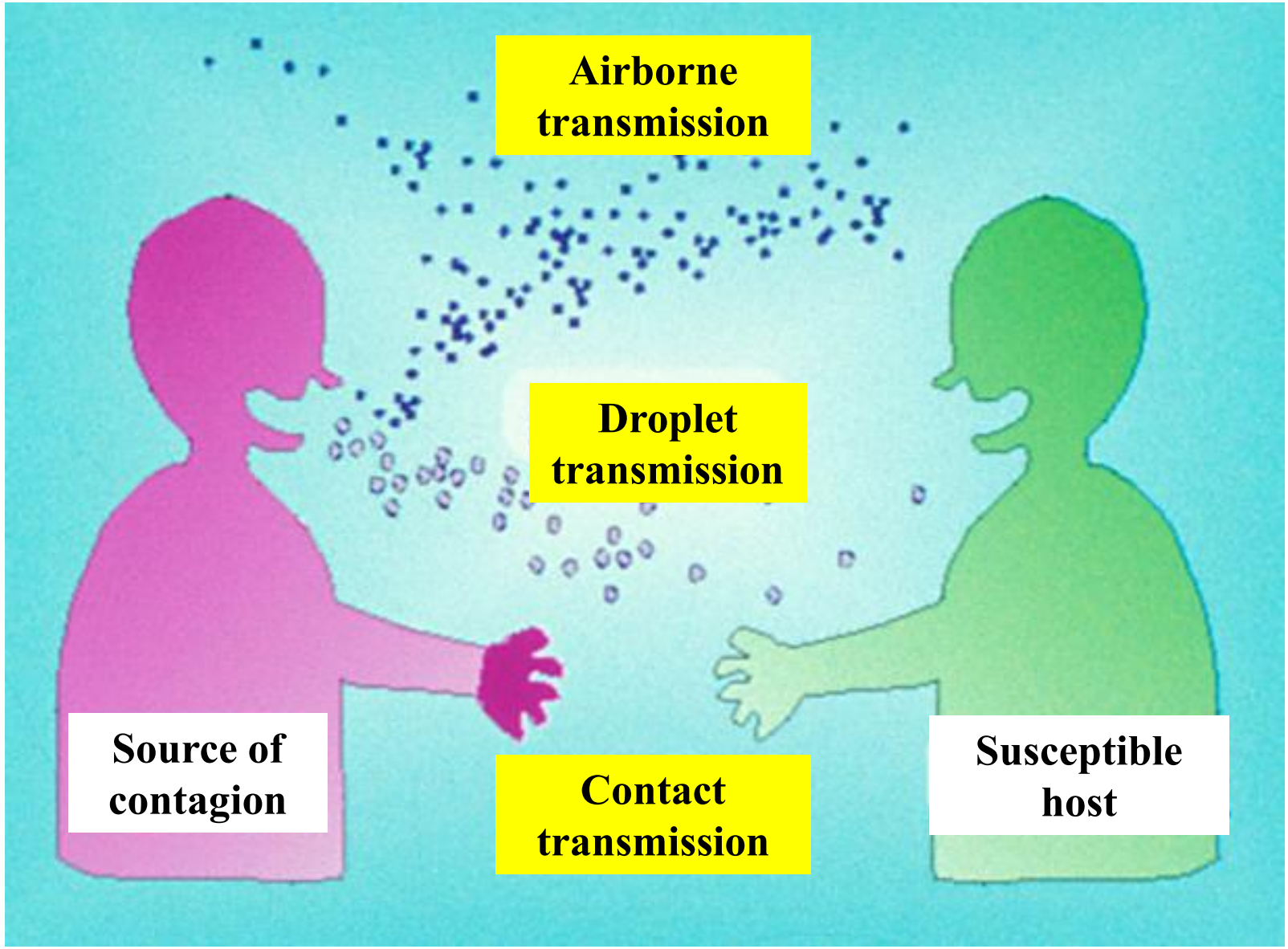
The concept of the "standard precautions"

Consider **hepatitis virus** and **AIDS** when you touch the **blood**.

Consider **tuberculosis** when you touch the **sputum**.

Consider **E. coli, O-157** when you touch the **stool**.

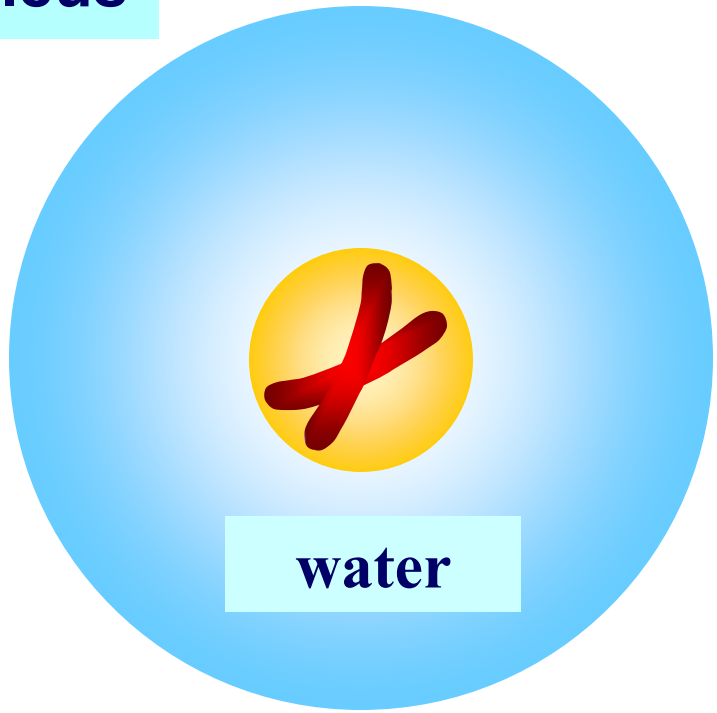
Consider **MRSA** when you touch the **face**.



Three main transmission routes of infection: Airborne, droplet and contact transmissions

Formation of droplet nucleus

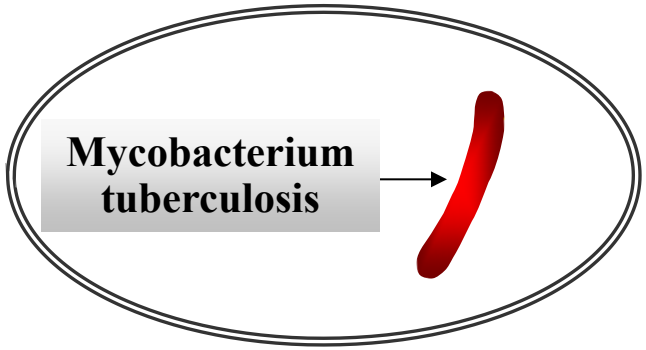
droplet



Diameter ≥5 μm

Falling velocity

30～80 ㎝/sec



Evaporation

droplet nucleus

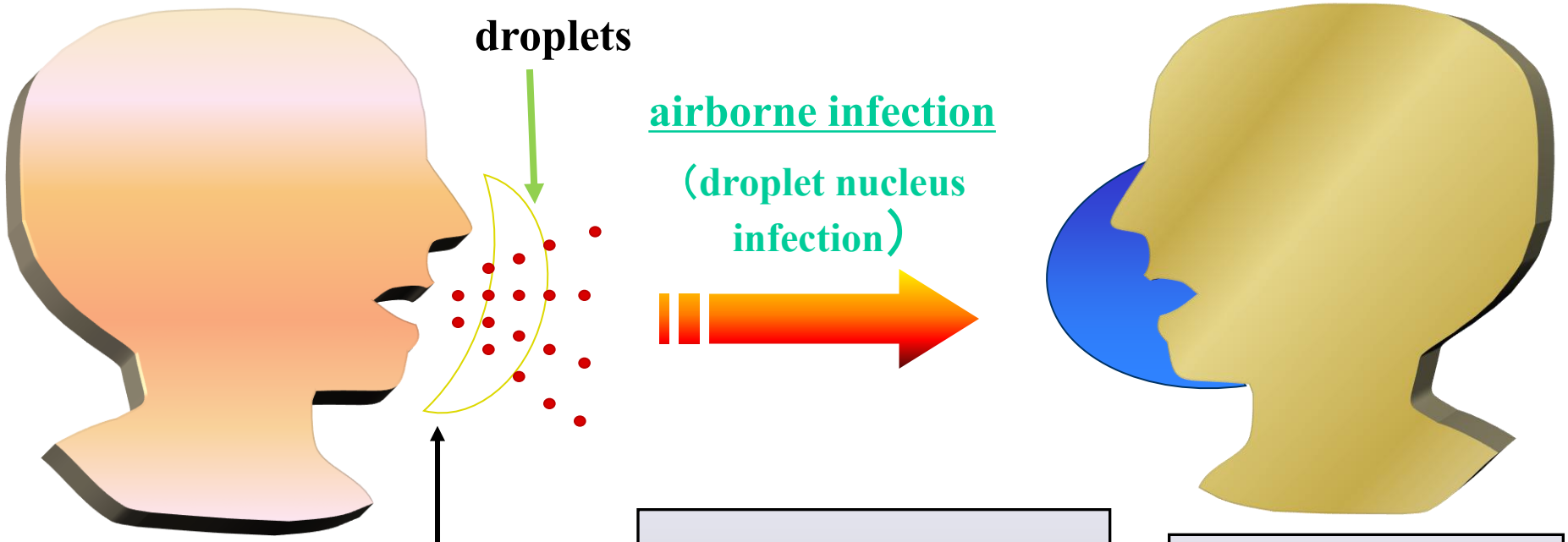
Diameter <5μm

Falling velocity 0.06～1.5 ㎝/sec

Protection against *Mycobacterium tuberculosis*

Patient discharging *M. tuberculosis*

Medical staff



Counter-measures

Gauze mask

Ventilation, ultraviolet light, HEPA filter

Particulate respirator N95

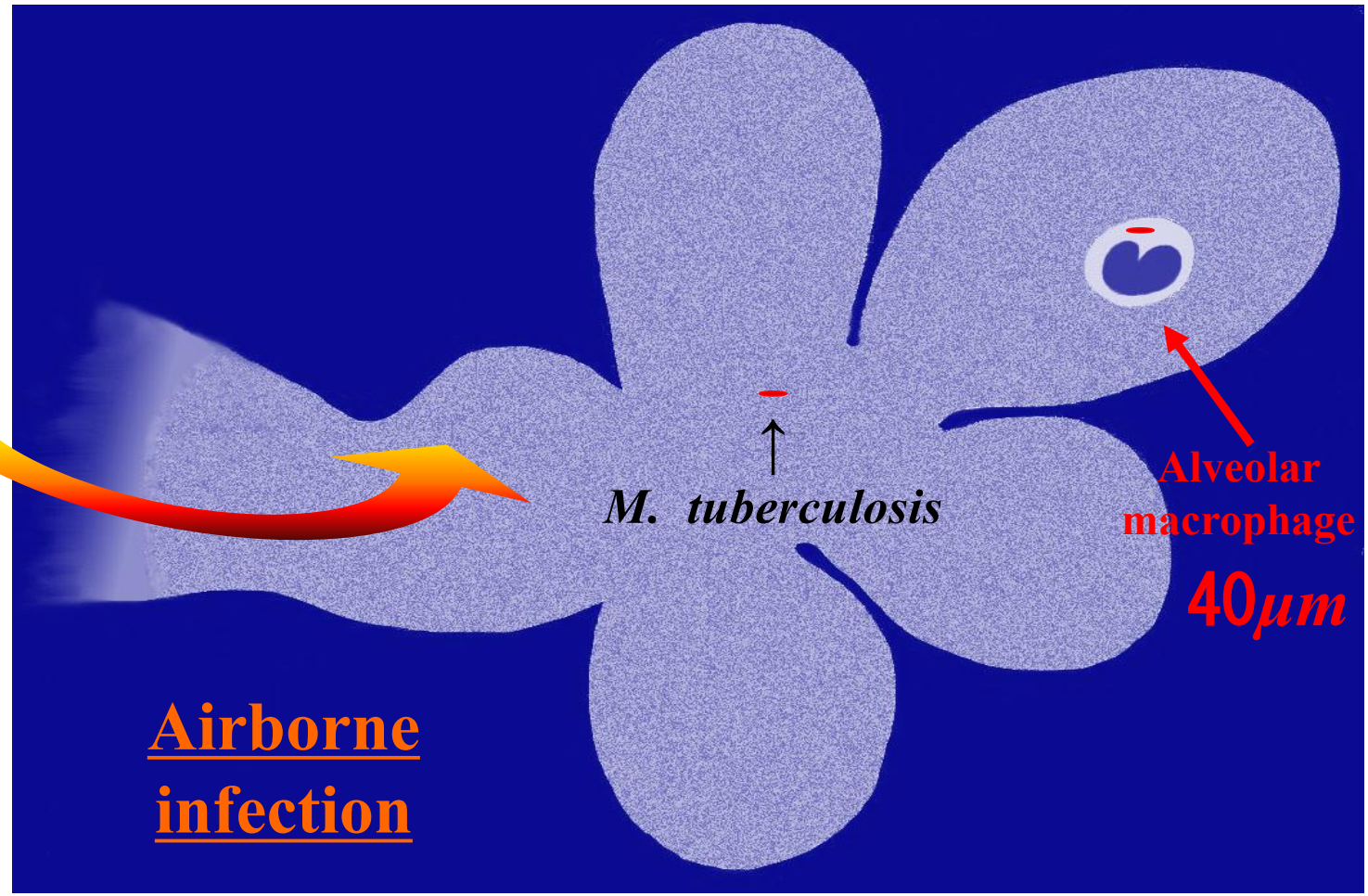
The size of *Mycobacterium tuberculosis*

2–4 *μm*

M. tuberculosis

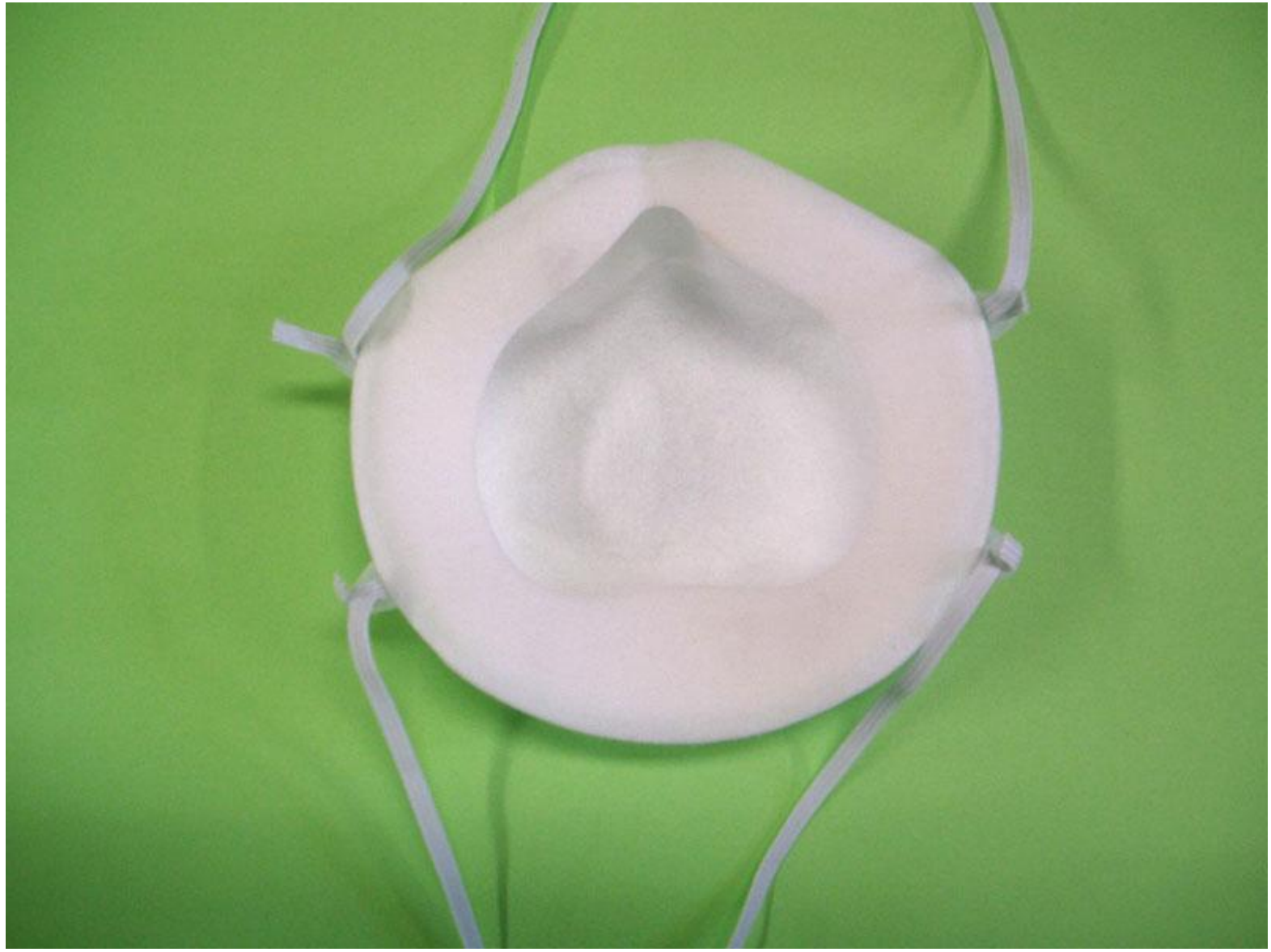
15*μm*

Neutrophil

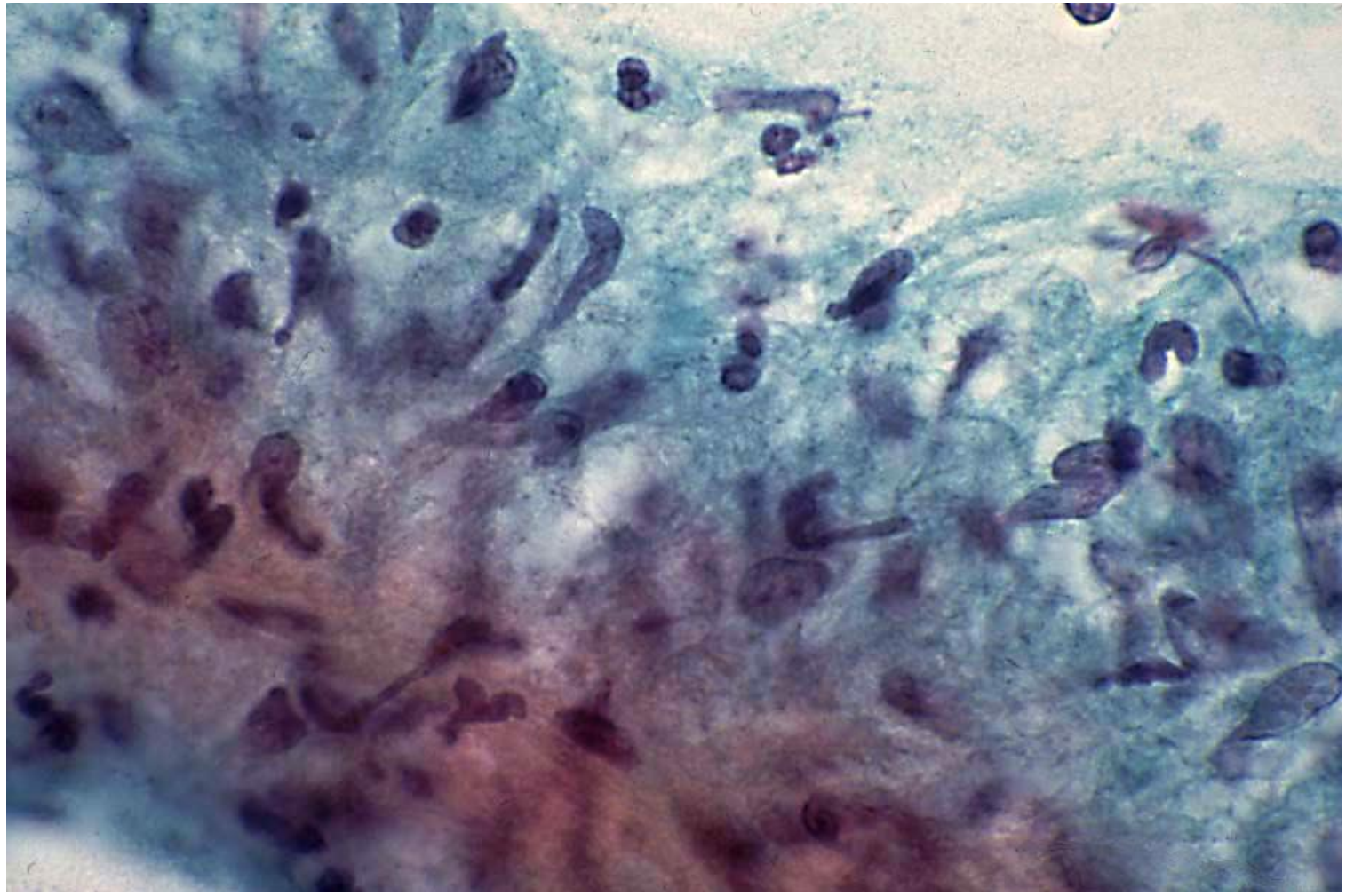


A resident wearing a hi-luck350 (particulate respirator N95). His wearing is not appropriate! The respirator should adhere onto the face closely.

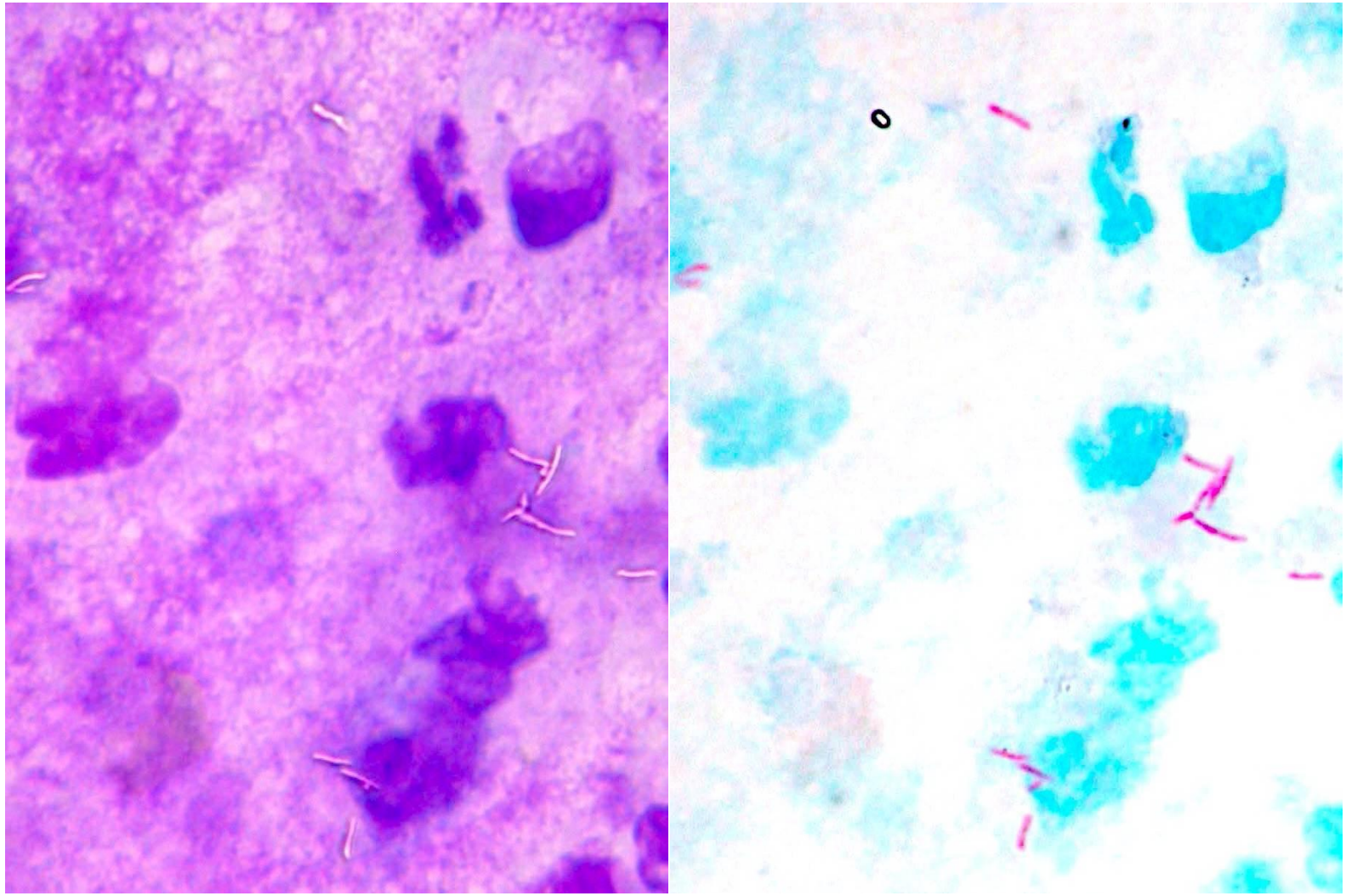
Left: Particulate respirator Hi-luck350 (N95-type mask wearable for a long time, Koken, Tokyo, Japan) , right: A simplified type N95-type particulate respirator, KFD-100 (Koken)



The inner part of the particulate respirator Hi-luck350 (N95-type mask wearable for a long time, Koken, Tokyo, Japan). The fit test is unnecessary, because of its fitness to the facial skin.



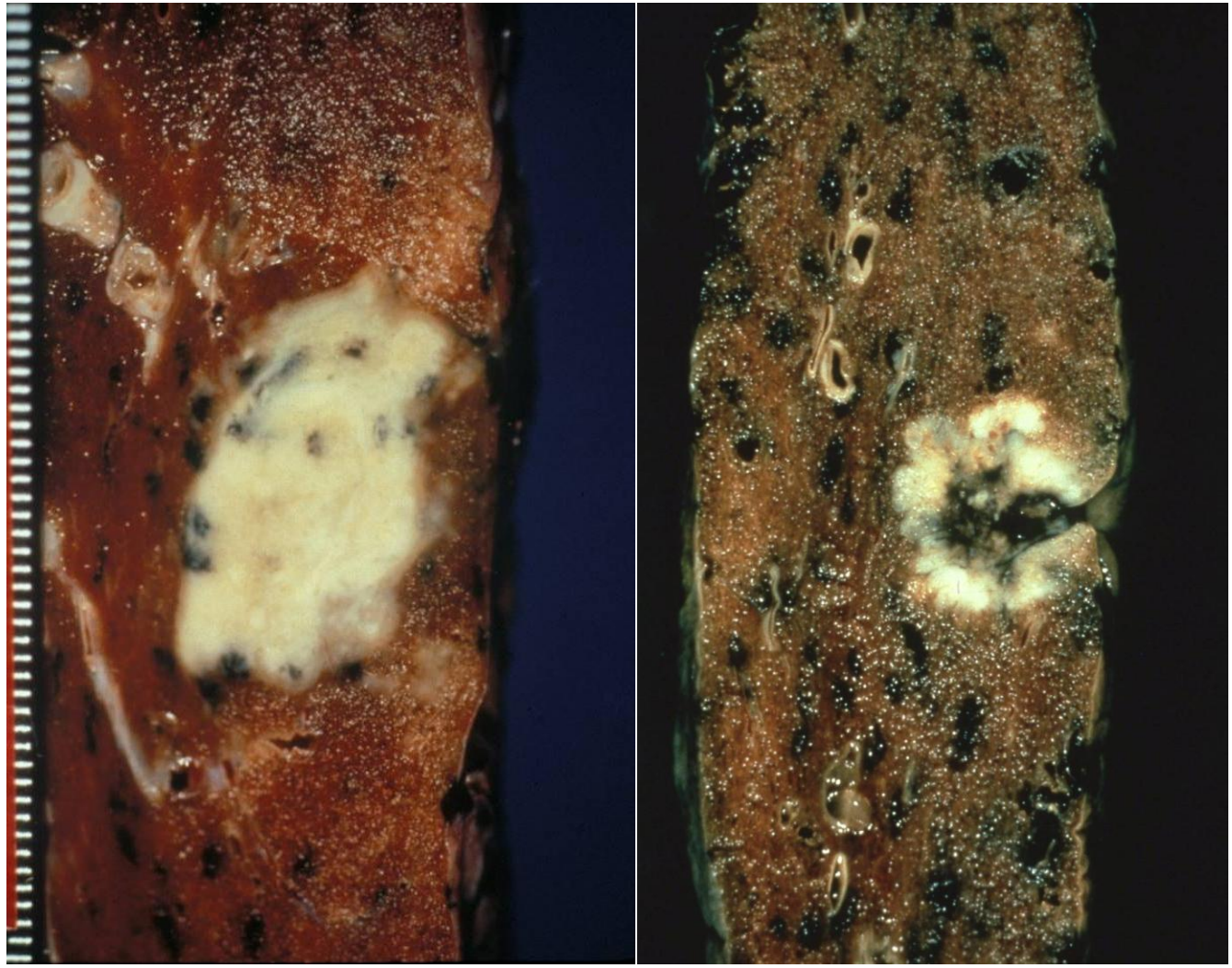
Bronchial scraping cytology demonstrating **epithelioid granuloma** (Pap). The possibility of biohazardous lung tuberculosis should be considered. You should contact immediately with the staff of both the bronchoscopy room and infection control team. Contact examination may be necessary. Note that non-tuberculous mycobacteriosis, microscopically indistinguishable from tuberculosis, is not biohazardous. Prompt PCR confirmation is needed.



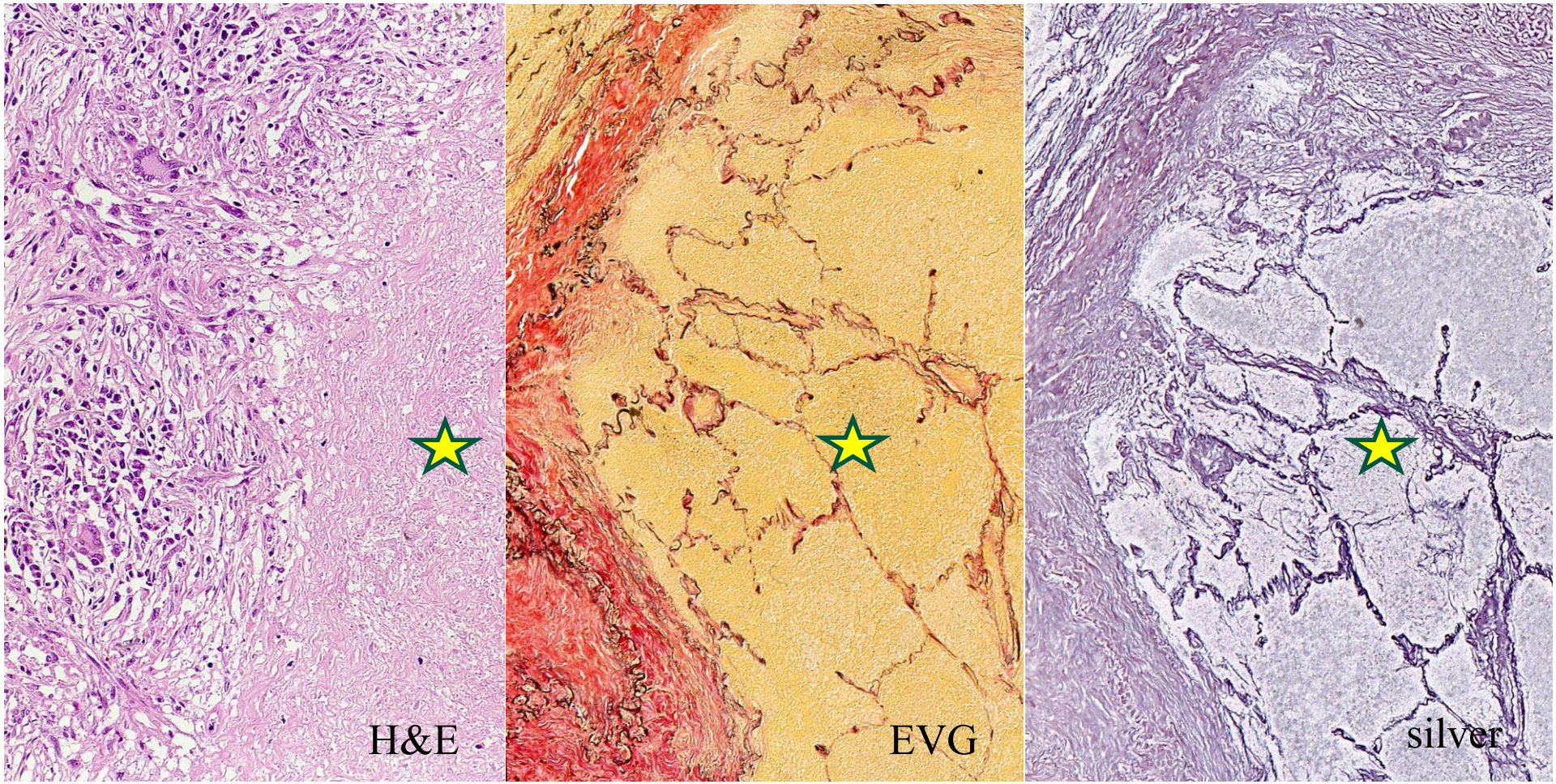
Acid-fast mycobacteria appear as **negative images** in Giemsa-stained cytology preparations. Re-staining of the same specimen with Ziehl-Neelsen's staining clearly discloses acid-fastness for *M. avium*. **Ref.**: Watanabe T, et al. *Mycobacterium avium* infection detected as a negative image in Giemsa-stained sputum cytology preparations. Ann Infect Dis Ther 2021; 2(1): 1-5.

Protection against occupation-related infection of *Mycobacterum tuberculosis*

1) Countermeasures against airborne infection
2) Gross diagnosis of tuberculosis
3) Examination for the exposed persons



Gross appearance of the cut surface of **lung tuberculosis** (left) and **adenocarcinoma** (right) after formalin fixation. The tuberculous lesion shows a localized subpleural nodule with caseous necrosis (left). 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 adenocarcinoma often shows central scarring with anthracosis and pleural indentation (right).



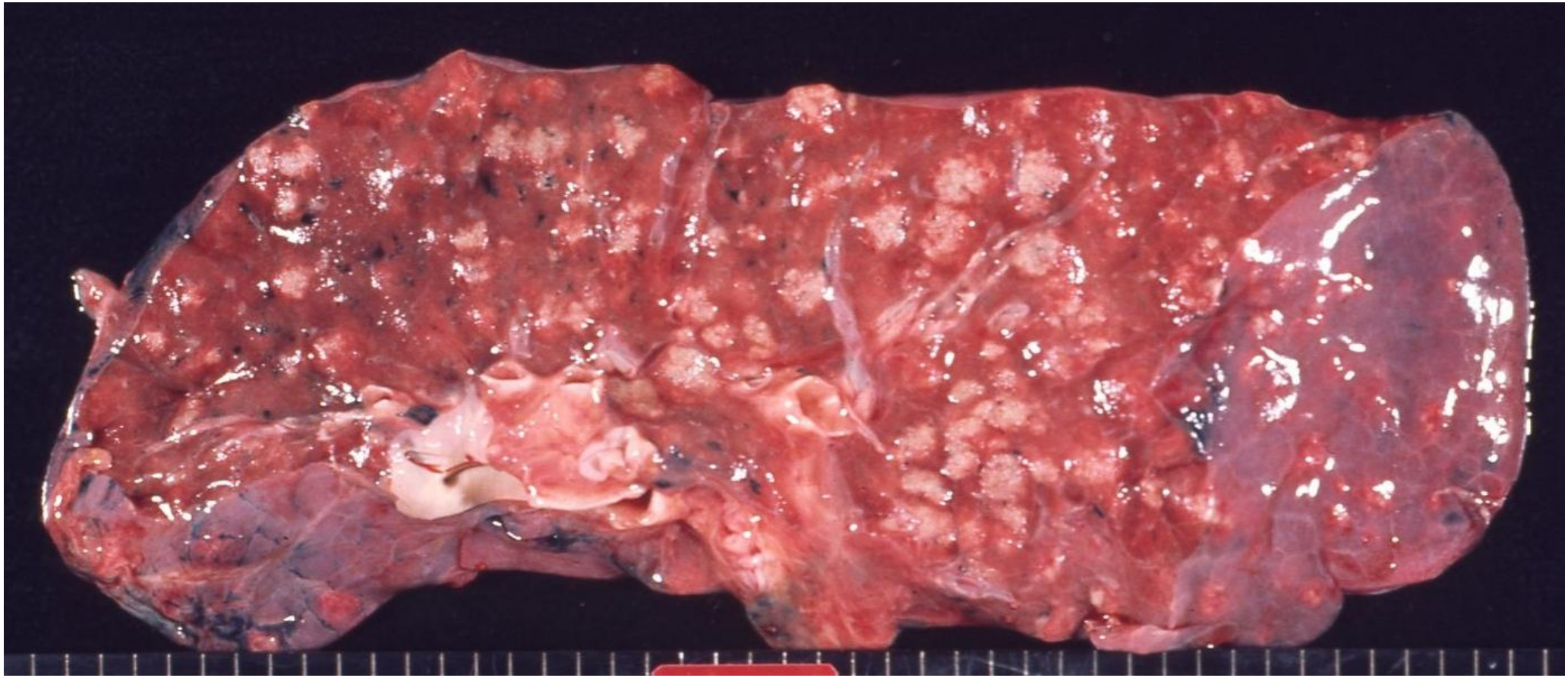
Lung tuberculosis with massive caseous necrosis. Left: H&E, epithelioid granulomatous reaction is seen at the periphery. EVG (center) and silver impregnation (right) reveal preservation of the pre-existing alveolar structure in the caseous necrosis (asterisks). Caseous necrosis belong to a type of coagulation necrosis.

To avoid biohazard of tuberculosis during intraoperative pathology diagnosis services

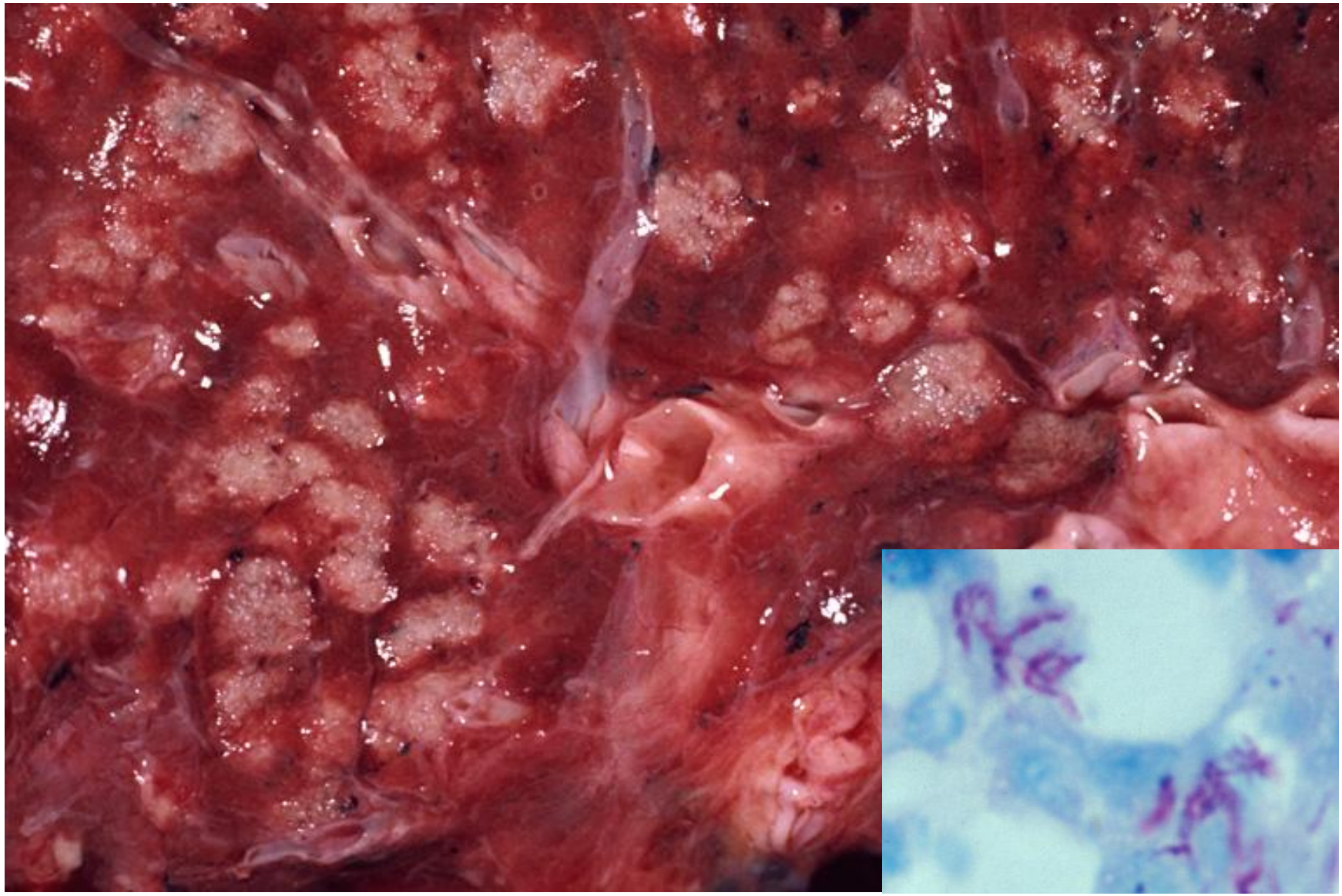
A coin lesion of the lung may be submitted to the pathology division for intraoperative frozen section diagnosis, in order for distinguishing from lung cancer.

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

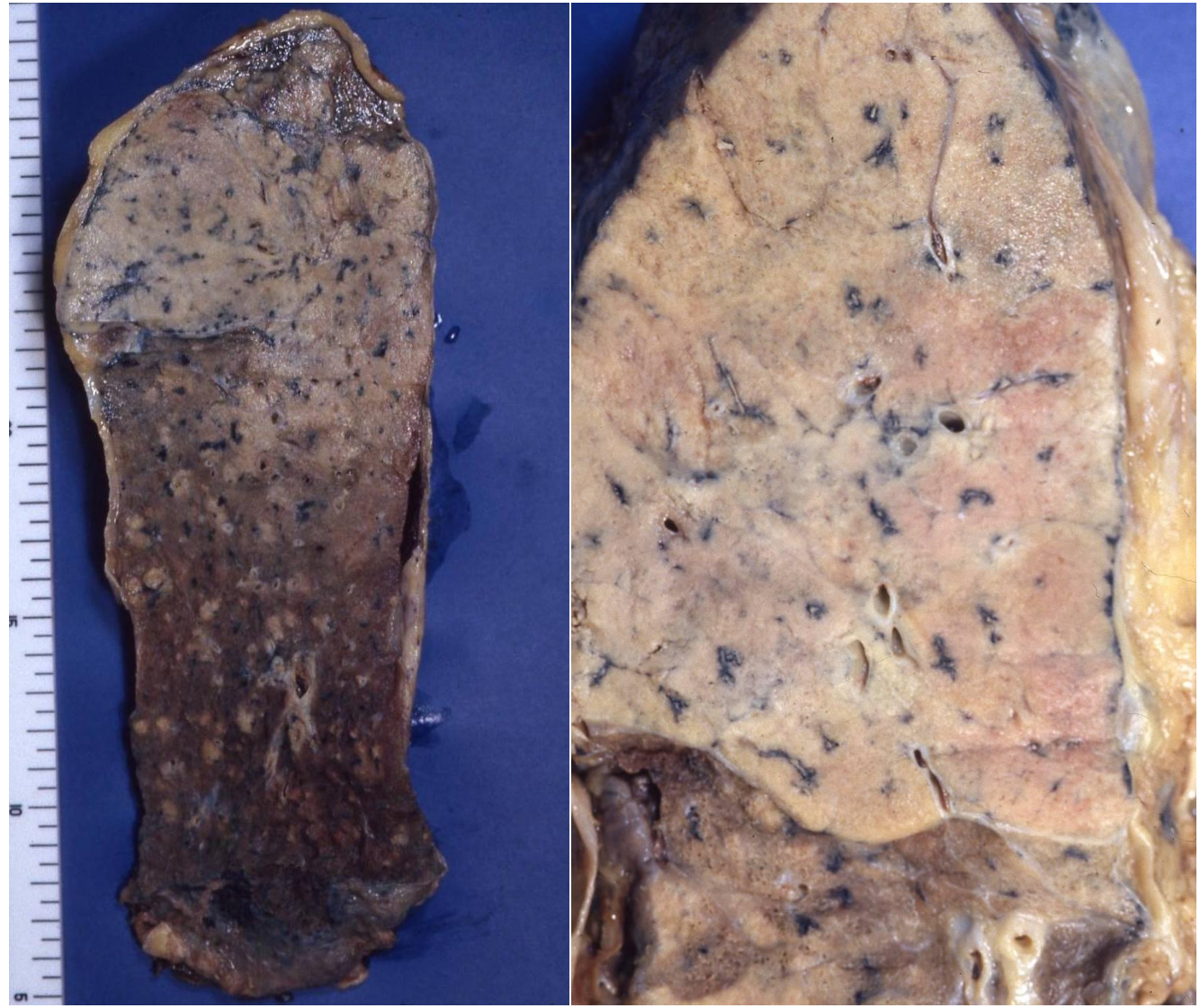
Mycobacterium tuberculosis will survive in the cryochamber of the cryostat kept at −20℃.



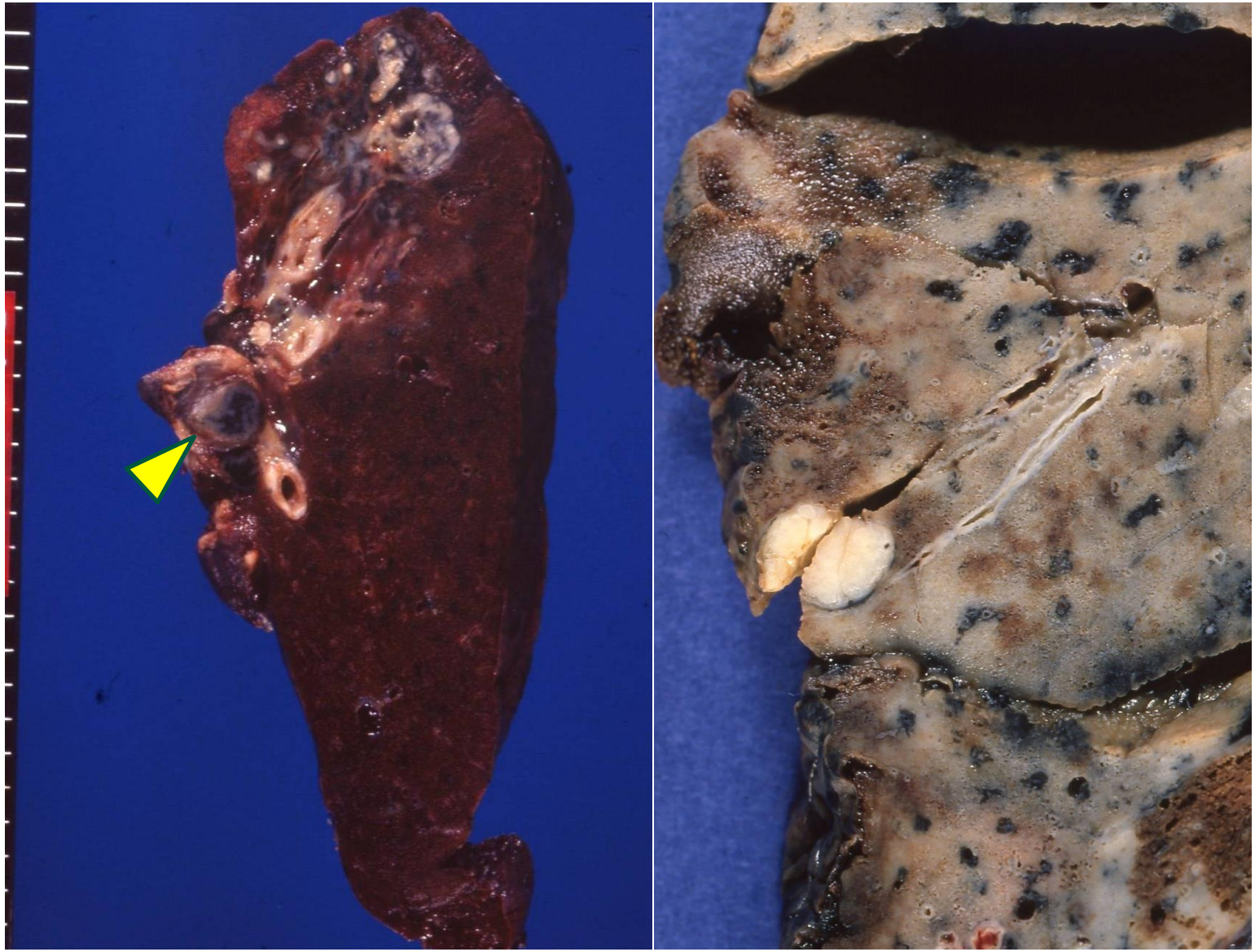
Exudative lung tuberculosis seen in an autopsy case of acute myeloid leukemia after intensive chemotherapy. Exudative lesions, 5-15 mm in size are distributed in the lung. Macroscopic diagnosis of highly biohazardous tuberculosis is quite important to minimize the exposure of the biohazard during autopsy practice. Photographing of the cut surface of the lung should not be done.



Exudative lung tuberculosis seen in an autopsy case of acute myeloid leukemia after intensive chemotherapy. Inset demonstrates tuberculous bacilli with acid-fast staining. Photographing of the cut surface of the lung is highly biohazardous, and should not be done any longer.

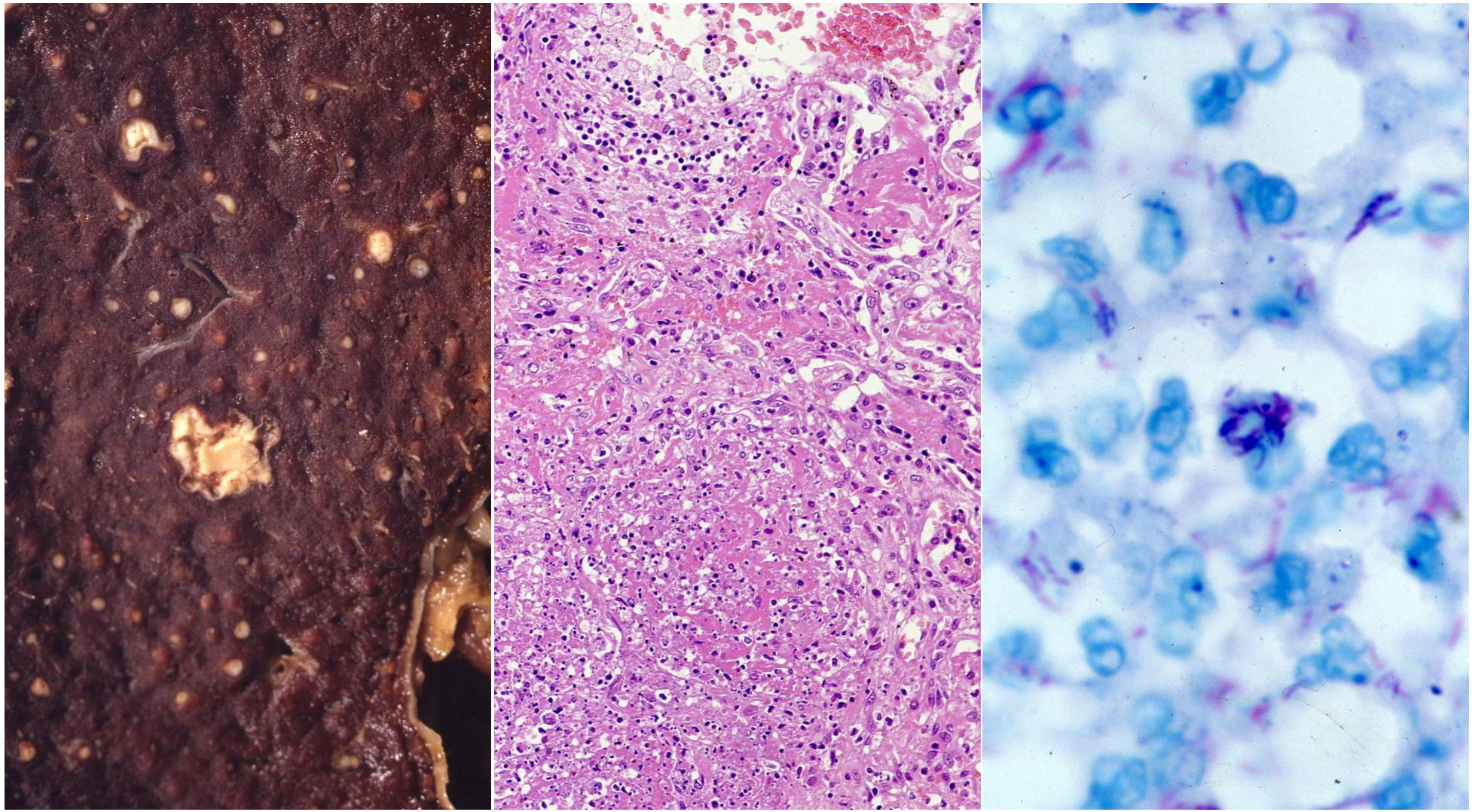


Another autopsy case of biohazardous **exudative tuberculosis** in a 72 y-o male patient with idiopathic thrombocytopenic purpura. The upper part of the lower lobe (left) and the upper lobe (right) show diffuse and massive exudation (gross appearance after formalin fixation). Disseminated nodules are also seen in the lower lobe.

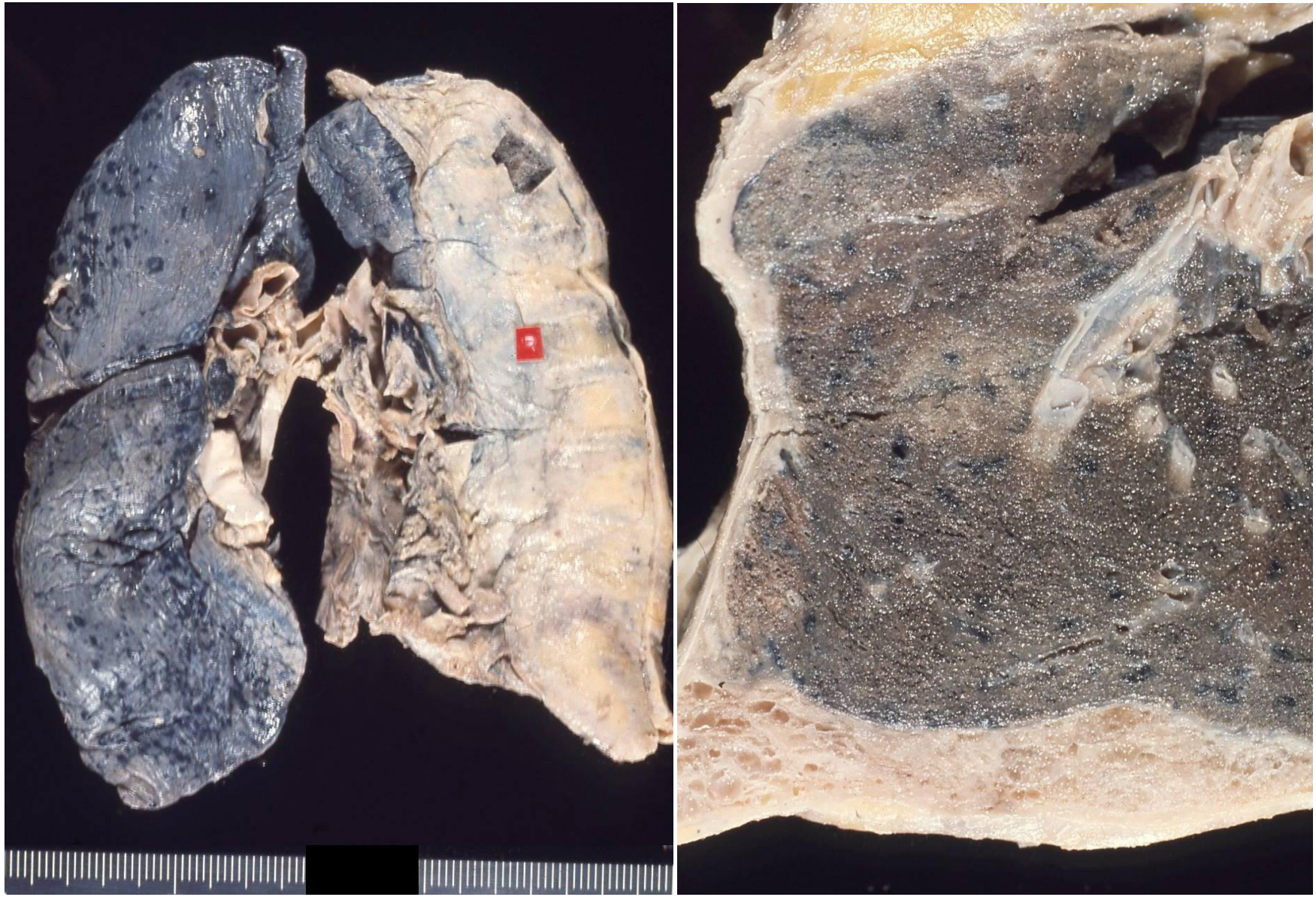


Gross appearance of **tuberculous hilar lymphadenitis**. Left: a surgical specimen of the lung with a cavity-forming peripheral lesion and regional lymphadenitis (arrowhead), right: an autopsy specimen of exudative tuberculosis with hilar lymphadenitis with caseous necrosis.

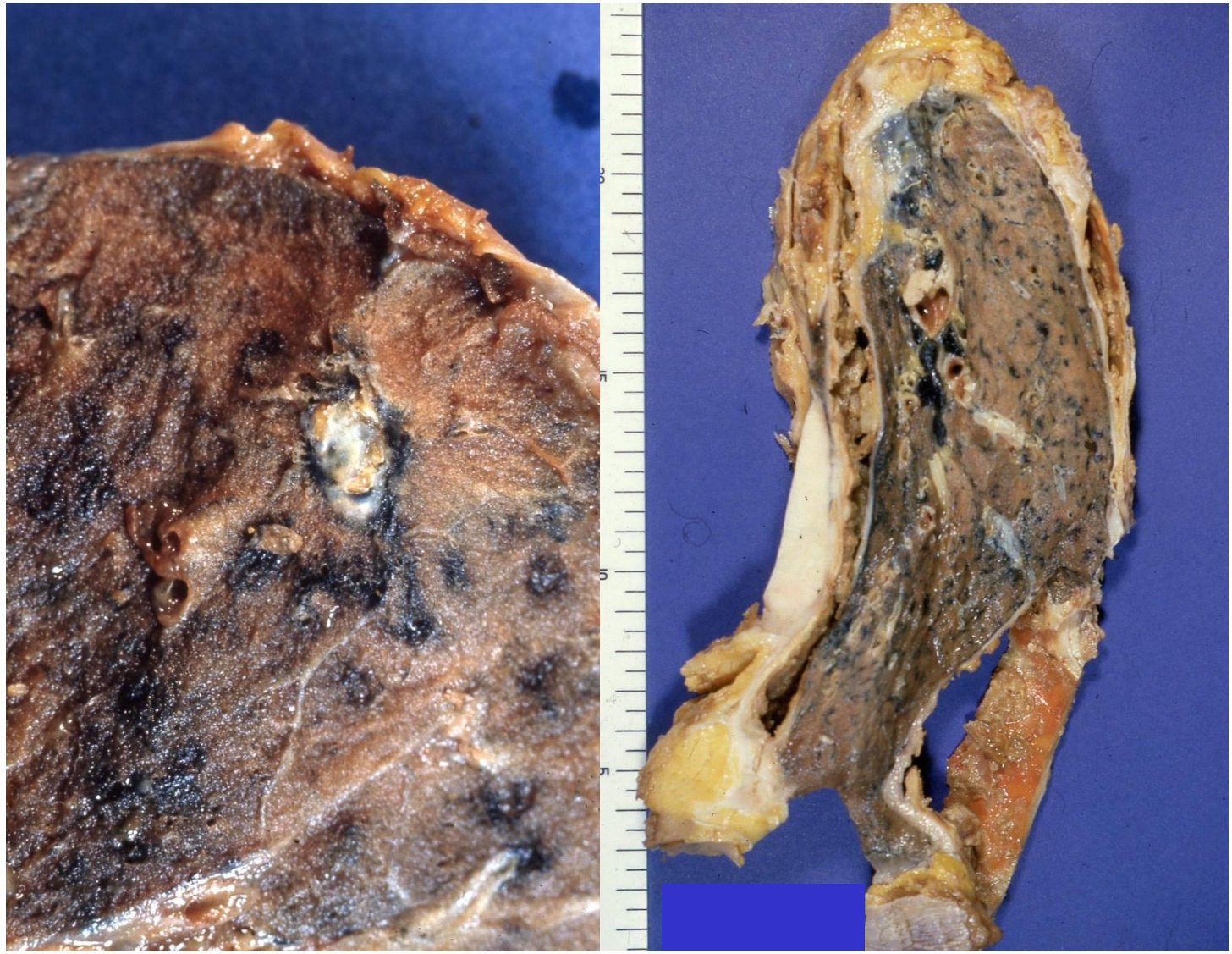
Massive lung tuberculosis forming a huge (13 x 8 cm-sized) cavity in the whole lung (after formalin fixation for years). The lesion was seen during the World War II, before the era of antibiotic treatment.



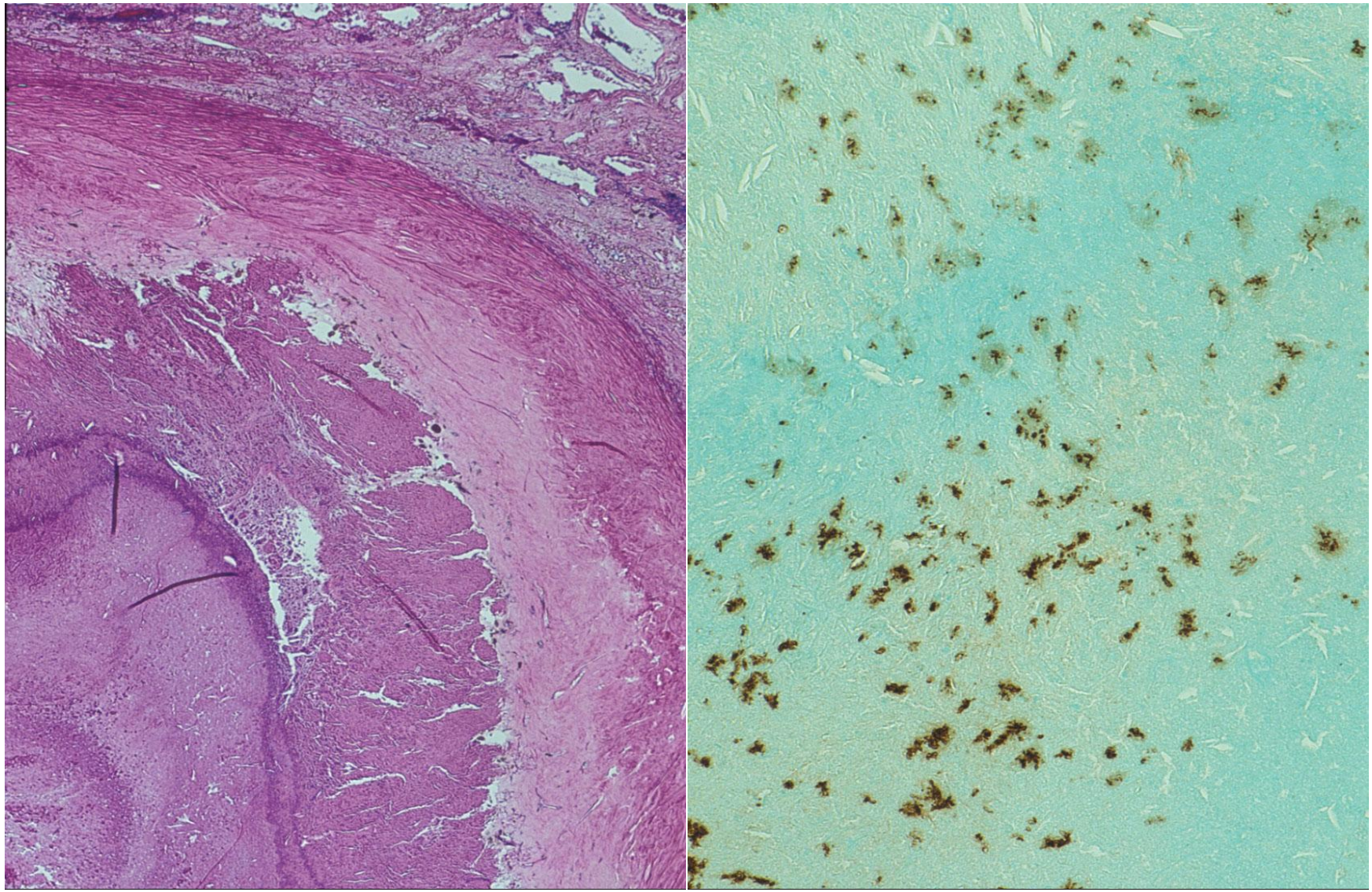
Miliary tuberculosis (left: gross appearance after formalin fixation). Hematogenous dissemination of *M. tuberculosis* reveals miliary-sized exudative lesions in the lung (center: H&E) and systemic organs. Numerous acid-fast bacilli can be observed (right: Ziehl-Neelsen). The autopsy performance is highly biohazardous.



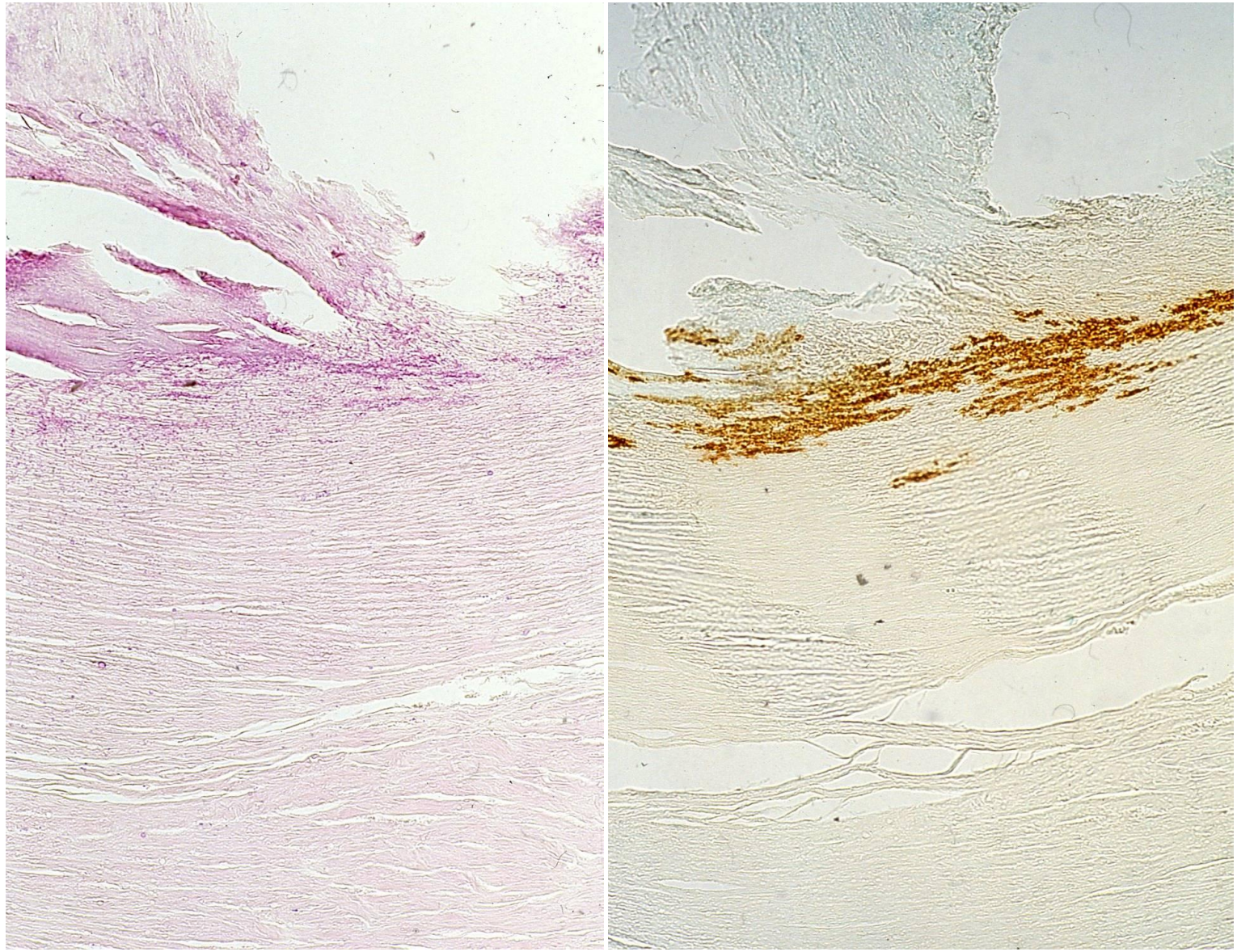
Active **pleural tuberculosis** (gross appearance after formalin fixation). Dissemination on the right pleura with a markedly thickened and adhesive lesion is evident.



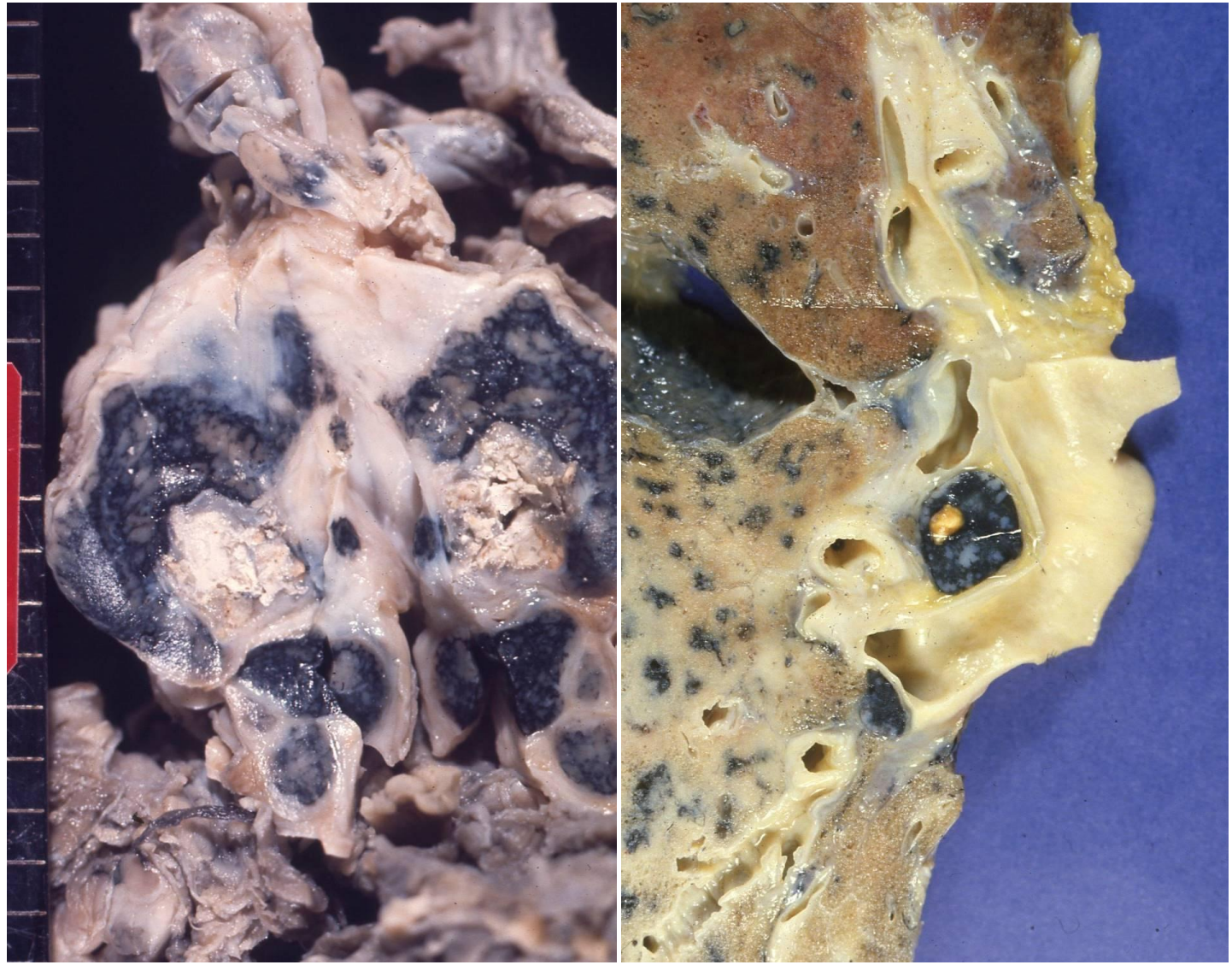
Gross appearance of **old tuberculous lesions** after formalin fixation. Left: an old calcified lesion in the lung apex, right: old tuberculous pleuritis with diffuse pleural adhesion.



Old calcified tuberculous nodule in the lung apex (left: H&E, right: BCG immunostaining). It should be noted that the mycobacterial antigens remain in the old calcified lesion. Ziehl-Neelsen's staining is negative.

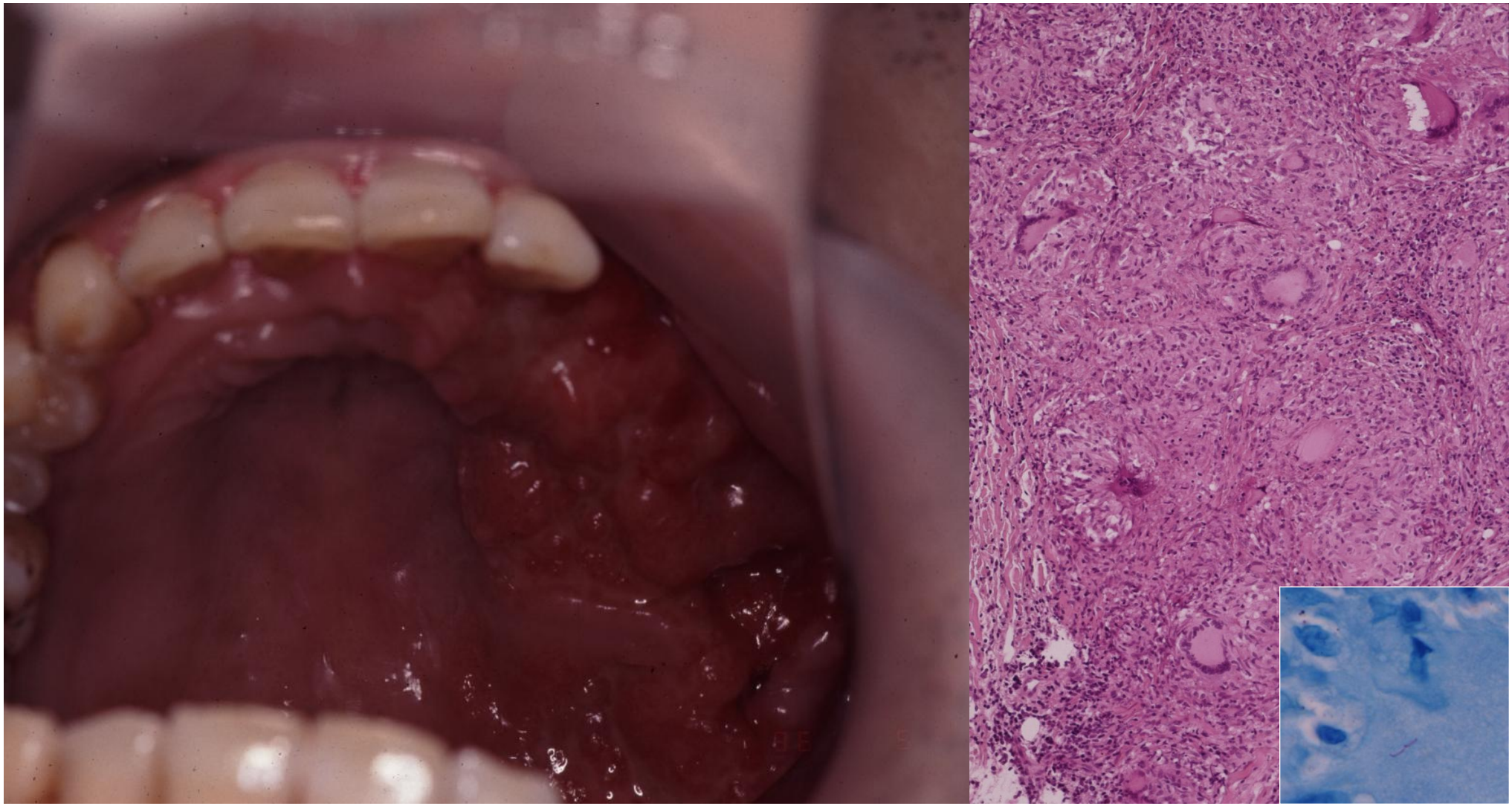


Another **old calcified tuberculous nodule** in the lung apex (left: H&E, right: BCG immunostaining). It should be noted that the mycobacterial antigens remain in the old calcified lesion. Ziehl-Neelsen's staining is negative.

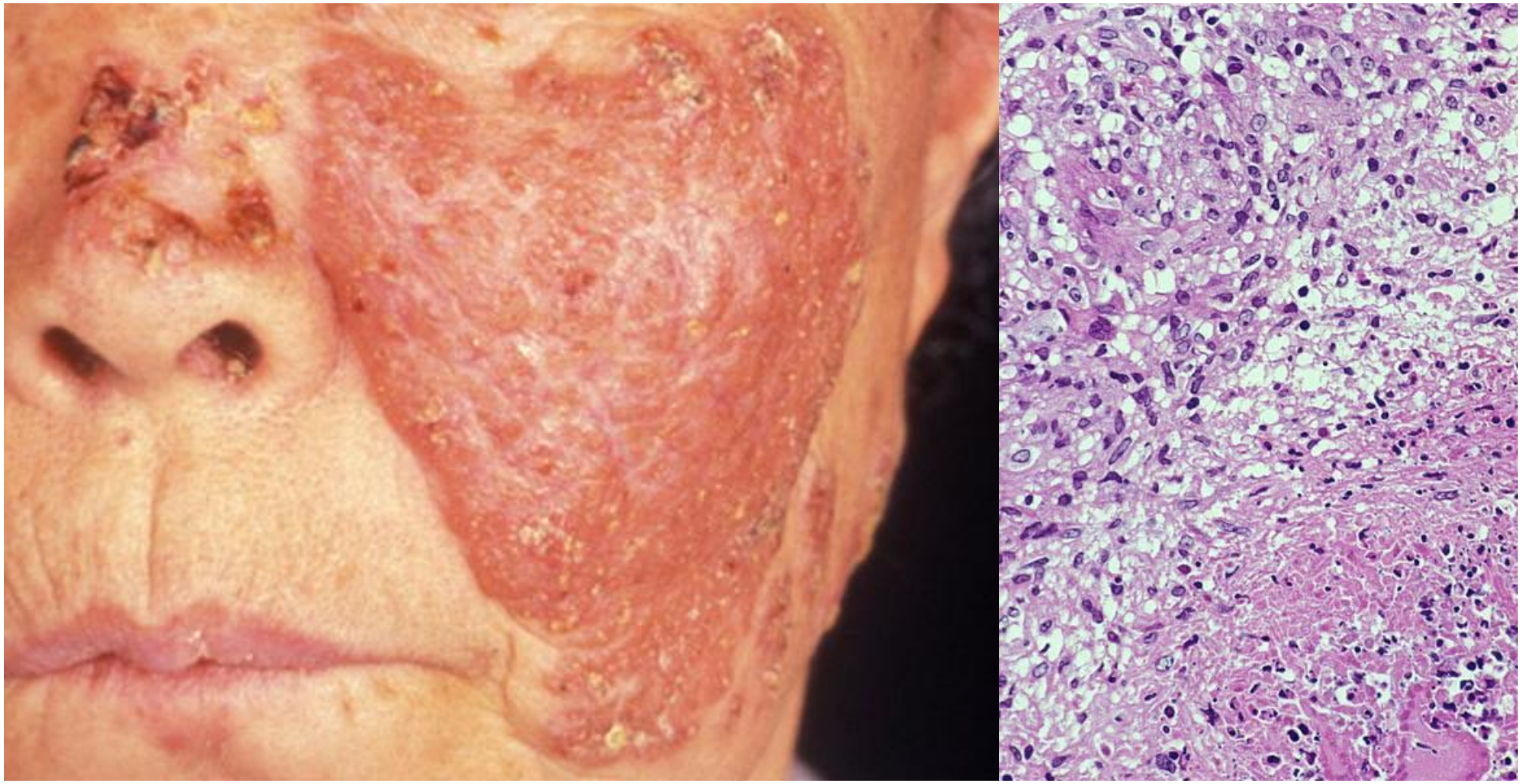


Old tuberculous lymphadenitis in the lung hilar nodes. Left: caseous lesions, right: a calcified lesion. The hilar nodal lesion tends to remain for a long period of time.

Gross appearance of **ileal tuberculosis** after formalin fixation. A circumferential ulcer is formed. The lesion was formed as peroral dissemination secondary to lung tuberculosis.

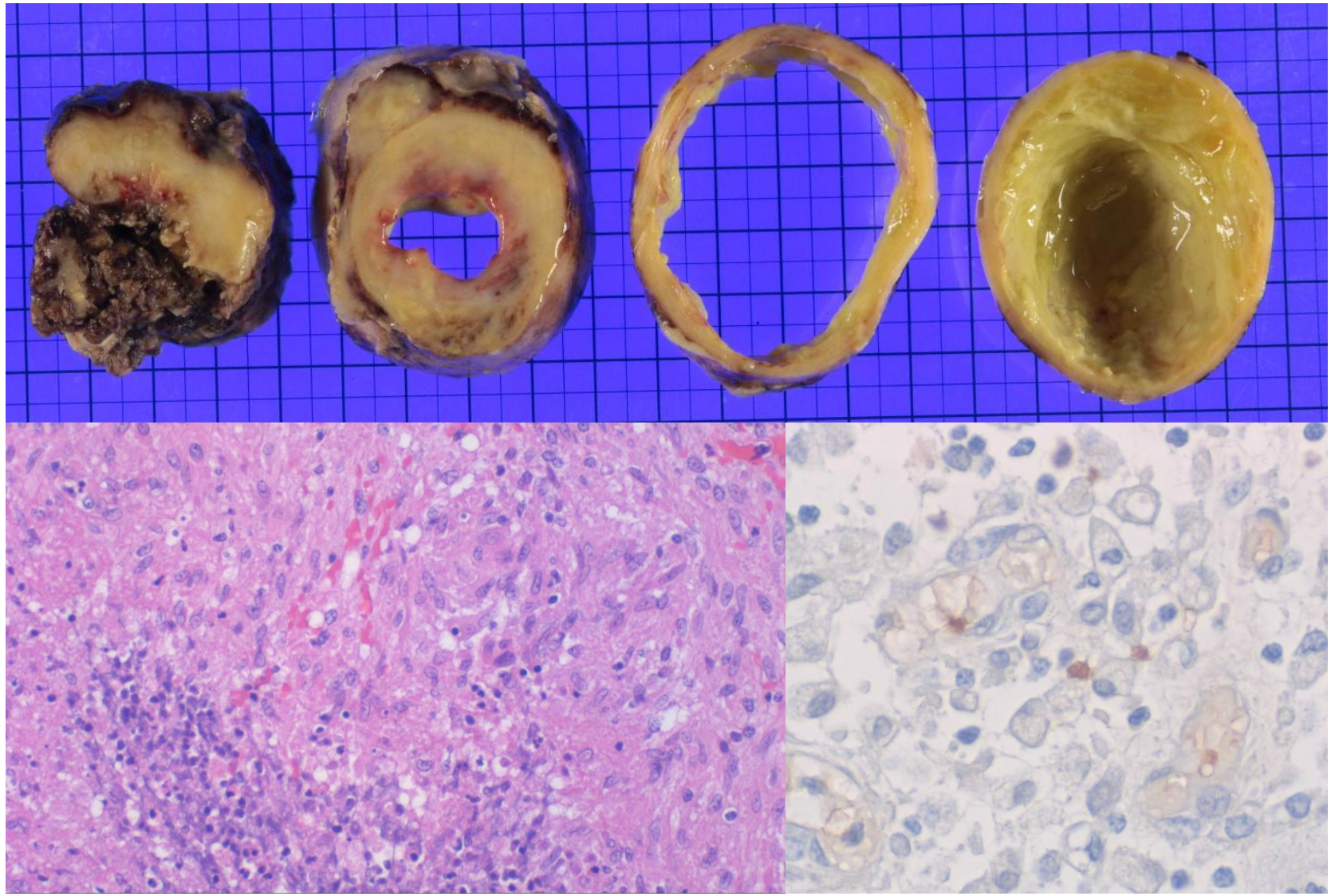


Tuberculosis of the oral cavity. A large ulcerative nodule is formed in the left-sided palate (left). Biopsy reveals epithelioid granuloma with Langhans multinucleated giant cells (right: H&E). A few acid-fast bacilli phagocytized by macrophages are seen (inset: Ziehl-Neelsen).



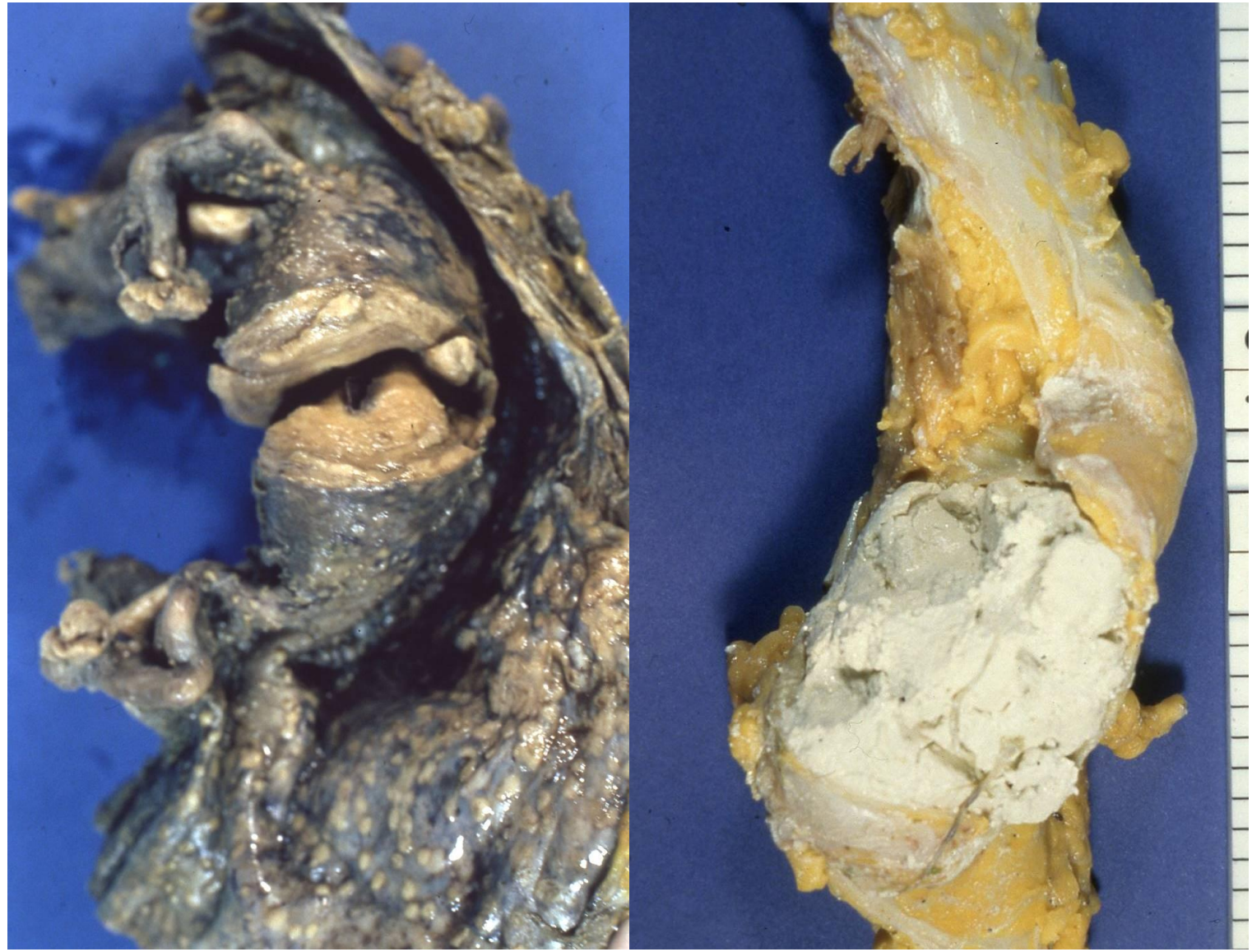
Gross appearance of **lupus vulgaris** (**cutaneous tuberculosis**) on the face of an 88 y-o female (left). The facial skin is the most common site of reinfection tuberculosis. Biopsy reveals caseous granulomas in the dermis (right: H&E).

Renal tuberculosis. The autopsied kidney shows marked atrophy due to multifocal formation of caseous granulomas filled with caseous materials. It has been called as “mortar kidney”.

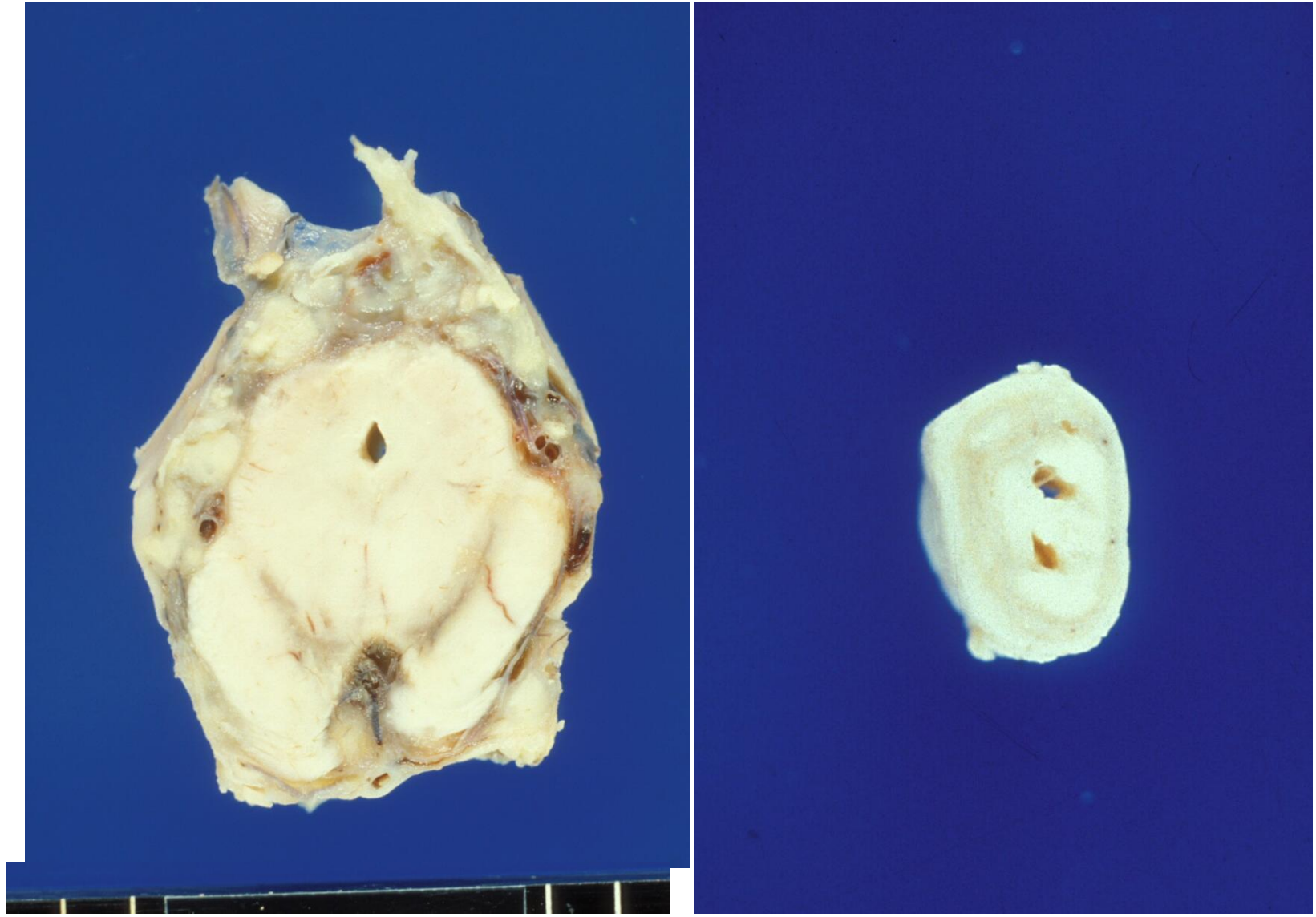


Tuberculous salpingitis. Top: Gross appearance of cut surfaces, bottom left: H&E, bottom right: BCG immunostaining. Marked thickening of the oviduct wall is observed. Microscopically, epithelioid granuloma is formed, and BCG antigens are detectable in the cytoplasm of epithelioid cells.

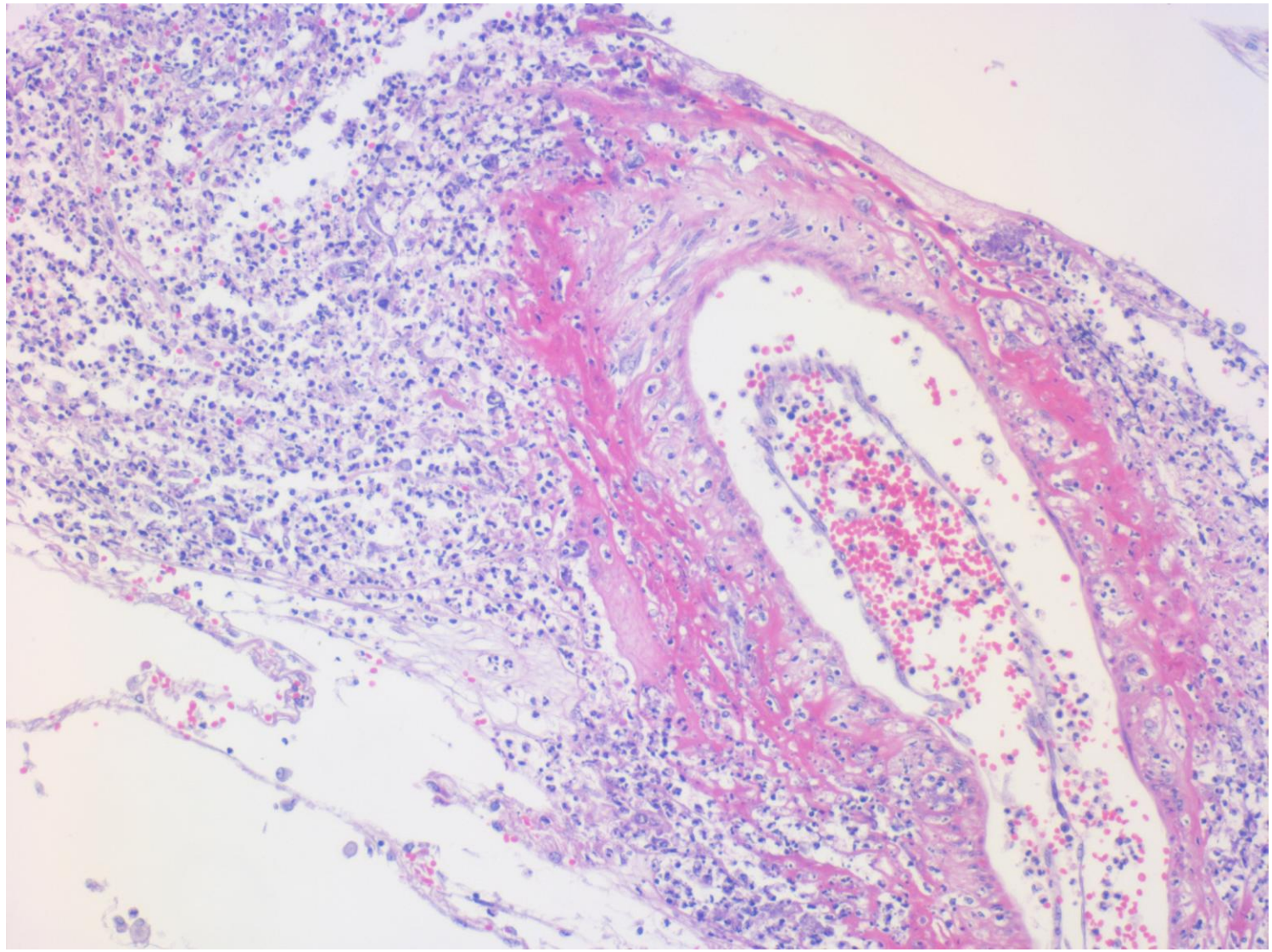
Adrenal tuberculosis with **Addison's disease**. Adrenalectomy was performed from a 56 y-o male patient complaining of lethargy and pigmentation of the lips and nails. Caseous granuloma formation is grossly evident, and the diagnosis of Addison's disease caused by adrenal tuberculosis was made.



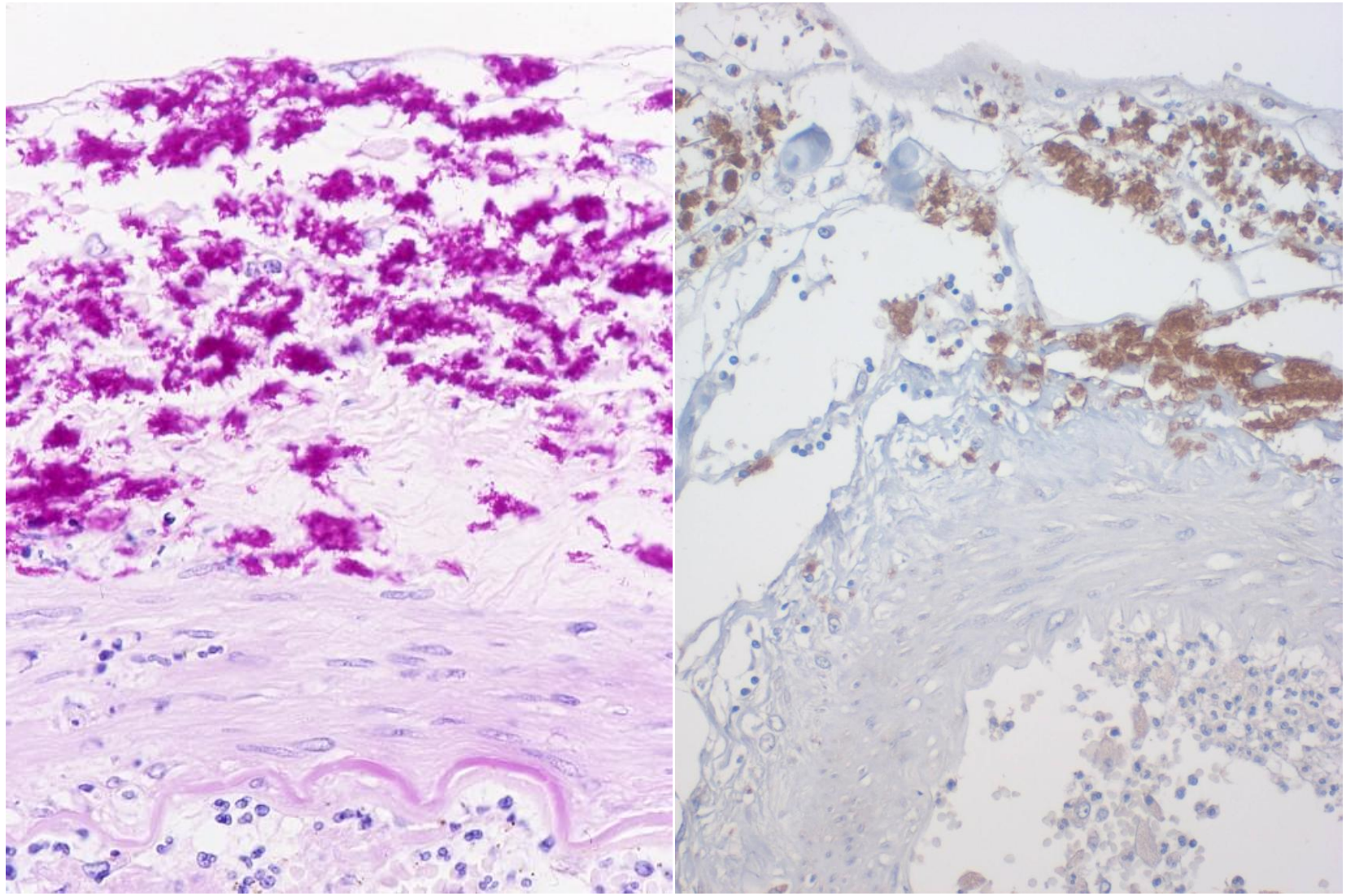
Gross appearance of **peritoneal peritonitis** (left) and **cold abscess** in the psoas muscle (right). Small yellowish nodules are characteristic of tuberculous peritonitis (left). A mass of caseous material drains from the spinal caries to and along the psoas muscle (right).



Gross appearance of **tuberculous meningitis**. Caseous granulomas are disseminated in the meningeal space (left: mid-brain, right: spinal cord with syringomyelia).



Askanazy-type necrotizing angiitis in **tuberculous meningitis** (a 71 y-o male patient). Meningeal tuberculosis has provoked secondary necrotizing vasculitis of Askanazy type, resulting in multifocal cerebral infarction (H&E).



Askanazy-type necrotizing angiitis in **tuberculous meningitis** (a 71 y-o male patient). Left: Ziehl-Neelsen, right: immunostaining for BCG antigens. Numerous acid-fast bacilli grow in the meningeal perivascular spaces, and they are immunoreactive for the mycobacterial antigens. Meningeal tuberculosis has provoked secondary necrotizing vasculitis of Askanazy type.

Annual Incidence of Pulmonary Tuberculosis among Pathology Workers in Japan

Pathologists + pathology technicians (n=2,388)	639.5
Pathologists (n=1,201)	683.9
Pathologists, female (n=88)	2,136.8
Pathology technicians (n=1,187)	592.4
Pathology technicians(assisting at autopsy) (n=753)	823.4
Pathology technicians(not assisting at autopsy) (n=422)	125.1
Pathologists+pathology technicians (1978-1988)	559.3
Pathologists+pathology technicians (1978-1988) (40 years of age or younger)	673.8
Pathology staff(other than pathologists and technicians) (n=207)	76.7
Public health/preventive medicine staff (n=732)	55.3
Public health/preventive medicine staff (medical doctors+technicians) (n=414)	94.2
Japan Railway (JR) employees (n=500,000) (1982)	30.0
Nippon Telephone and Telegram (NTT) employees (n=42,000) (1982)	30.0
Japanese population (1982)	53.9
United Kingdom population (1982)	15.0
United Kingdom pathologists (1953-1955)	547.0
United Kingdom morbid anatomy-related personnel (1971)	401.8

Note 1: The data are based upon the questionnaire-based statistical survey (done in 1988) on the treatment history against tuberculosis (data/100,000 population/year).

Note 2: The year 1982 corresponds to the median value of the work period (6 yrs) of the Japanese pathology workers.

Note 3: Ref. Sugita M, et al. *Sugita M, et al. Pulmonary tuberculosis. An occupational hazard for pathologists and pathology technicians in Japan. Acta Pathol Jpn 1990; 40(2): 116-127. doi: 10.1111/j.1440-1827.1990.tb01550.x*

A nationwide poster for the prevention against tuberculosis:
A normal mask for the patients and an N95 mask for medical staff.
Mr. Sharaku (1763-1820) is a famous Ukiyoe painter in the Edo era.

Tuberculosis is not a historical disease in the 19th century

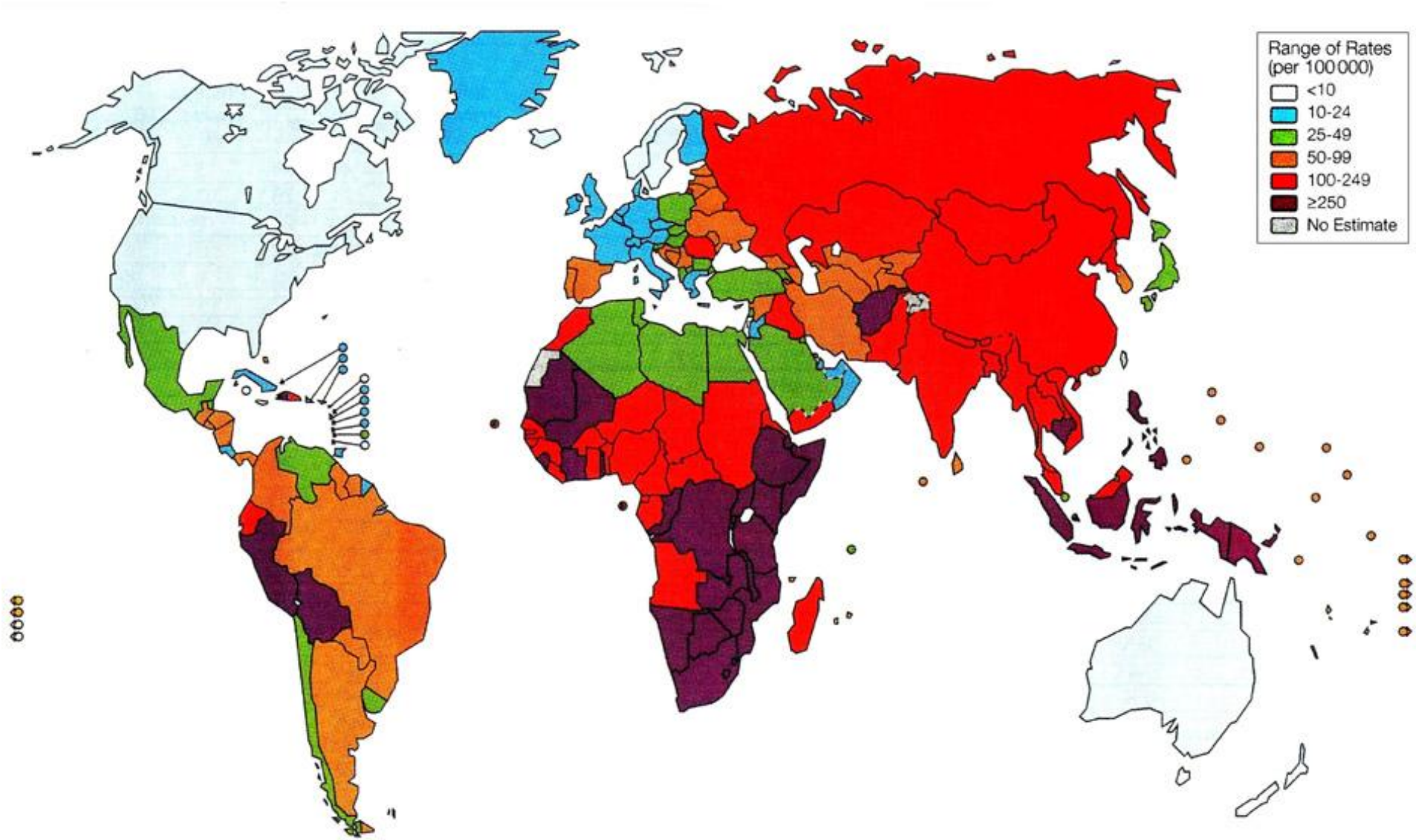
The death by tuberculosis in the world

3,000,000/year (1995)

2,100,000/year (1900)

World tuberculosis day (WHO): March 24

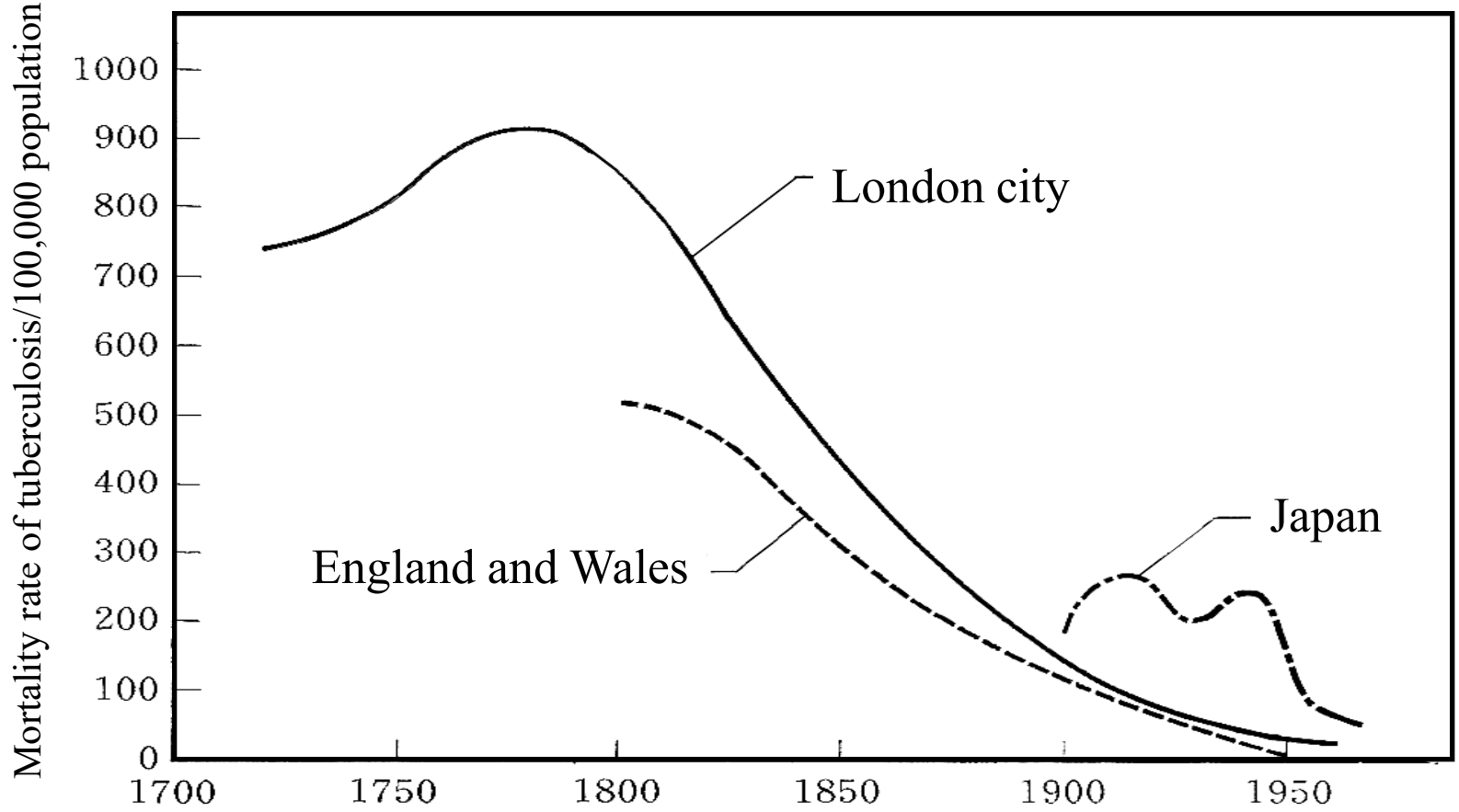
Estimated Per Capita Incidence Rates of Tuberculosis (All Forms) by Country in 1997



Tuberculosis, spreading throughout the world, is the number one killer disease.

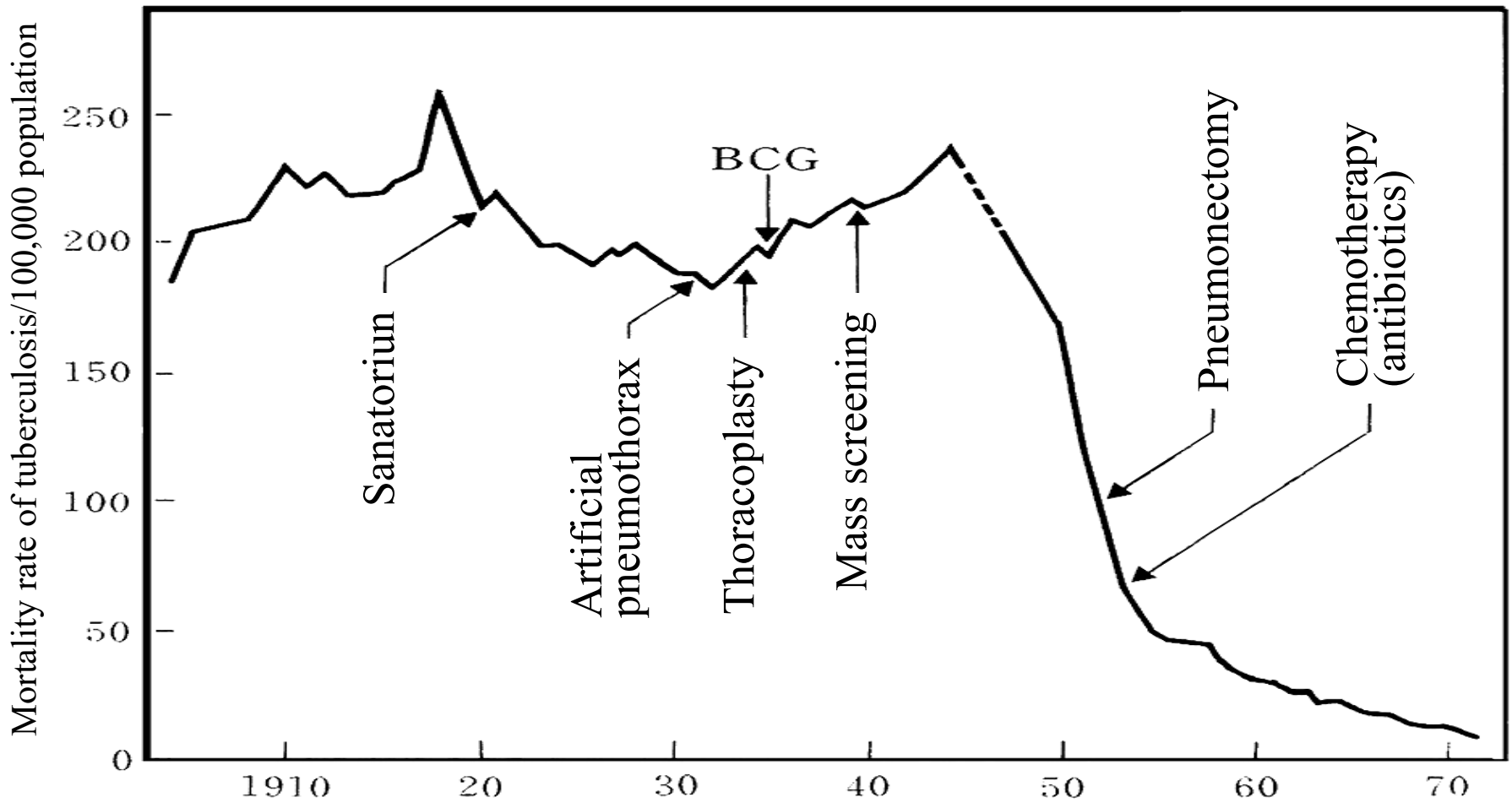
Change of mortality rate by tuberculosis in the United Kingdom

（Shimamura K. The present and past clinical studies on tuberculosis. Kekkaku 1980; 55(8): 383-388)



In the 19th century, the mortality rate by tuberculosis was extremely high in London city.

Changes of the mortality rate of tuberculosis in Japan



Tuberculosis Up to Date (Nankodo, Tokyo, 1999)

Cause of death of young ladies working for factories (percentage of the ladies who went back home and died there in the same year. 1909)

	Spinning	Silk	Fabric	Hemp
Lung tbc	41.3	37.4	35.4	33.8
Tbc, suspected	31.2	33.4	29.2	32.4
Beriberi	9.9	2.4	5.0	8.8
GI disease	6.6	11.4	11.8	4.4
Others	12.1	16.6	18.5	22.6

(Ishihara O. Female factory workers and tuberculosis, 1913)

Countermeasures against airborne infection

1) Preparation of N95 respirators
2) Quantiferon testing
3) Check for serum antibodies against measles and varicella
4) Check for air change rate of the room
5) Preparation of depressurized rooms

Tuberculin reaction and BCG vaccination

Positive tuberculin reaction after 72 hours:
erythema 93 × 51 ㎜ and induration 22 × 18 ㎜

The validity against tuberculosis prevention of **BCG vaccination** is doubted now.

New techniques for the diagnosis of tuberculosis: “QFT-gold plus” (Quantiferon-gold plus) and T-spot

- QFT-gold plus and T-spot are an interferon-gamma release assay (IGRA) using the serum. *M. tuberculosis* peptide antigens stimulate the release of interferon-gamma from the T cells of patients with the infection.
- The result of QFT-gold plus and T-spot is not affected by BCG vaccination.

Tuberculin reaction vs. QFT-gold plus

	Tuberculin reaction	QFT-gold plus
Antigen	PPD (purified protein derivative) Amino acid homology with BCG: 99.95%	ESAT-6/CFP-10 Not present on BCG
BCG vaccination	Affected	Not affected
Problems	Positive even without active tuberculosis	Accurate diagnosis of tuberculosis provided

The process of QFT testing

① Collect blood with heparin (5 mL).

② Transfer the blood at room temperature at 17～27℃.

(to prevent lowered activity of Th1 lymphocytes)

③ Day 1: Stimulate peripheral blood lymphocytes with the antigens.

④ Day 2: Assay the level of interferon-γ after separation of the serum.

⑤ Analyze the data and report the results.

The judgment of the results of QFT testing

Value	Judgment	Explanation
≧0.35 IU/mL	Positive	Suggestive of tuberculosis
0.1～0.35 IU/mL	Pending	The risk of infection should be taken into consideration
<0.1 IU/mL	Negative	Not infected with tuberculosis

QFT testing for the medical staff exposed to *M. tuberculosis* (Examination for the exposed persons-1)

Just after the exposure

1) QFT-negative : Re-evaluate the QFT 2 months later
2) QFT-pending: Re-evaluate the QFT 2 months later
3) QTF-positive: “Latent tuberculosis infection” should be considered (the positivity is unrelated to the present exposure).

～Based on the interview, medical examination, chest X-ray evaluation and tuberculin reaction, the necessity for the treatment is decided.～

QFT testing for the medical staff exposed to *M. tuberculosis* (Examination for the exposed persons-2)

Examination 2 months later

Subjects: persons negative or pending results just after the exposure

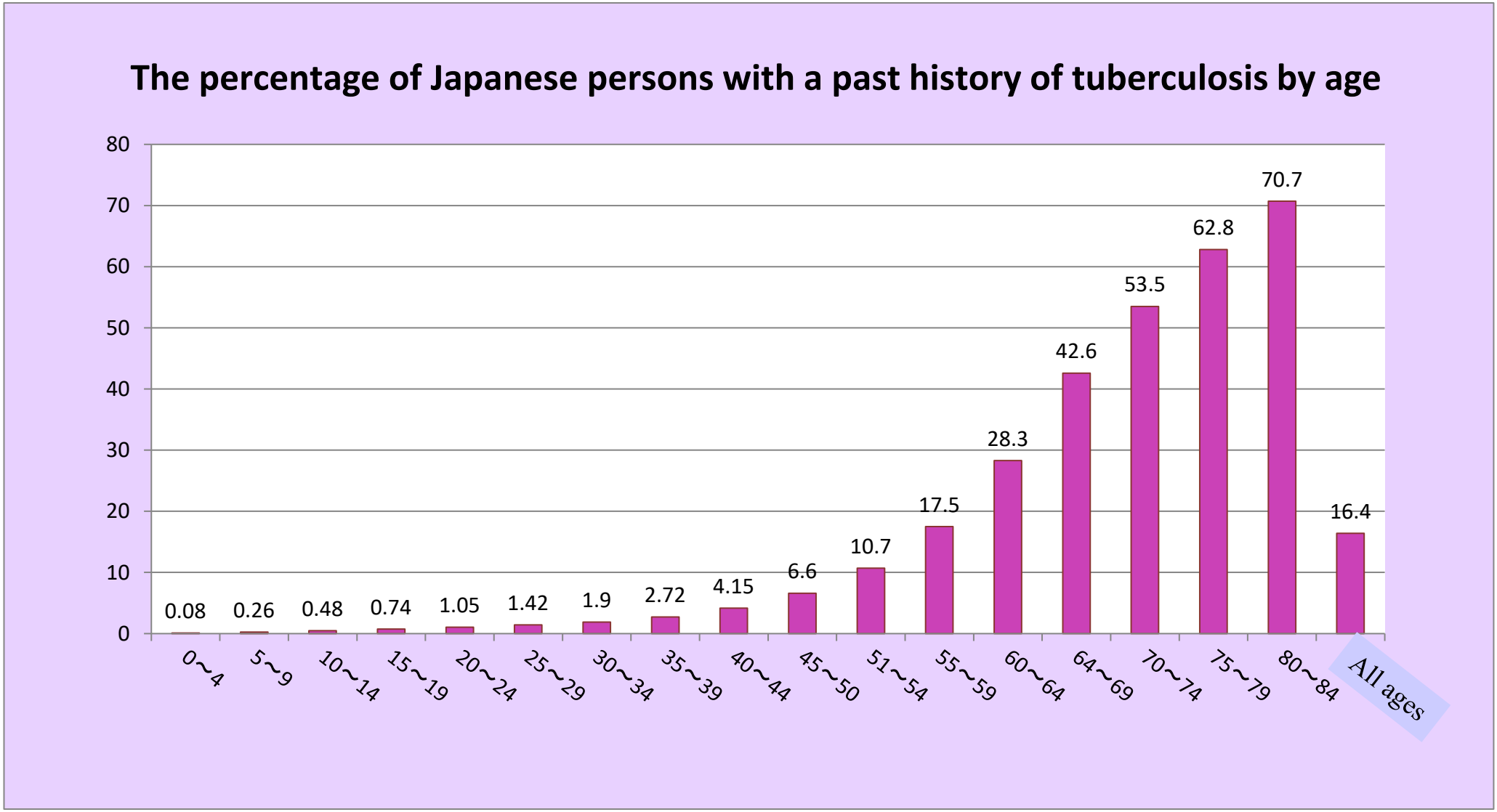
1) QTF-negative: Examination is completed.

2) QTF-negative, but probably with close exposure:

   Interview with contact history taking, chest X-ray evaluation and re-evaluation of the QFT testing 1-2 months later

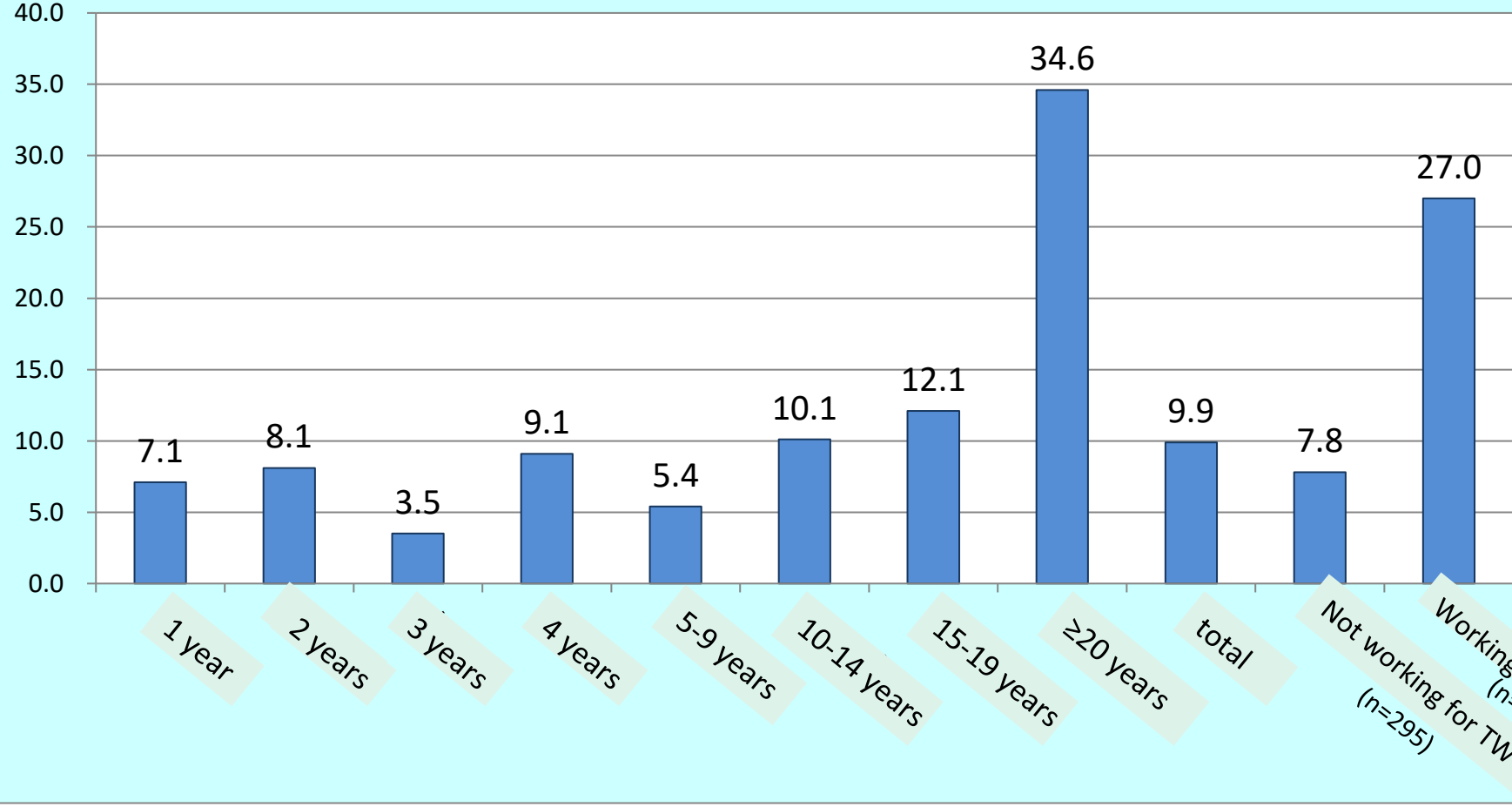
3) QFT-pending: Re-evaluate the QFT 1-2 months later

4) QTF-positive: Interview with contact history taking, chest X-ray evaluation and Isoniazid (INH) orally administered for 6 months. Continue the examination.



Mori W. The guideline for examining the tuberculosis-exposed persons. Japan Anti-tuberculosis Association, 2007

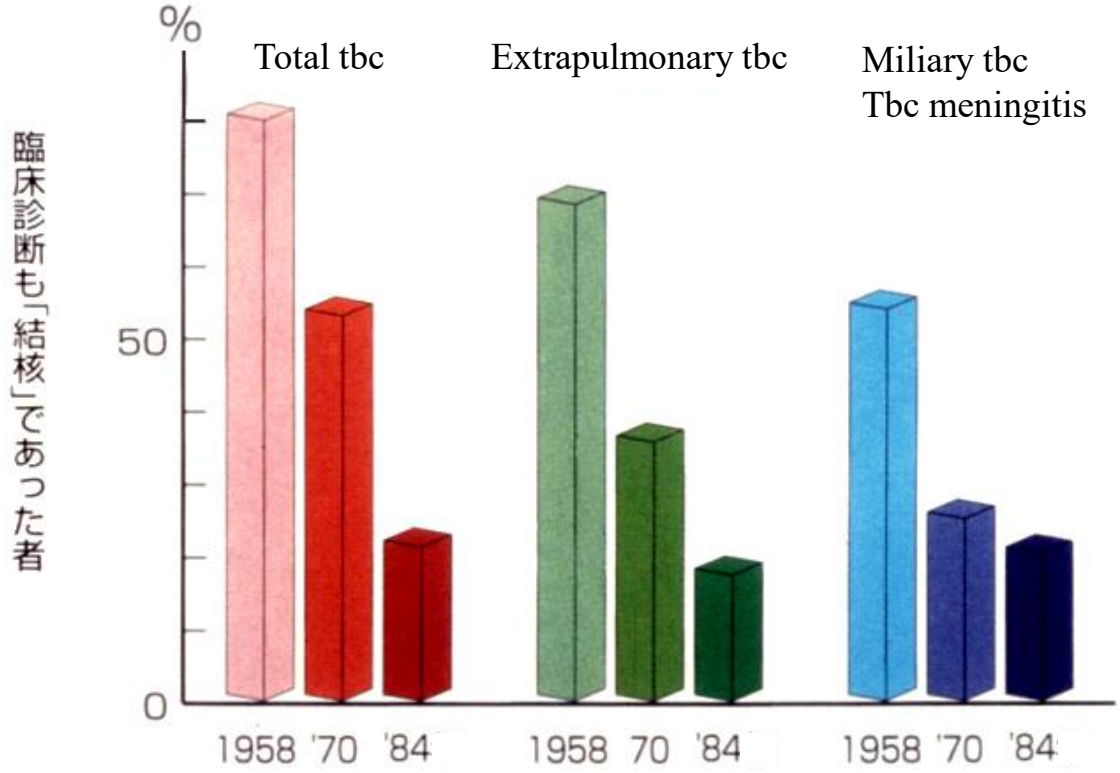
QFT-positive percentages (the rates of "Latent tuberculosis infection") among Japanese medical staff by the working period (n=332)



Harada N, et al: Infect Control Hosp Epidemiol 27:442-448, 2006.

The rate of correct clinical diagnosis is decreasing significantly: Comparative study using autopsy cases

Wada M. The 64th annual meeting of the Japanese Society for Tuberculosis



The clinical diagnosis of tuberculosis is often difficult.

Incidence of tuberculosis in autopsy cases (comparison among 3 hospitals)

	University Hospital A		City hospital B	City hospital C	
	1975–1987	1997–1999	1991–1995	1980–1989	1990–1999
Autopsy (total)	2705	450	538	621	305
Cases of tuber–culosis	251 (9.3%)	36 (8.0%)	72 (13.2%)	102 (16.4%)	49 (15.9%)
Infective tbc	160 (6.2%)	5 (1.1%)	10 (1.9%)	41 (6.6%)	19 (6.2%)
Healed tbc	82 (3.0%)	31 (6.9%)	61 (11.3%)	61 (9.8%)	30 (9.7%)

20 principles in autopsy of active tuberculosis-1

1) Do not bring the patient record or X-ray films into the autopsy suite
2) Pathologists with negative tuberculin reaction should not perform the autopsy.
3) No observers are allowed to enter the autopsy suite.
4) Autopsy clothes should be disposable.
5) The autopsy examiners should wear an N95 respirator for a long-time work (hi-luck350, Koken).
6) Dissection of the organs should be done on the autopsy table, as much as possible.
7) Inject formalin into the bronchus of the lung.
8) Slicing the organs should be minimized.
9) Do not prepare frozen sections from the lesion.
10) Cover the bone cutter (Stryker) with a plastic bag to avoid spattering bone fragments.

20 principles in autopsy of active tuberculosis-2

11) Take photographs of the organs after enough formalin fixation.
12) When the autopsy record is contaminated with the body fluid, rewrite on another sheet of the record, or disinfect the portion of contamination with hypochlorous acid solution.
13) The implements should be disposable as much as possible. The used instruments should be disinfected with hypochlorous acid solution.
14) Disinfect the floor before the stretcher carrying the cadaver is brought into the Autopsy suite,
15) The autopsy examiners and assistants should have body-showered and hair-washed after the autopsy.
16) Used disposable implements should be stored in a dedicated container, labeled and incinerated.
17) After autopsy, full ventilation of the autopsy suite should be done.
18) After autopsy, the autopsy examiners and assistants should have a contact examination.
19) Autopsy results should be reported as early as possible for infection control purposes.
20) Brush up the ability for the gross diagnosis of tuberculosis.

Other types of biohazard in pathology practice

Examples include plague, diphtheria, pneumococcal pneumonia, meningococcal meningitis, prion disease, and hepatitis C virus. It is important to know certain pathogens do not transmit from human to human, and are thus not biohazardous.

Autopsy of a cadaver of plague in Manchu, China in 1911.
The autopsy executor: Prof. Akira Fujinami at Kyoto University (2nd person from the left)

Lethal diphtheria

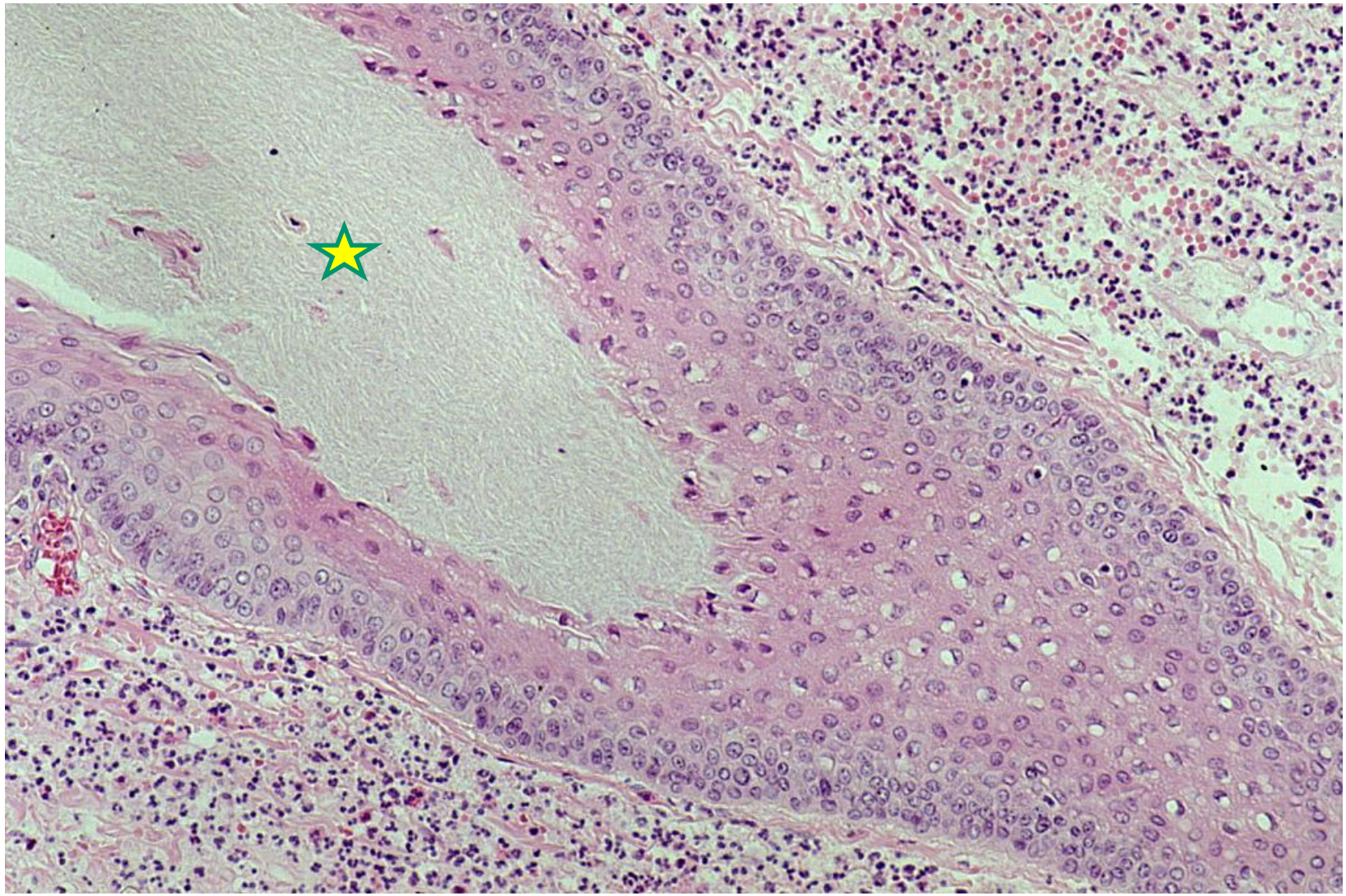
A 75 years-old Japanese male

Acute respiratory distress without fever

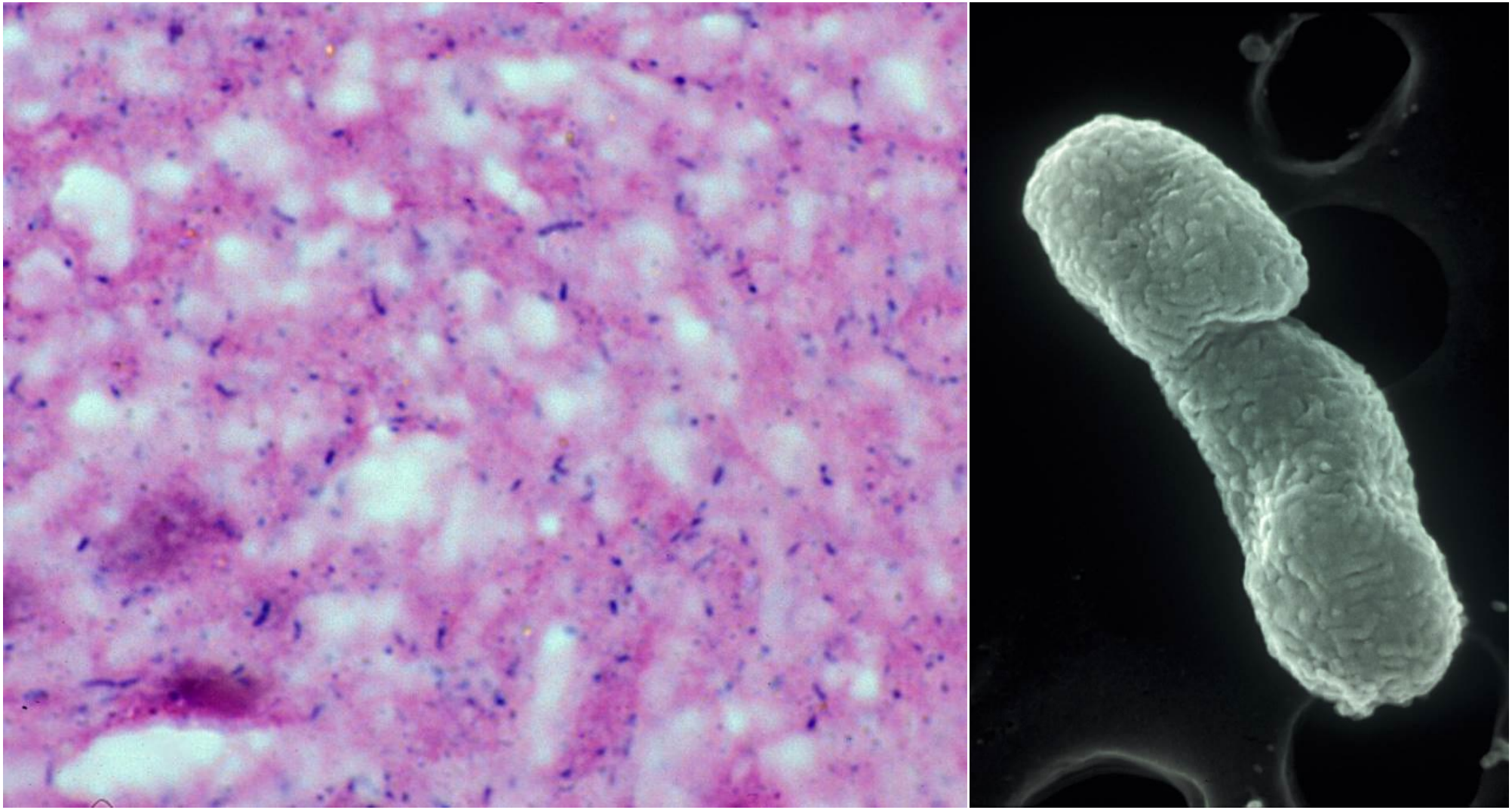
Intubation failed at emergency unit

A piece of pharyngeal mucosa was submitted to pathology department

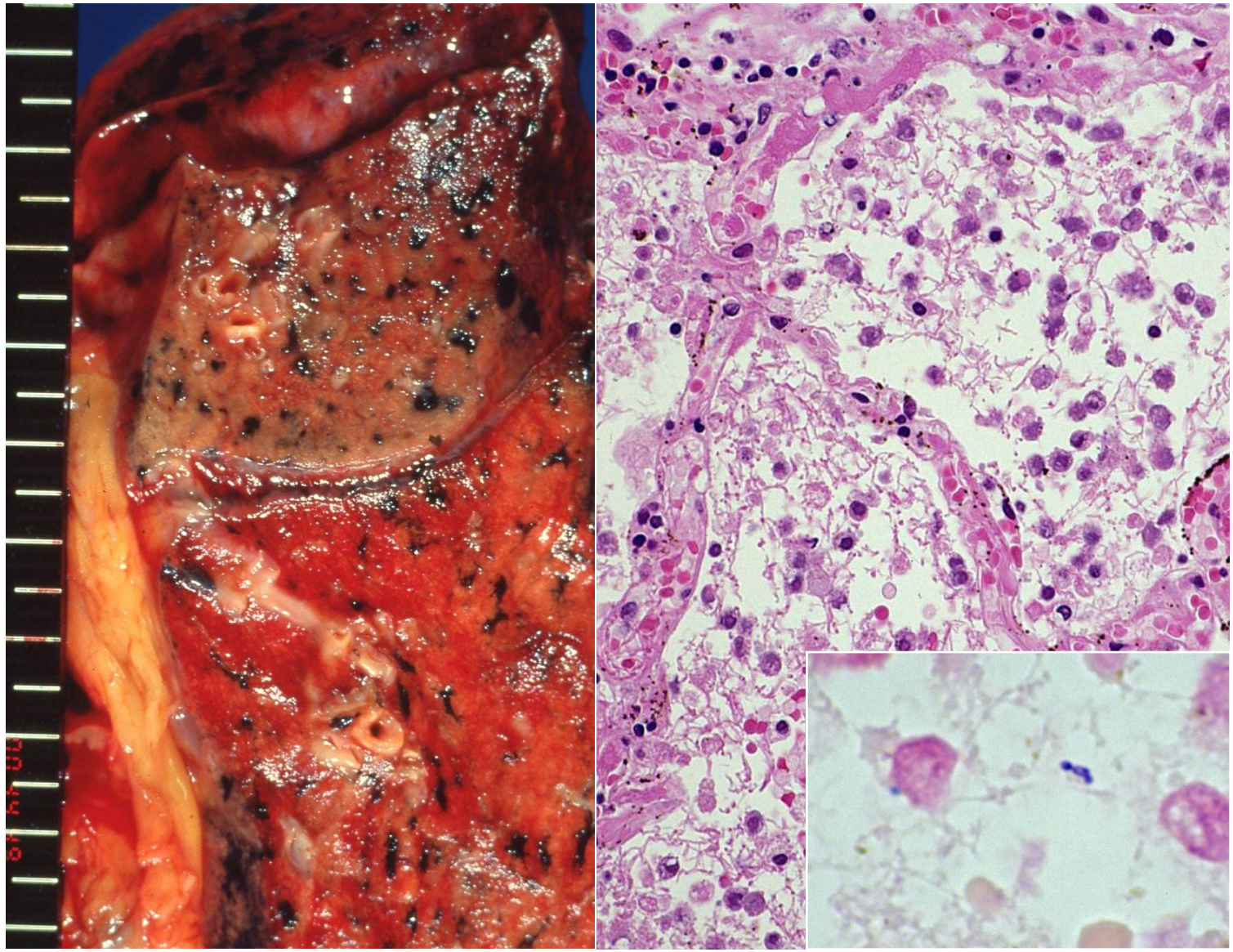
Patient died on the table. How about biohazard?



Diphtheria. The diagnosis was confirmed by the biopsy specimen from the throat. The male patient aged 70's died on the table in the emergency suite. Thick pseudomembrane (asterisk) hampered the intubation trial. Clinicians did not suspect the possibility of diphtheria, because of the lack of experience. The situation was highly biohazardous. DPT vaccination protected the medical staff from transmission.



Diphtheria. The diagnosis was confirmed by the biopsy specimen from the throat. The male patient aged 70's died on the table in the emergency suite. In the pseudomembrane, numbers of Gram-positive rods are demonstrated. Scanning EM features of the causative bacterium (non-flagellated, club-shaped rod) is shown in the right-sided panel. Since no bacterial culture or autopsy was performed in the present case, Gram staining is significantly important for the histopathological diagnosis of diphtheria.



Pneumococcal lobar pneumonia seen in a male patient aged 70's. Neutrophilic infiltration with fibrinous exudation is diffusely seen in the right middle lobe without destruction of the lung structure (left: gross, right: H&E). Inset reveals Gram-positive cocci scattered in the involved alveoli. Biohazard happens during autopsy.

Pathogens without showing cadaver to autopsy executor transmission

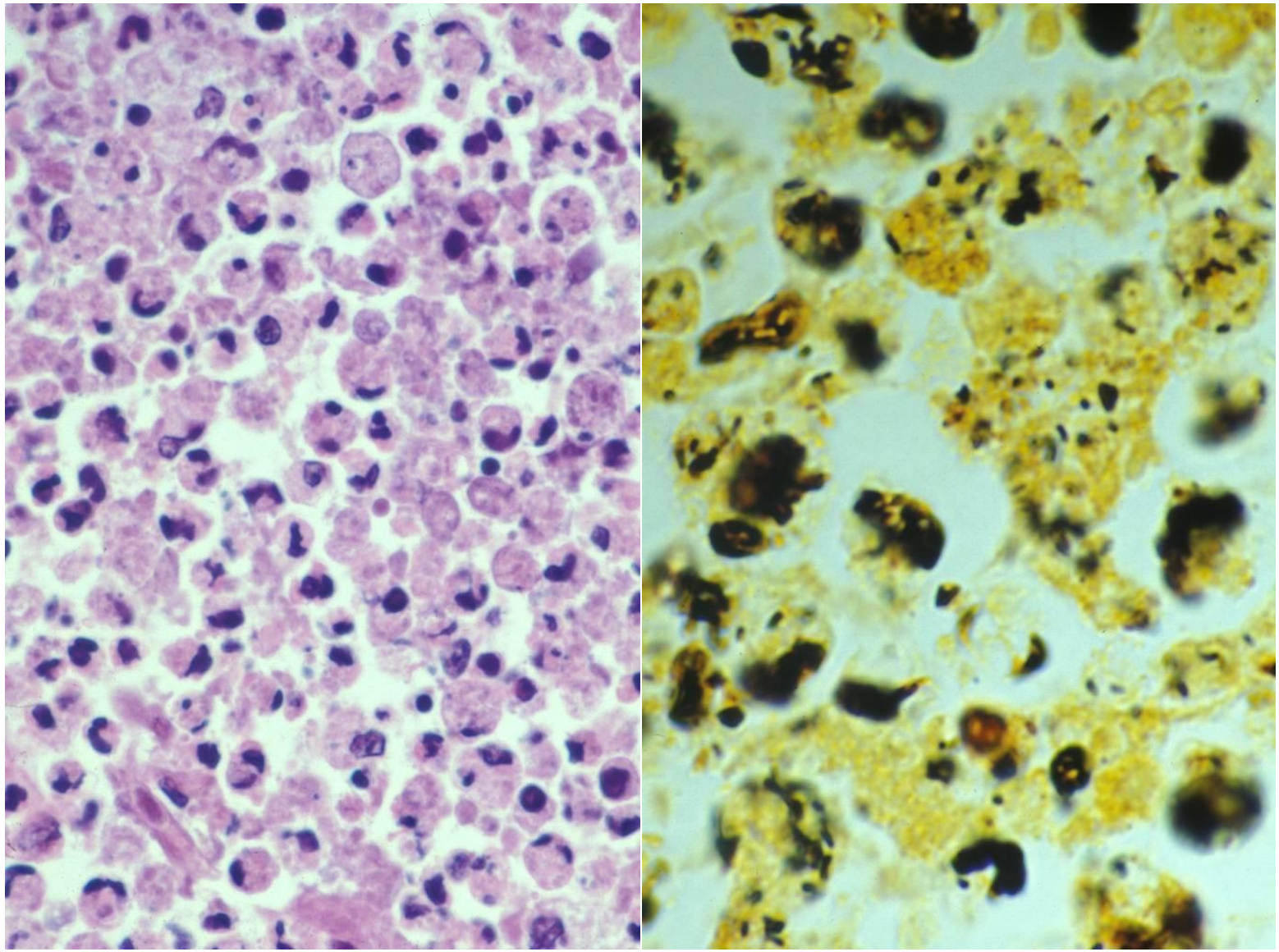
1) Legionella pneumonia

2) Non-tuberculous *Mycobacterium* infection

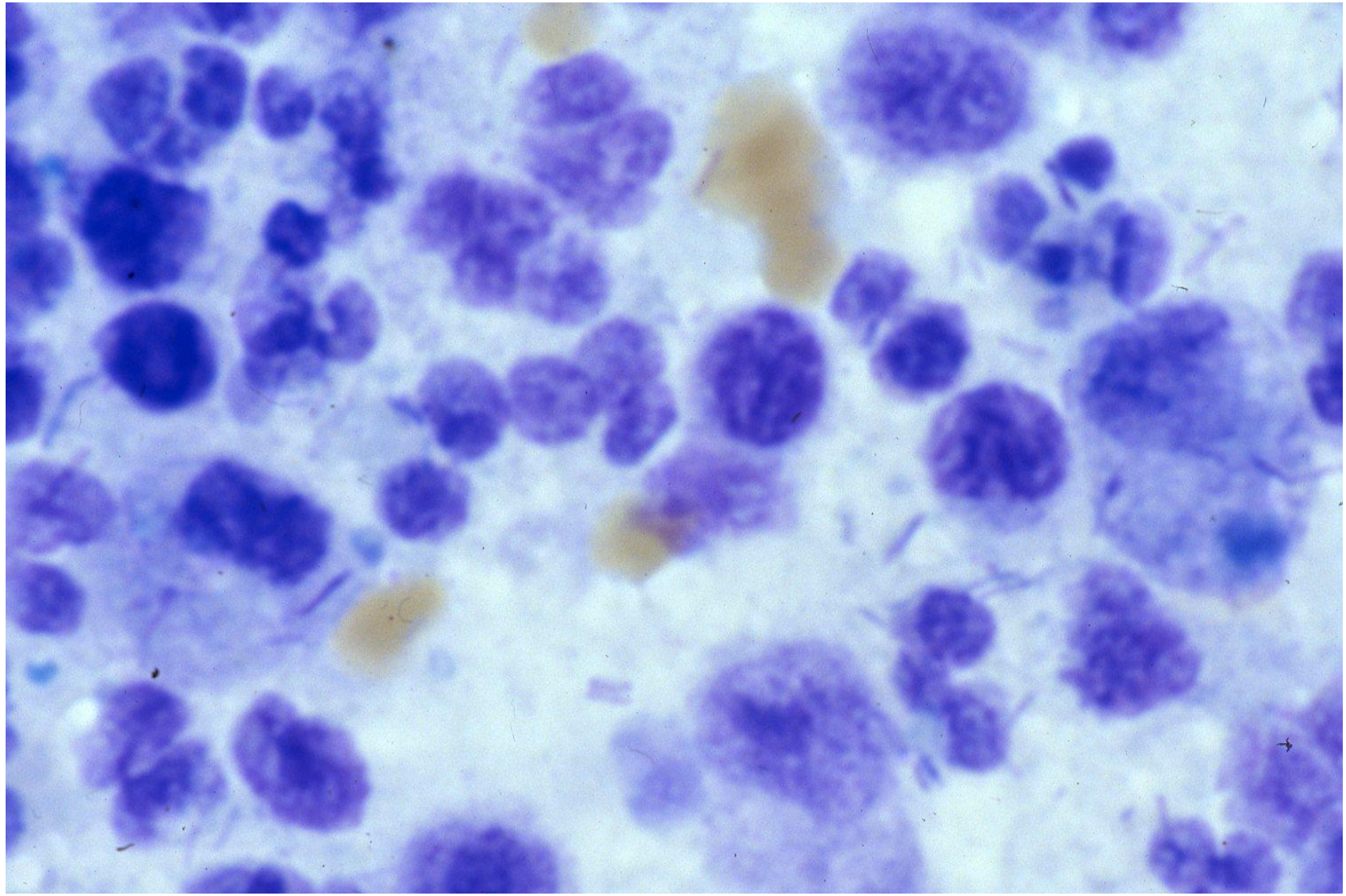
3) Amebic dysentery

4) Meningococcal meningitis (after keeping the cadaver in a refrigerator)

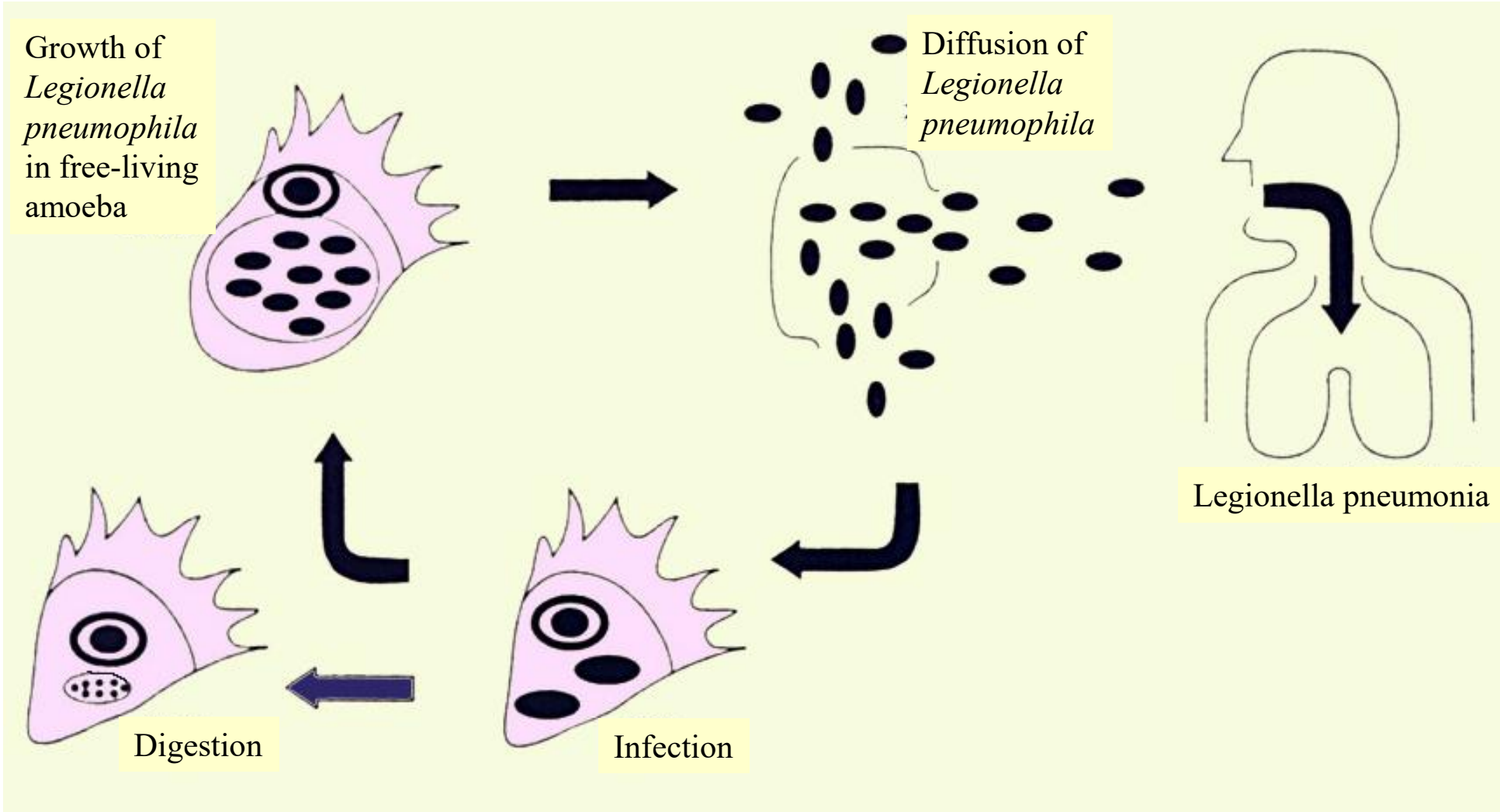
5) Malaria (except for cuts accident)



Legionella pneumonia (left: H&E, right: Warthin-Starry). Note that *Legionella pneumophila* lacks the possibility of human-to-human infectivity.



Stamp smear preparation of legionella pneumonia (Giemsa). During autopsy, lobar pneumonia was found, and the stamp cytology disclosed rods phagocytized by macrophages, confirming the diagnosis of legionella pneumonia and excluding the possibility of biohazard. Student observers thus stayed in the autopsy suite.

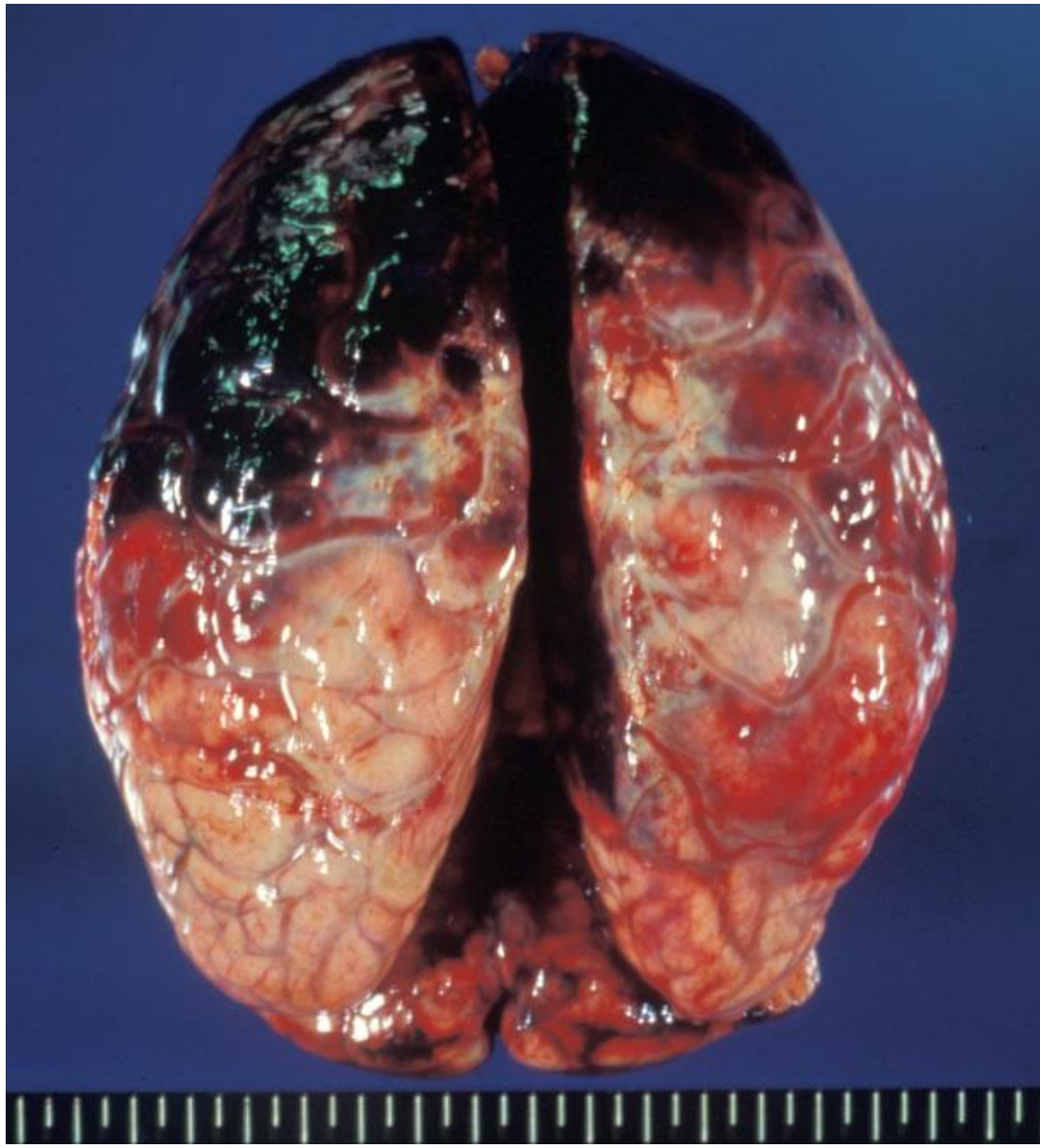


The role of free-living amoeba in environmental water in transmission of *Legionella pneumophila* to the human. Note that no human-to-human transmission happens.

Meningococcal meningitis accompanying Waterhouse-Friederichsen's syndrome

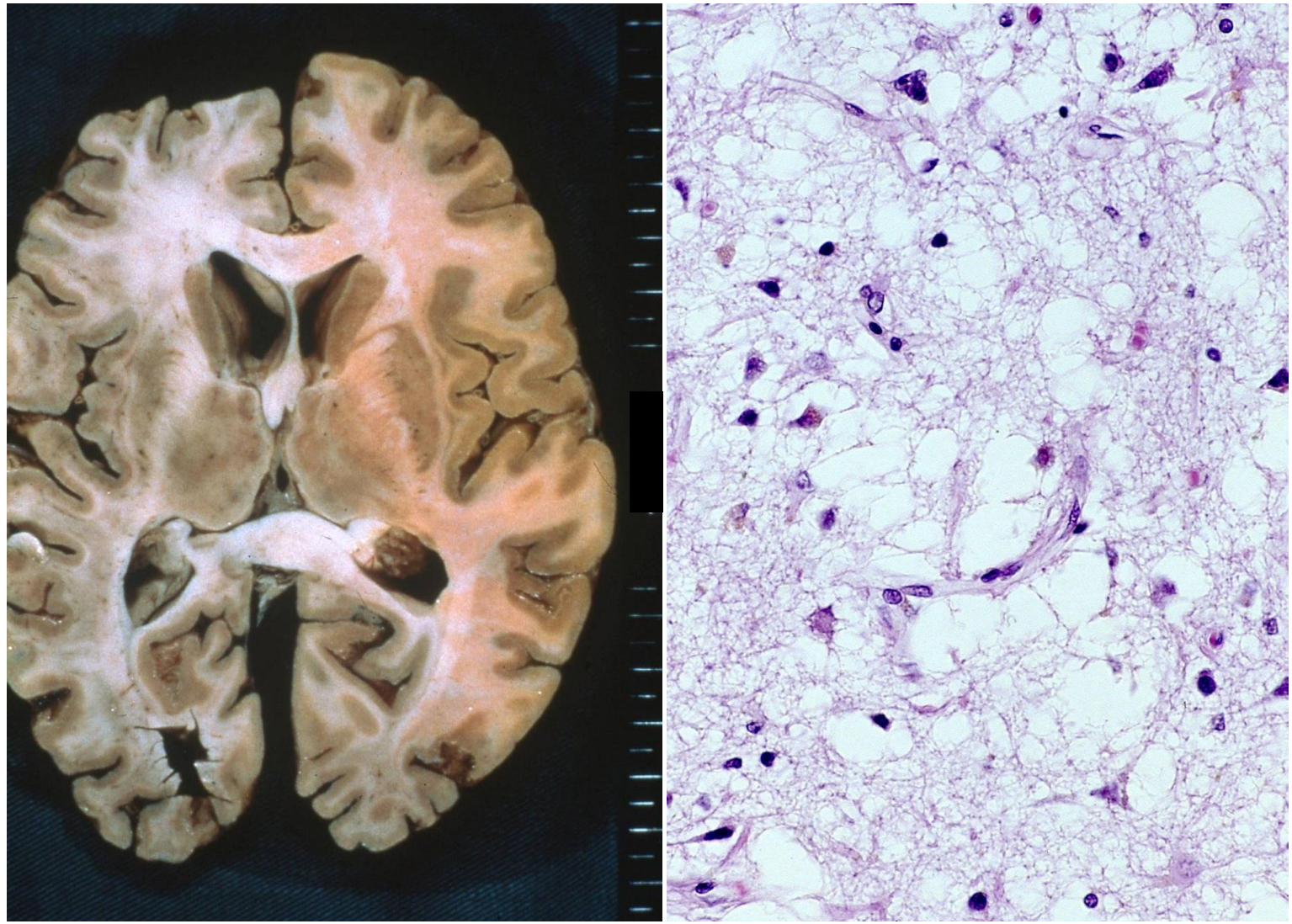
- A 25 years-old Japanese female staying abroad for trip
- Manifesting fever, headache and consciousness disturbance
- Death from disseminated intravascular coagulation and shock
- Clinical course: 3 days; autopsy was done next morning

  The dead body was kept overnight in a refrigerator.
- Culture of cerebrospinal fluid: negative. Why?

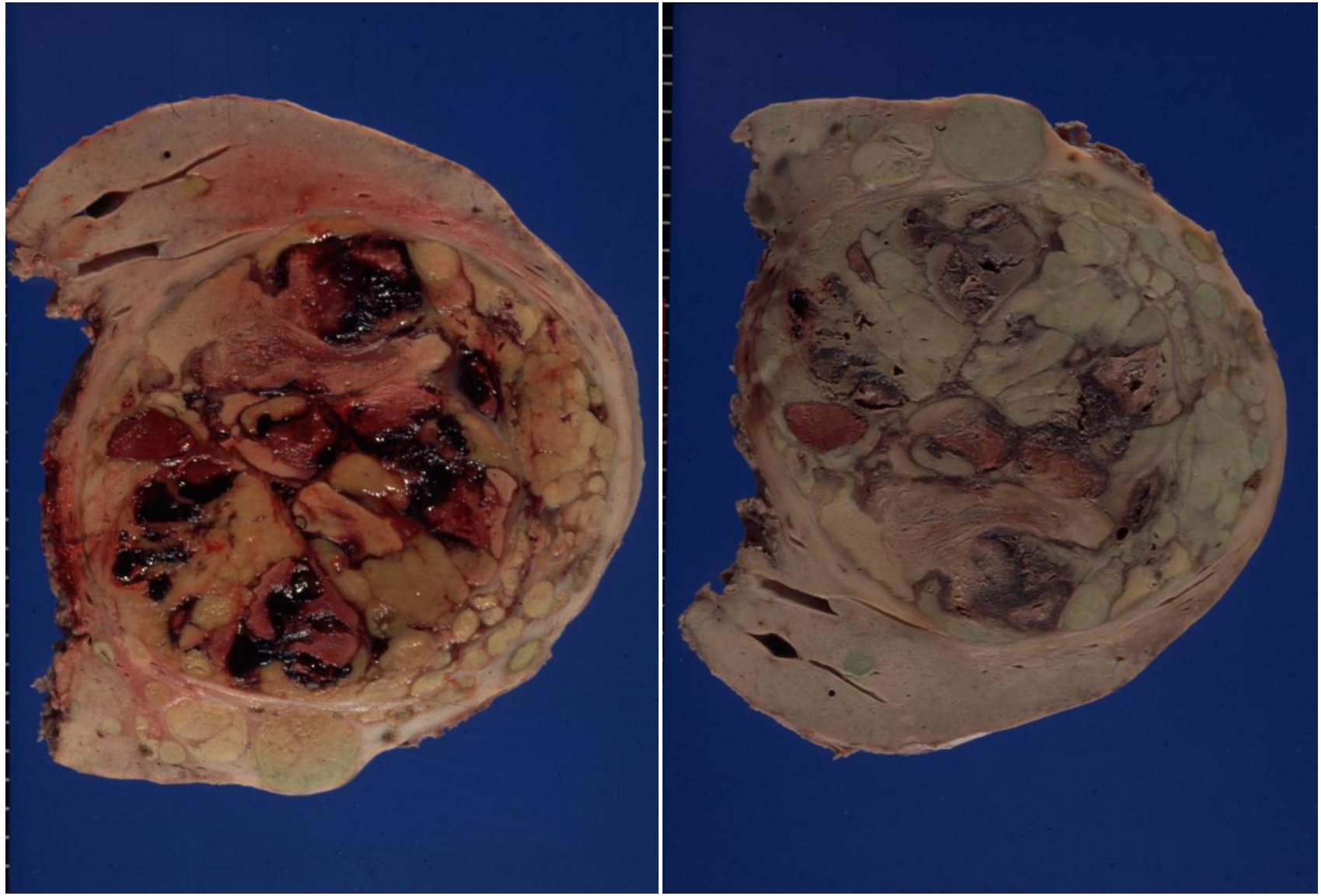


Bilateral adrenal hemorrhage in Waterhouse-Friderichsen's syndrome

Acute hemorrhagic purulent meningitis (3-days clinical course). How about the biohazard in this situation? The cadaver was kept in refrigerator overnight. The exposure at low temperature inactivated the meningococcal activity. The secondary dissemination in the autopsy suite did not occur.



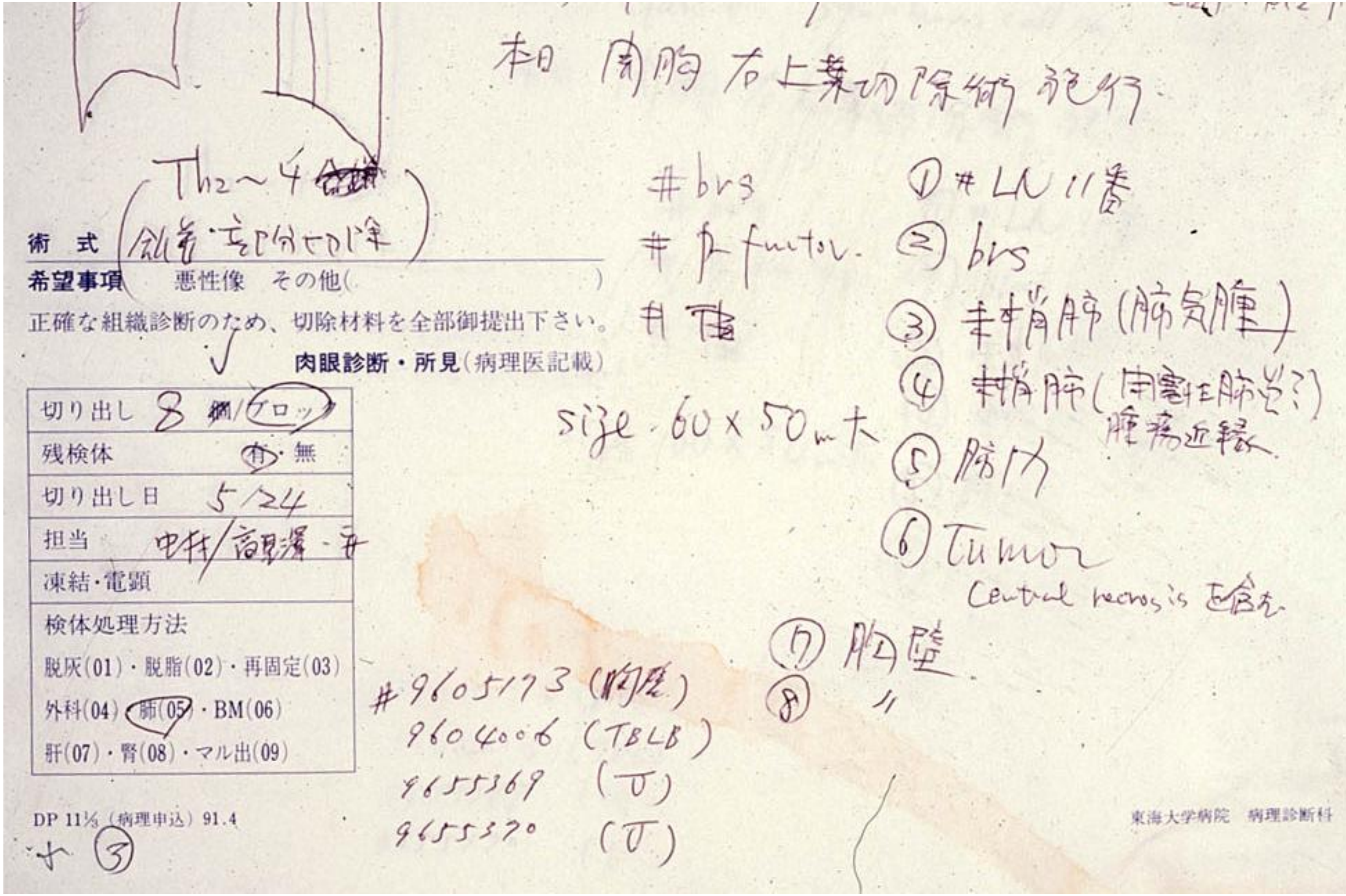
Creutzgeldt-Jakob's disease caused by prion infection. Progressive dementia is noted. At autopsy, the cerebral cortex is diffusely atrophic and pigmented (left: cut surface of the brain). Spongiform change is evident in the cerebral corted (right: H&E). The prion is resistant to formalin fixation and paraffin embedding. To inactivate the prion infectivity, soaking in 100% formic acid is effective.



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%



術式 縦隔・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 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)	

DP 11⅓（病理申込）91.4

東海大学病院 病理診断科

Th2〜4

#brs

size 60 x 50 mm 大

① #LN 11番

② brs

⑥ Tumor

Central necrosis

⑦ 胸壁

⑧ 〃

#9605173

9604006 (TBLB)

9655369

9655370

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