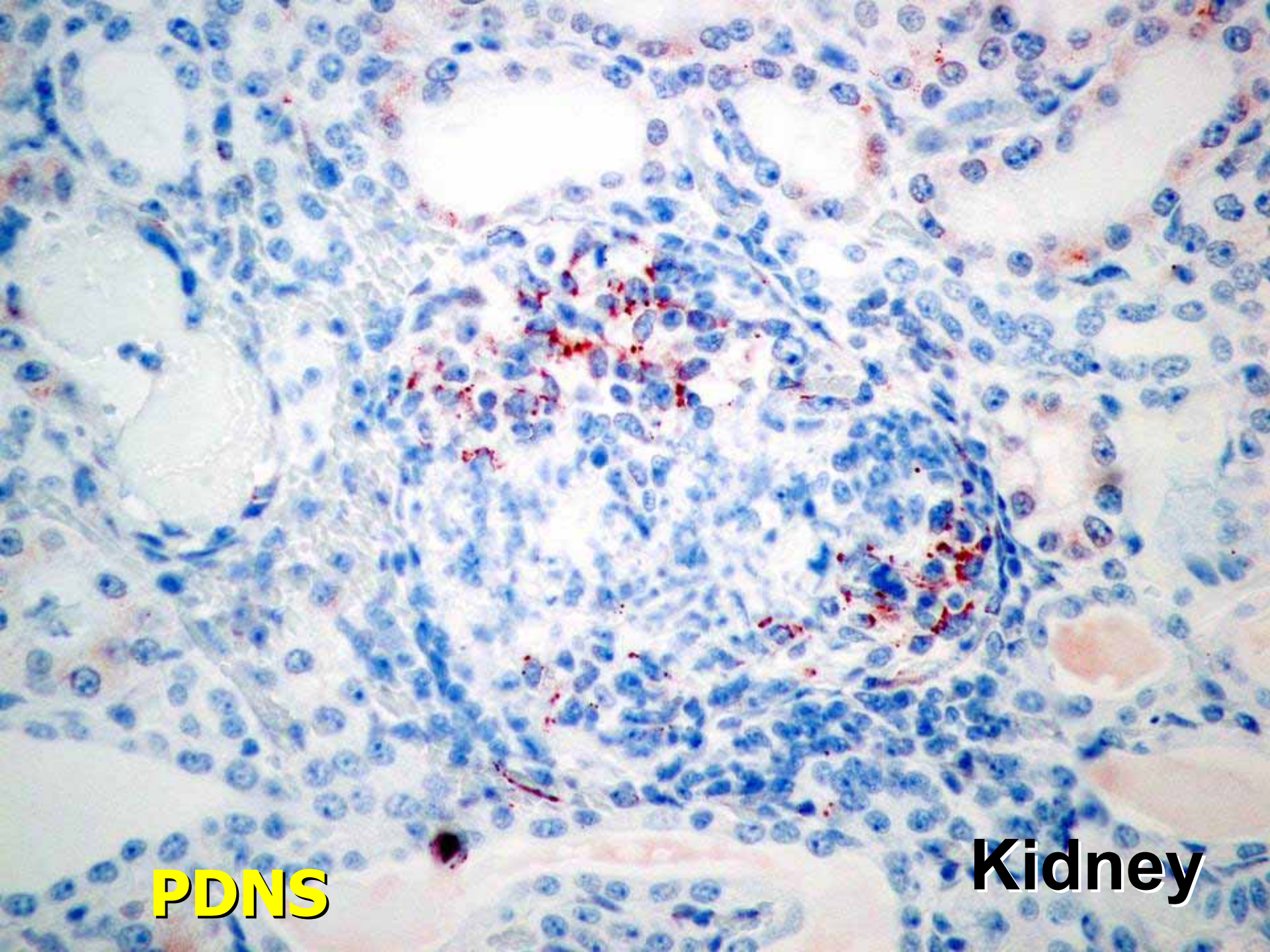
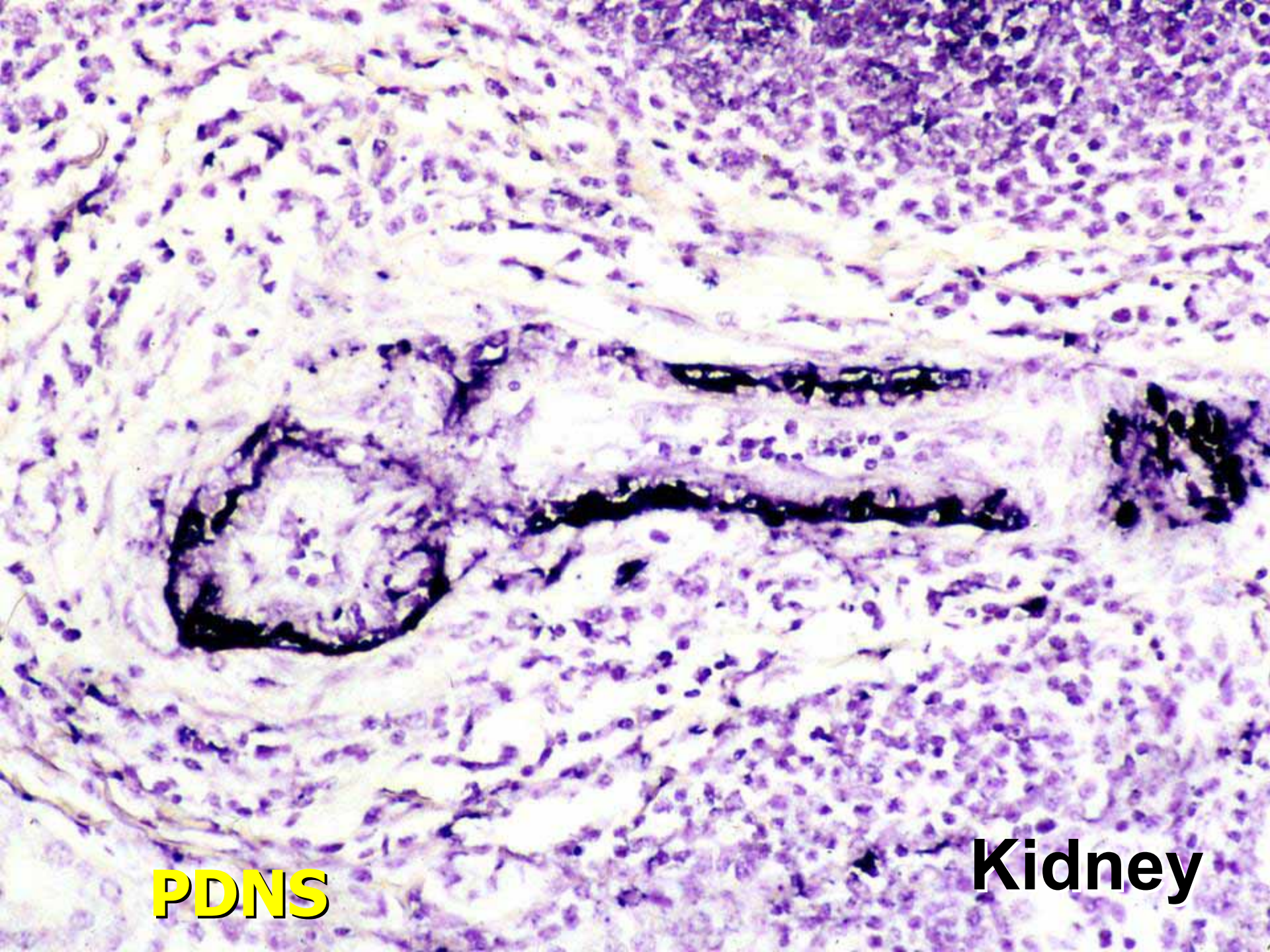
Porcine Dermatitis and Nephropathy Syndrome

- Etiology, pathogenesis, and immunologic mechanisms for this syndrome unclear
  - PRRS virus via immune mediated vasculitis
  - PCV2 has been associated with PDNS
  - Single variant of *P. multocida*
  - Variant of *S. typhimurium*
  - Various other bacterial organisms
  - Combos
  - Other????


PDNS
Kidney


PDNS
Kidney

Torque Teno Viruses

- Anelloviruses in family Circoviridae
- Encapsulated single stranded circularized DNA
- Described in humans, primates, cattle, swine, cats
- Generally considered orphan viruses
- Common contaminants of vaccines and drugs
- TTV1 and TTV2 described in swine, 2.9 kb viruses
- Virus detected in lungs, ileum, lymph nodes, tonsil
- TTV1 causes no clinical signs in experimentally inoculated gnotobiotic pigs, but interstitial pneumonia, membranous glomerulonephrosis, transient thymic atrophy, and modest lymphocytic to histiocytic infiltrates in the liver
- Co-infection of PCV2 and TTV1 caused PMWS in gnotobiotic pigs
- TTV2 more commonly seen in pigs with PMWS

Torque Teno Virus and PDNS

- Recent reproduction of cutaneous and renal PDNS-like lesions in gnotobiotic pigs with PRRSV and g1-TTV co-infection (no PCV2)
- Lesions 7 days PI, most severe 2 weeks PI
- Seroconversion to PRRSV 21 days PI
- G1-TTV viremia 7 days PI
- Questionable immunocomplex pathogenesis
- Rapid onset systemic coagulation defect/DIC?

Porcine Respiratory Disease Complex (PRDC)

- Clinical manifestation of multiple disease agents working in concert
  - Subclinical bacterial infection ≠ pneumonia
  - Viral versus Bacterial Disease
  - Primary and secondary pneumonia
    - Initiators vs. Followers
- Impaired lung defenses
  - Level of challenge
  - Risk factors for bacterial pneumonia
  - Virulence of bacterial organism

Proliferative and Necrotizing Pneumonia (PNP)

- Mainly in nursery and finishing pigs
- Clinical signs: fever, dyspnea, and abdominal respiration,
  coughing not a significant finding
  survivors with growth retardation/wasting
- Gross lesions: confluent consolidation of cranial lobes
- Microscopic lesions: necrosis, fibrin exudation, hyaline membranes, type II pneumocyte proliferation, syncytial cells
- Numerous etiologic agents have been implied:
  - PCV2 and PRRSV co-infection
  - New antigenic variant of H1N1 swine influenza virus A

Increased Risk of PCVAD

- High stocking density
- Frequent mixing of pigs
- Large variation in age in pens or rooms
- ☮ 200 pigs per air space
- Low ventilation rates
- Non-solid partitions between pens
- Breaches in biosecurity
- Other infections in herd (PPV, PRRSV, Mycoplasma spec.)
- Other PMWS herds in less than 3 km distance
- Earlier PCV2 infection in herd
- Low levels of neutralizing PCV2 antibodies
- Infection with PCV2 type 1

Prevention and Control of PCVAD

- Biosecurity
  - Control visitors/rodents/animals
  - Wash sows and treat for parasites before farrowing
  - Ensure strict hygiene (tail and teeth clipping, injections…)
- Production/Management
  - Apply strict all-in / all-out
  - Limit cross-foster (within 24 hours of farrowing only)
  - Lower stocking density (3 pigs / m^2), do not mix batches
  - Use small pens (<13 animals), solid partitions
  - Increase space at the feeder (> 7 cm / piglet)
  - Adequate colostrum
- Environment
  - Improve temperature control
  - Improve air quality (NH_3 < 10ppm, CO_2 < 0.15%)
- Herd Health
  - Use the appropriate vaccination program
  - Ensure sensible flow within buildings (air, animals)
  - Remove sick pigs in a timely manner (hospital or euthanasia)

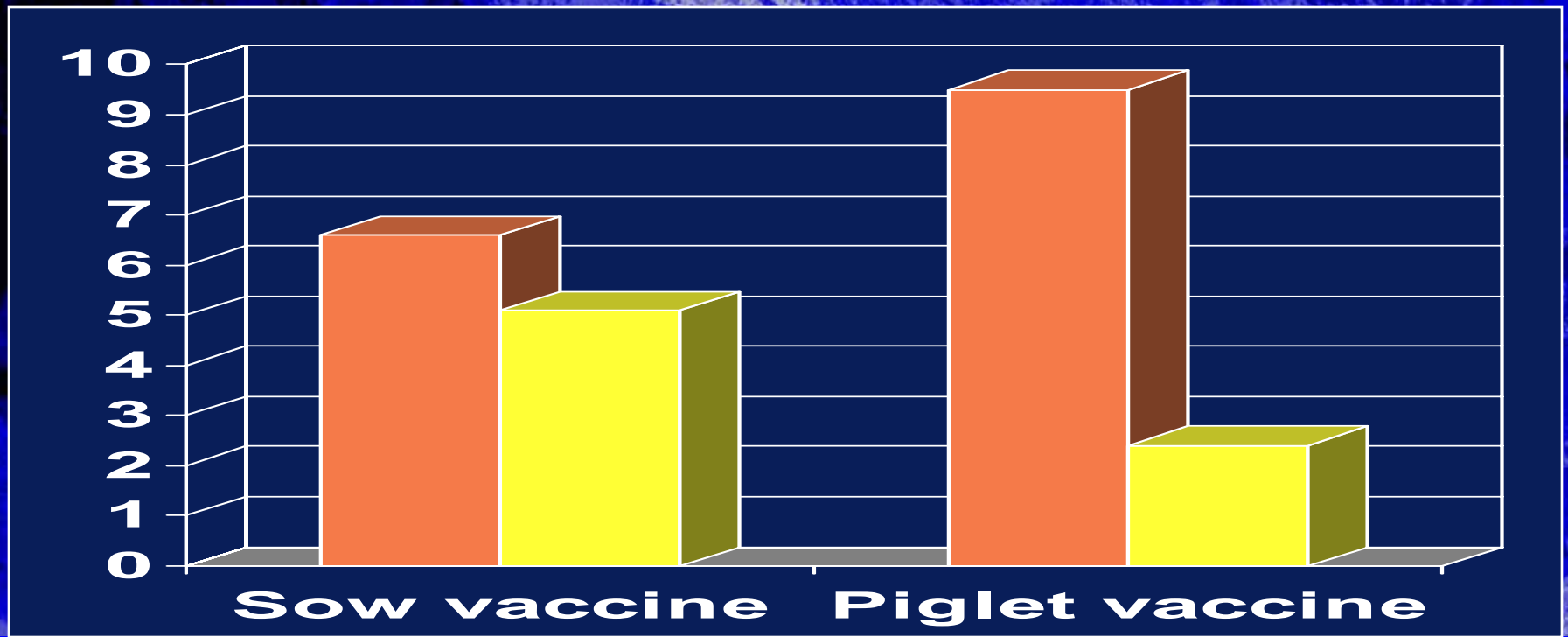
Vaccination against PCVAD

- Licensed vaccines available in US and Europe

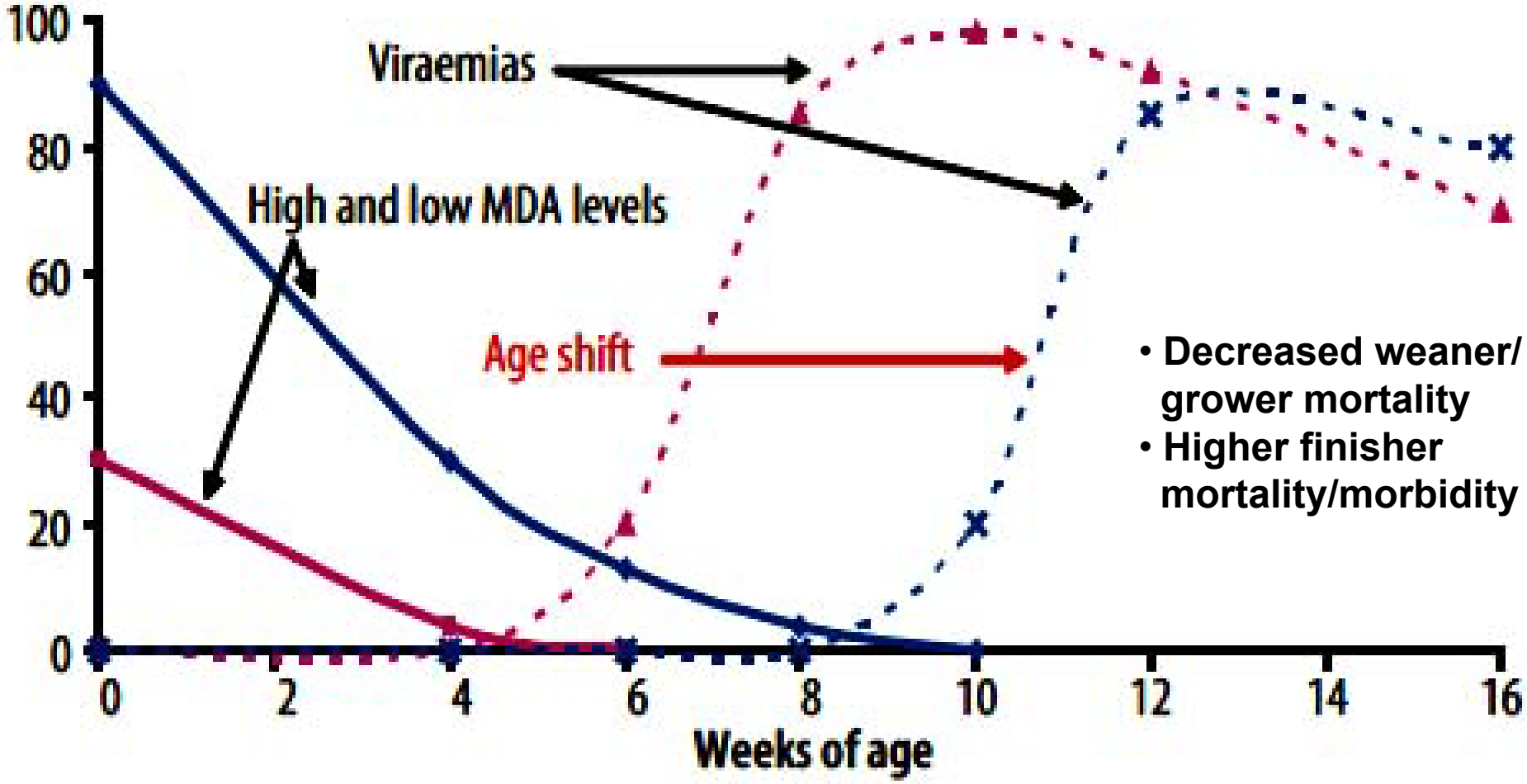
Company	Product	Sow/Piglet	Type of Vaccine	Adjuvant	Number of injections
Merial	Circovac	Sow	Killed PCV2 virus	Mineral oil	2+ boosters each gestation
Boehringer Ingelheim	Ingelvac Circoflex	Piglet (2 weeks +)	PCV2 capsid	Aqueous polymer	1
Fort Dodge	Suvaxyn PCV2 One Dose	Piglet (4+ weeks)	Killed recombinant PCV1 & 2	SL-CD aqueous	1
Intervet	Porcilis PCV	Piglet (3+ weeks)	PCV2 capsid	Diluvac Tocopherol	2

Vaccination against PCVAD

- Sow vaccine dropped finisher mortality from 6.6% > 5.1%
- Piglet vaccine dropped finisher mortality from 9.5% > 2.4 %

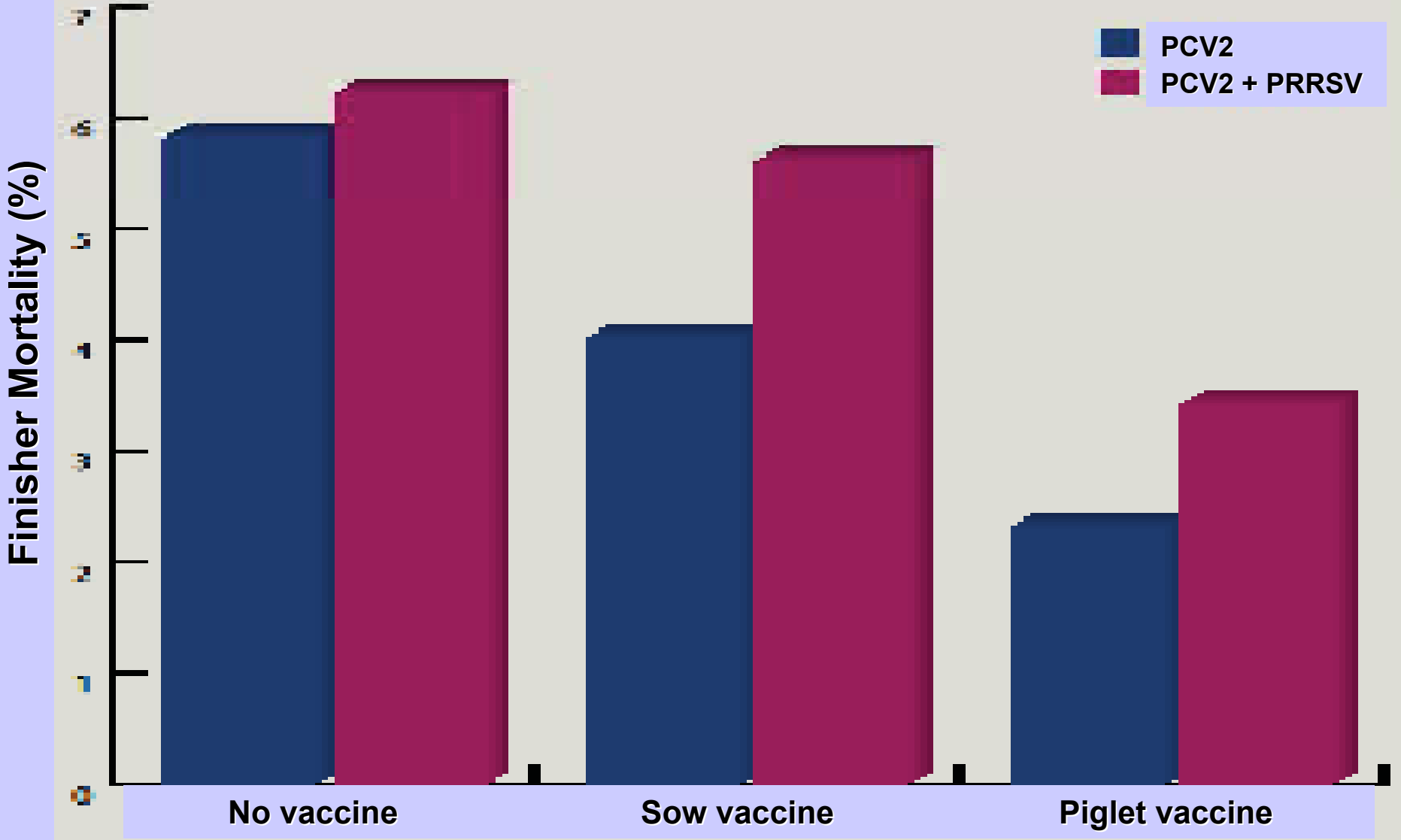


Effects of Low and High Levels of Maternally Derived Antibodies on Age when PCV2 Viremia Occurs



- Decreased weaner/ grower mortality
- Higher finisher mortality/morbidity

Vaccination against PCV2

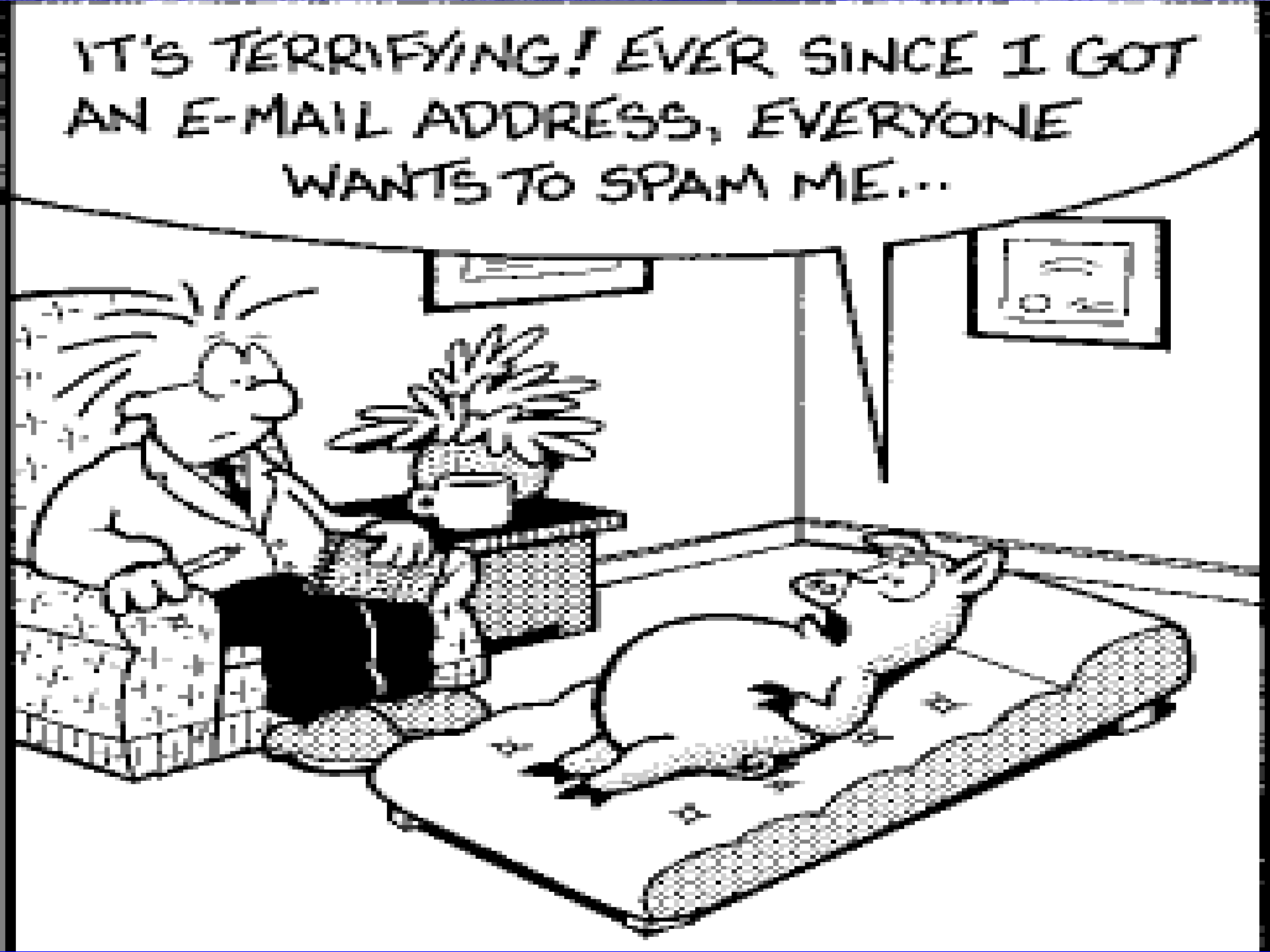


PCV in other species

- PCV2 nucleic acid detected in dairy cattle, sheep and bison:
  - in lungs with interstitial pneumonia (Nayar et al., 1999)
  - in tissues of aborted fetuses
- Antibodies against PCV detected in:
  - humans, mice and cattle (Tischer et al., 1995)
  - highest seroprevalence among hospitalized patients with fever of unclear etiology
- No antibodies against PCV detected in other species (Allan et al., 1994) and veterinarians (Allan et al., 2000)
- PCV1 can be grown in cell lines of different species including bovine, ovine and green monkey (Allan et al., 1994)
- Experimental inoculation of lambs with PCV2 failed to produce lesions and seroconversion (Ellis et al., 2000)

Conclusions

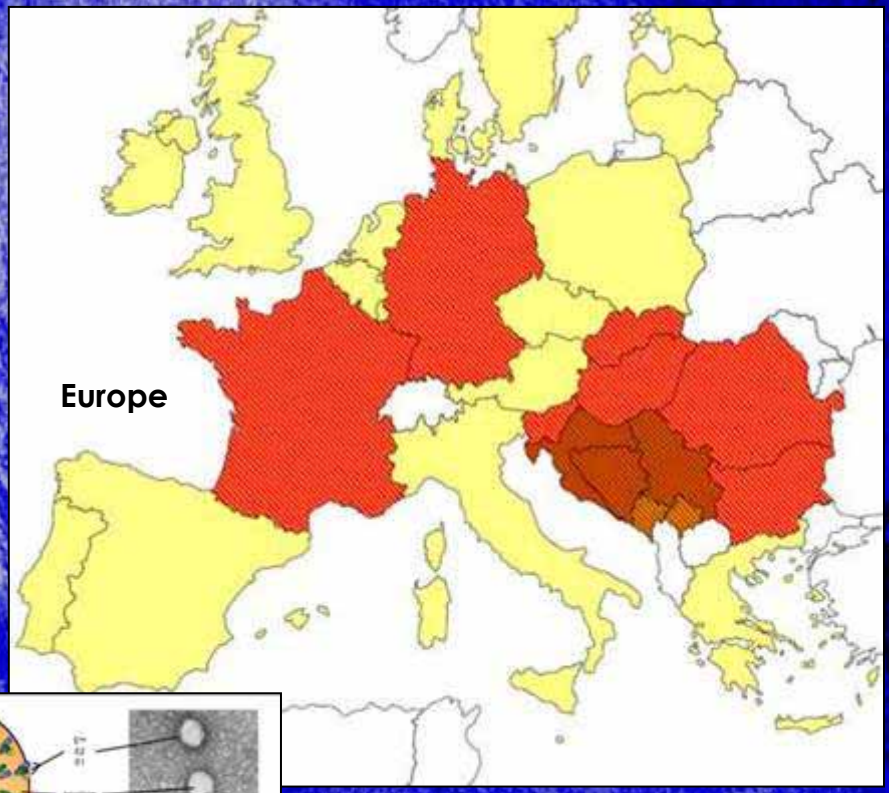
- PCV2 is an indisputable pathogen and principle cause of PMWS!
- PCV2 causes common subclinical infection!
- Cofactors are required for clinical disease?
- Stimulation of replication of PCV2 is crucial for development of PMWS!
- PCV2 is a reproductive pathogen?
- PCV is a potential initiator of multiple other disease syndromes

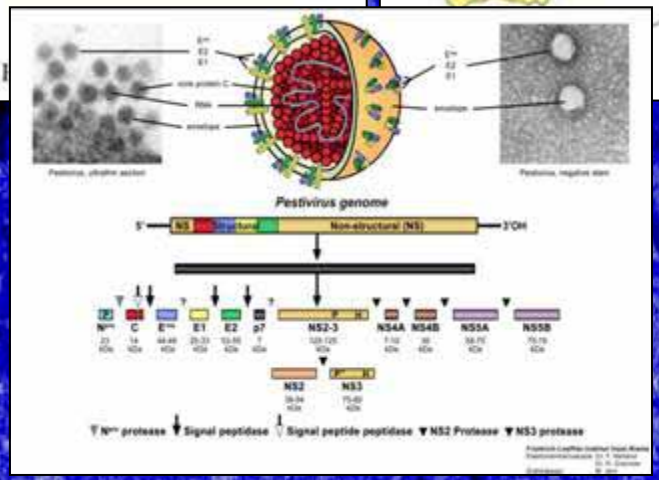

IT'S TERRIFYING! EVER SINCE I GOT AN E-MAIL ADDRESS, EVERYONE WANTS TO SPAM ME...

Classical Swine Fever

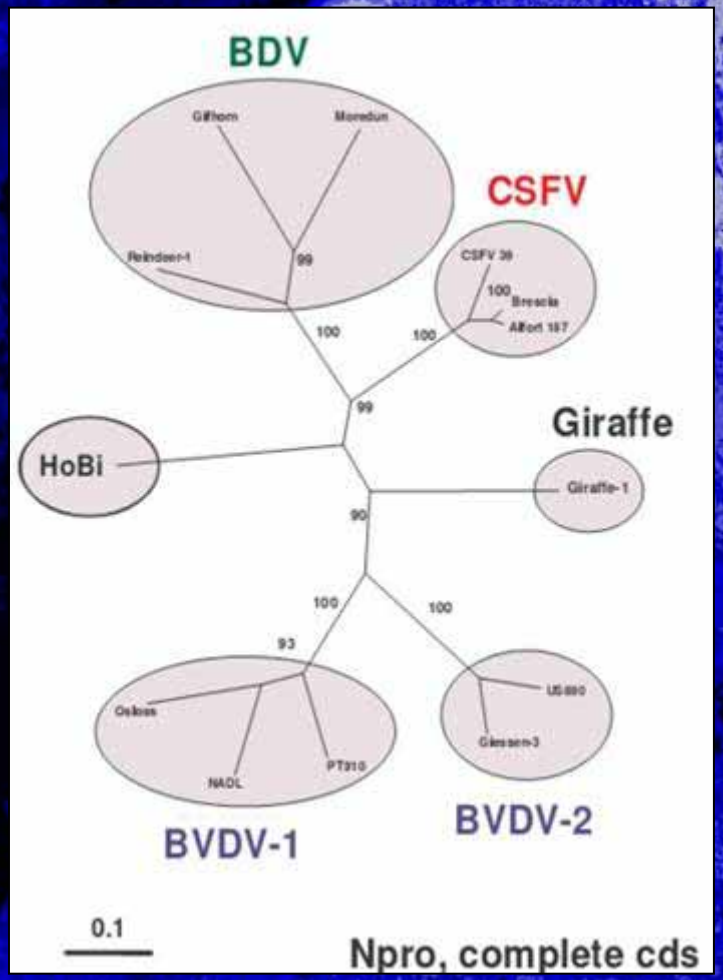
- Forms: acute, subacute, reproductive
- Pyrexia, cutaneous cyanosis, conjunctivitis, anorexia, constipation followed by severe diarrhea (“cholera”), convulsions and death
- Peripheral hemorrhages of lymph nodes, generalized vasculitis, tonsillar necrosis, splenic infarcts, serosal hemorrhages, button ulcers in colon
- Mummified, stillborn and weakborn pigs, congenital tremors, cerebellar hypo- or aplasia, limb deformation, arthrogryposis

Classical Swine Fever





Classical Swine Fever



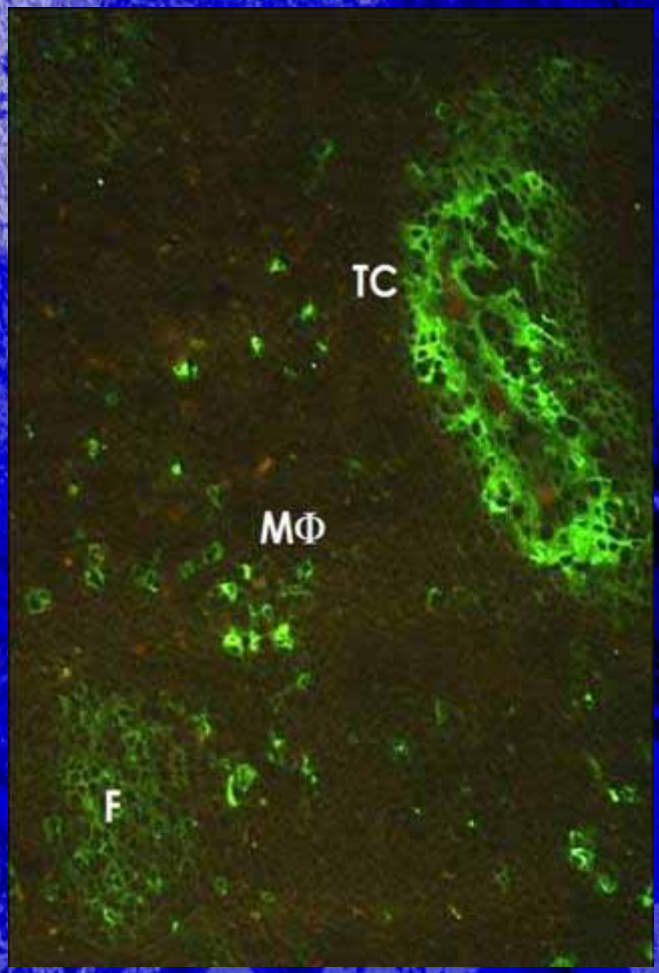
Flaviviridae
Pestivirus

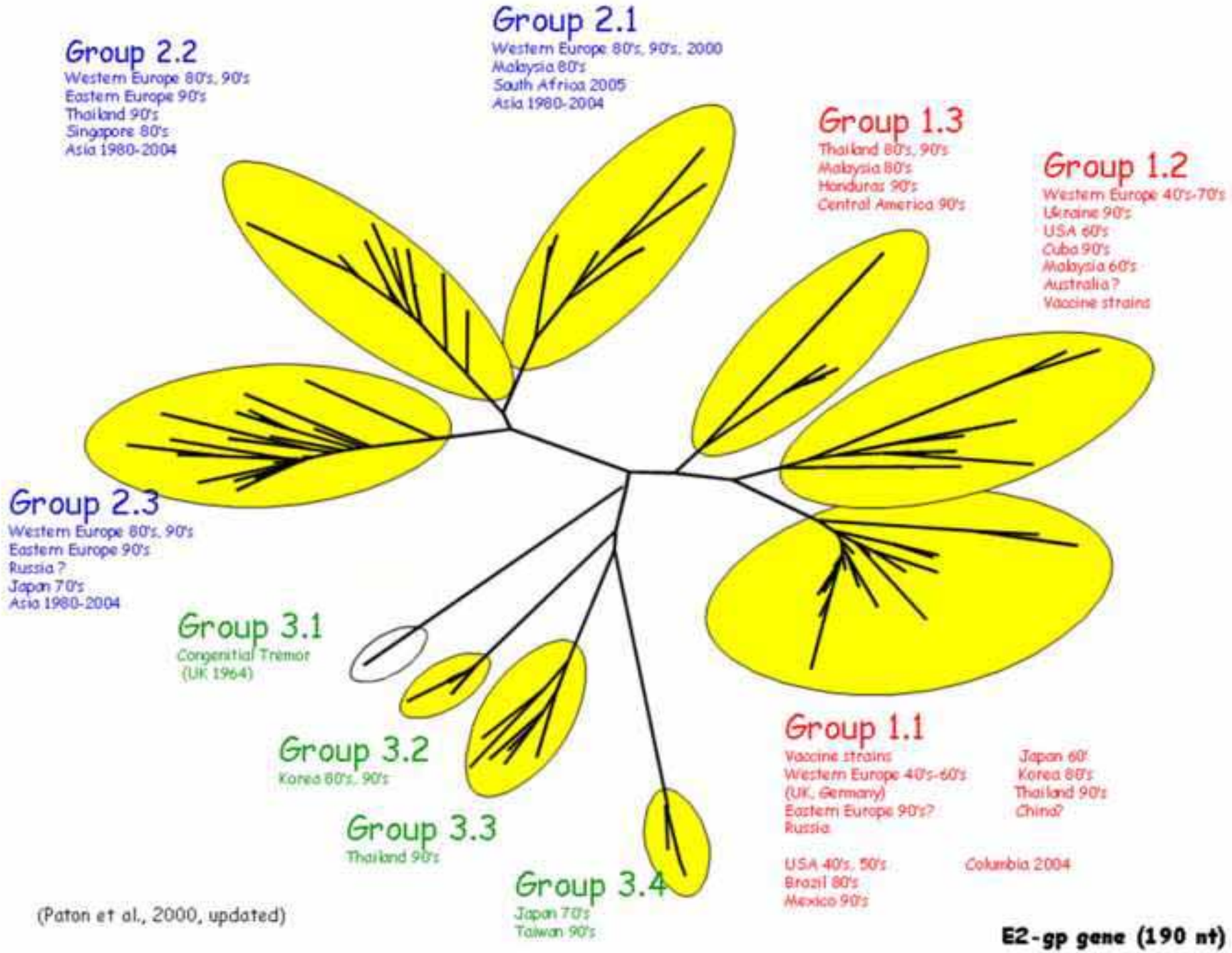
CSFV
Classical Swine Fever Virus

BVDV
Bovine Viral Diarrhea Virus
BVDV-1
BVDV-2

BDV
Border Disease Virus
BDV 1
BDV 2
BDV 3

„Atypical“ Pestiviruses
Giraffe pestivirus
HoBi (FCS, Brazil)
Pronghorn antelope virus
Bungowannah virus




Group 2.1
Western Europe 80's, 90's, 2000
Malaysia 80's
South Africa 2005
Asia 1980-2004
Group 2.2
Western Europe 80's, 90's
Eastern Europe 90's
Thailand 90's
Singapore 80's
Asia 1980-2004
Group 1.3
Thailand 80's, 90's
Malaysia 80's
Honduras 90's
Central America 90's
Group 1.2
Western Europe 40's-70's
Ukraine 90's
USA 60's
Cuba 90's
Malaysia 60's
Australia?
Vaccine strains
Group 2.3
Western Europe 80's, 90's
Eastern Europe 90's
Russia ?
Japan 70's
Asia 1980-2004
Group 3.1
Congenital Tremor
(UK 1964)
Group 3.2
Korea 80's, 90's
Group 3.3
Thailand 90's
Group 3.4
Japan 70's
Taiwan 90's
Group 1.1
Vaccine strains
Western Europe 40's-60's
(UK, Germany)
Eastern Europe 90's?
Russia
Japan 60'
Korea 80's
Thailand 90's
China?
USA 40's, 50's
Brazil 80's
Mexico 90's
Columbia 2004
(Paton et al., 2000, updated)
E2-gp gene (190 nt)


CSF


CSF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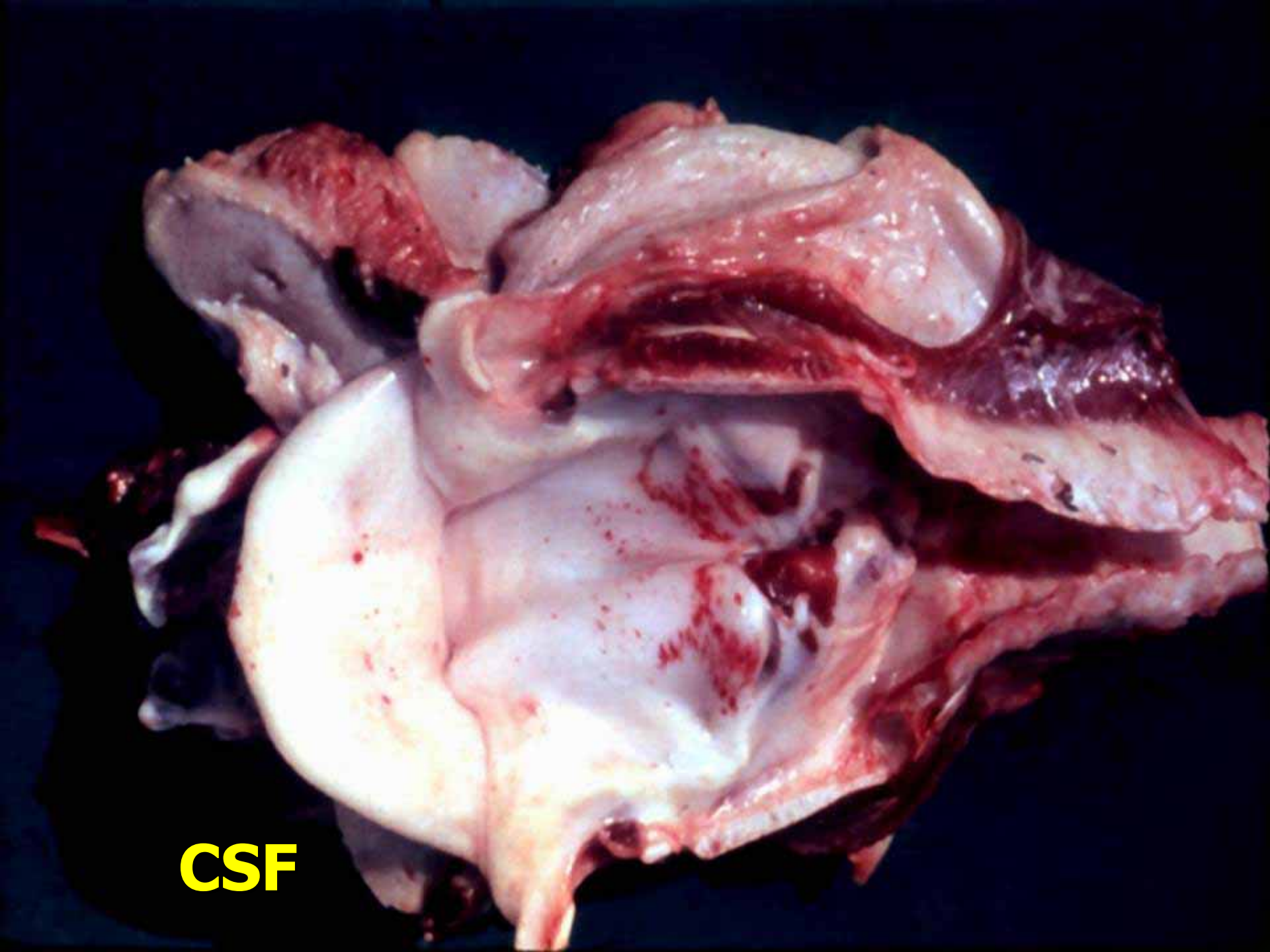
CSF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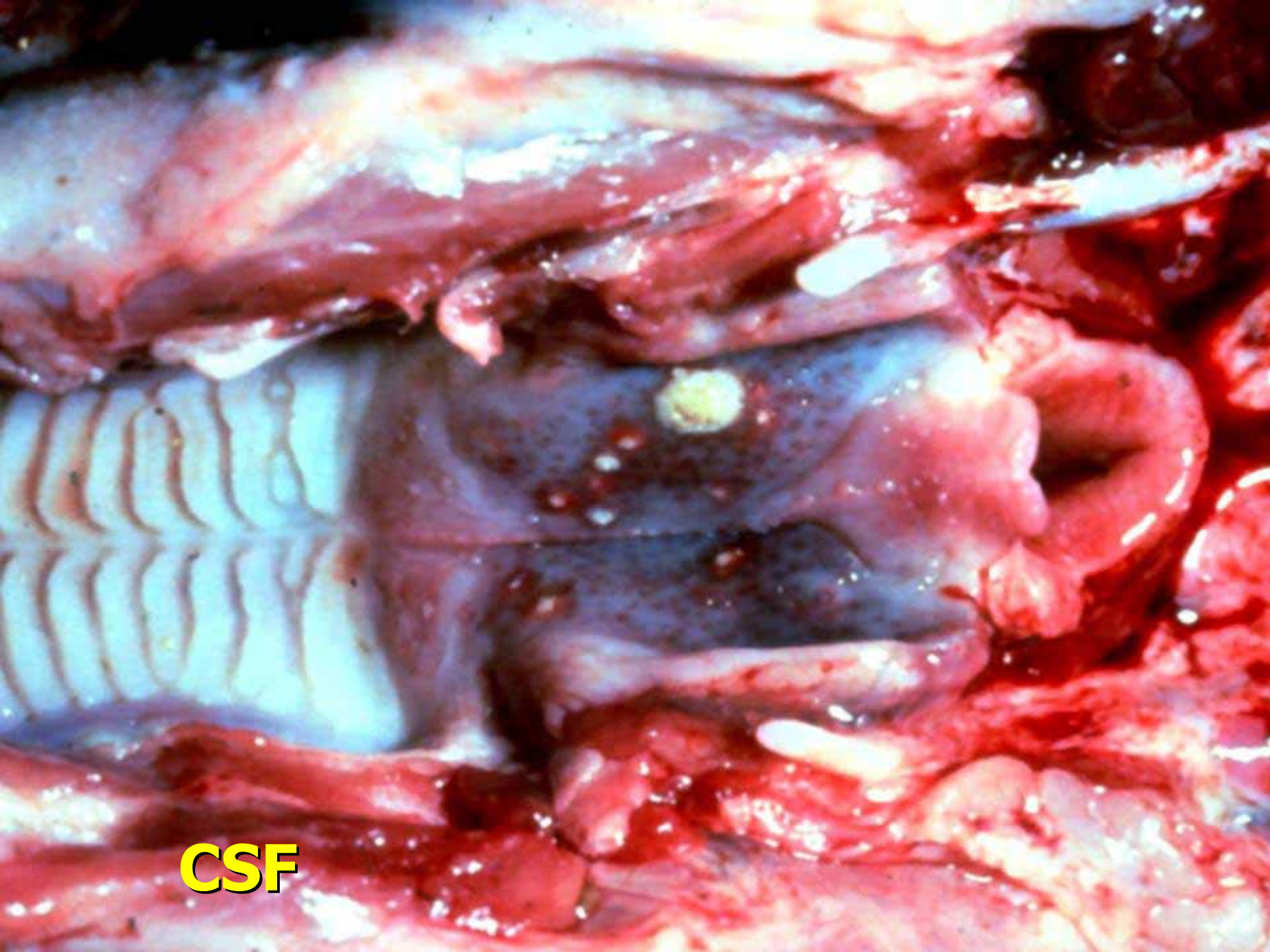
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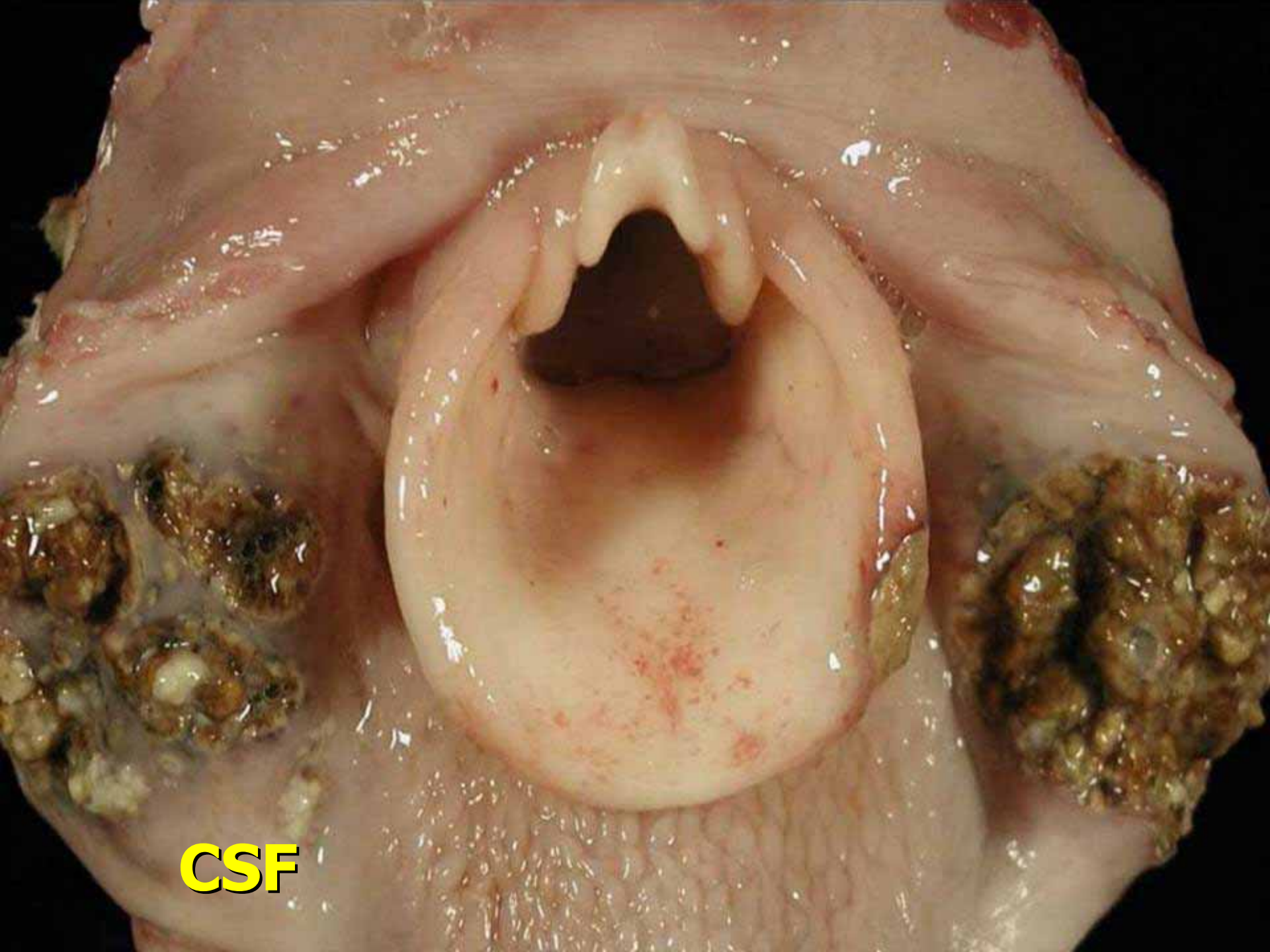
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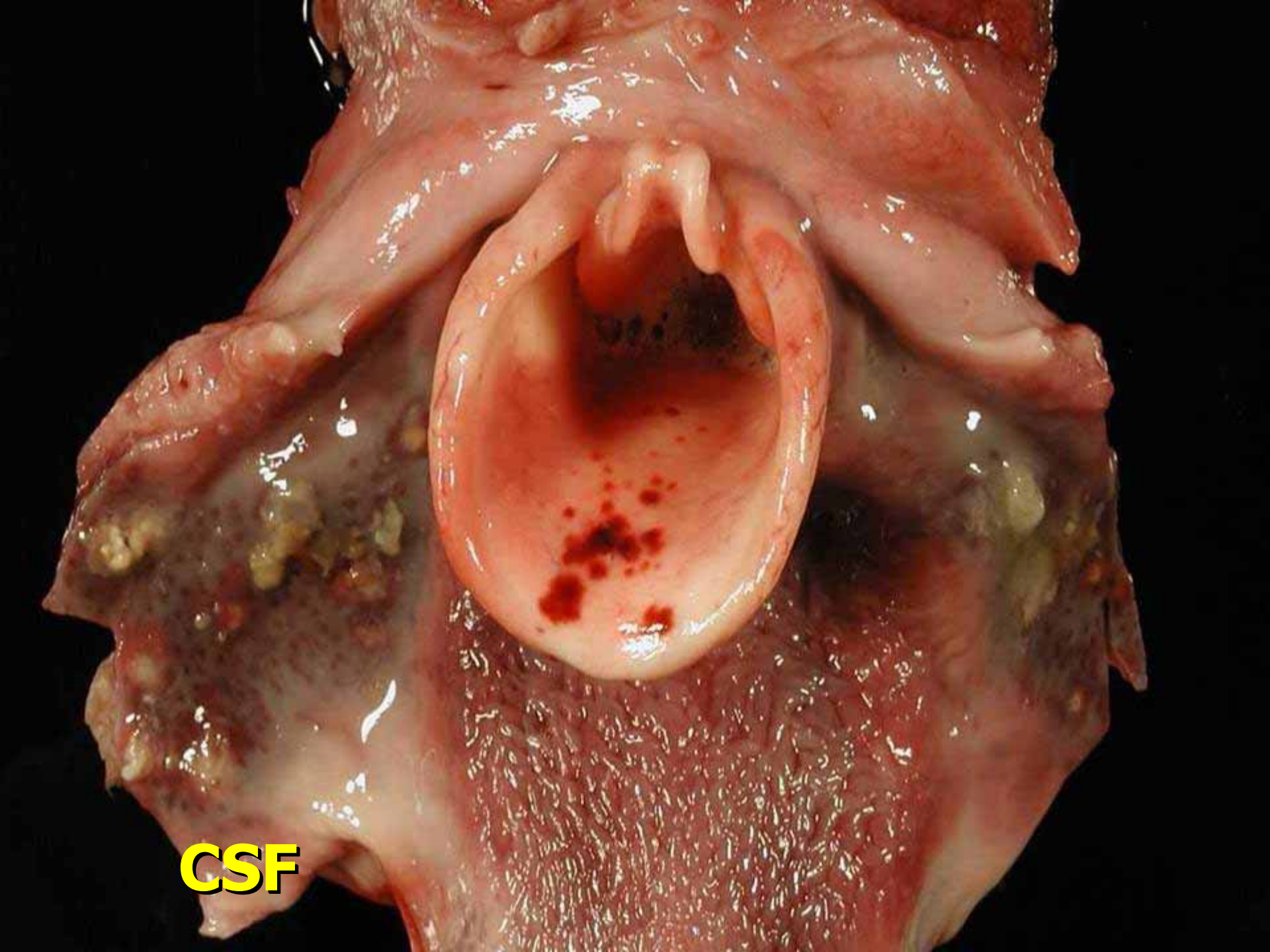
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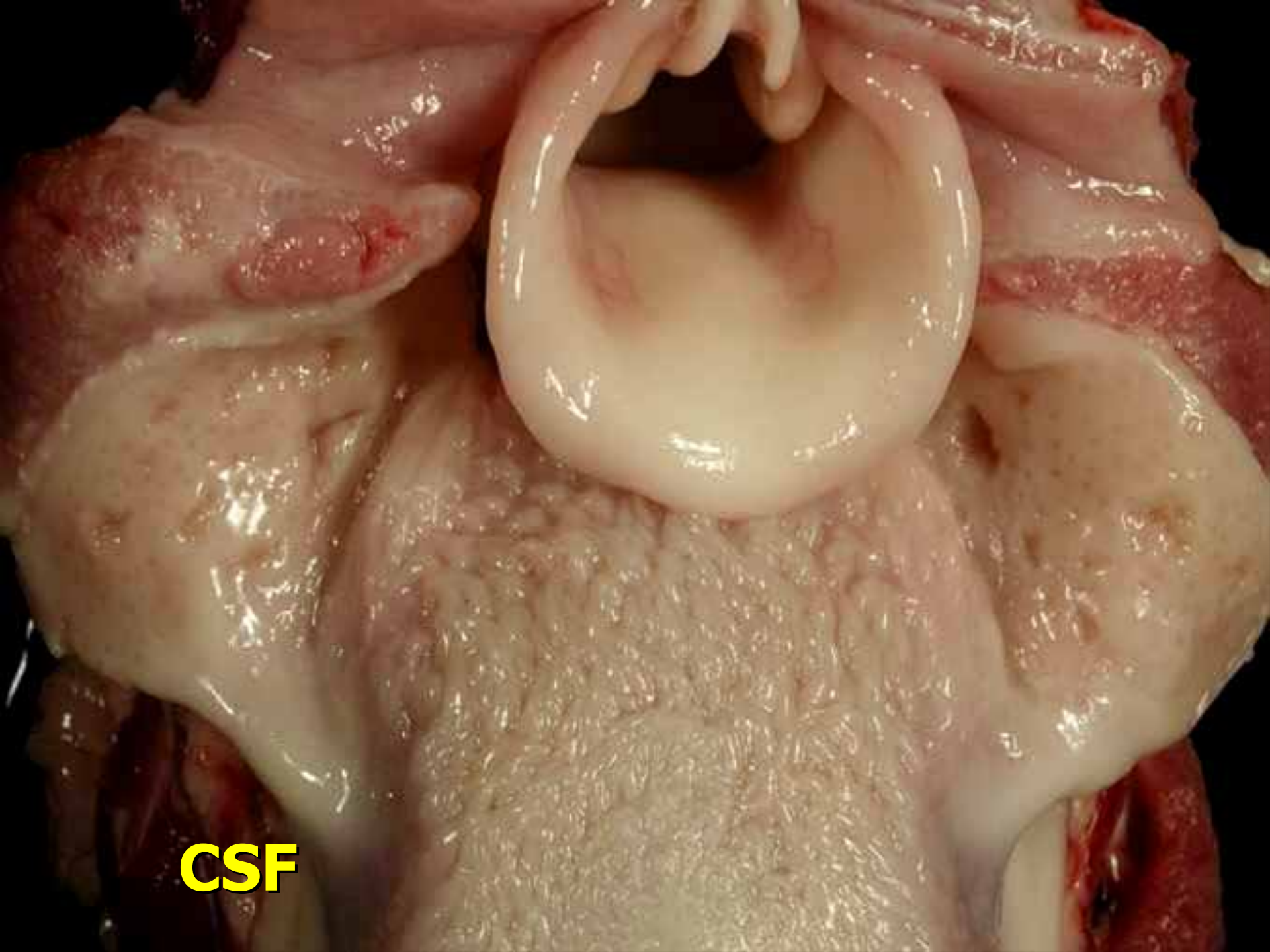
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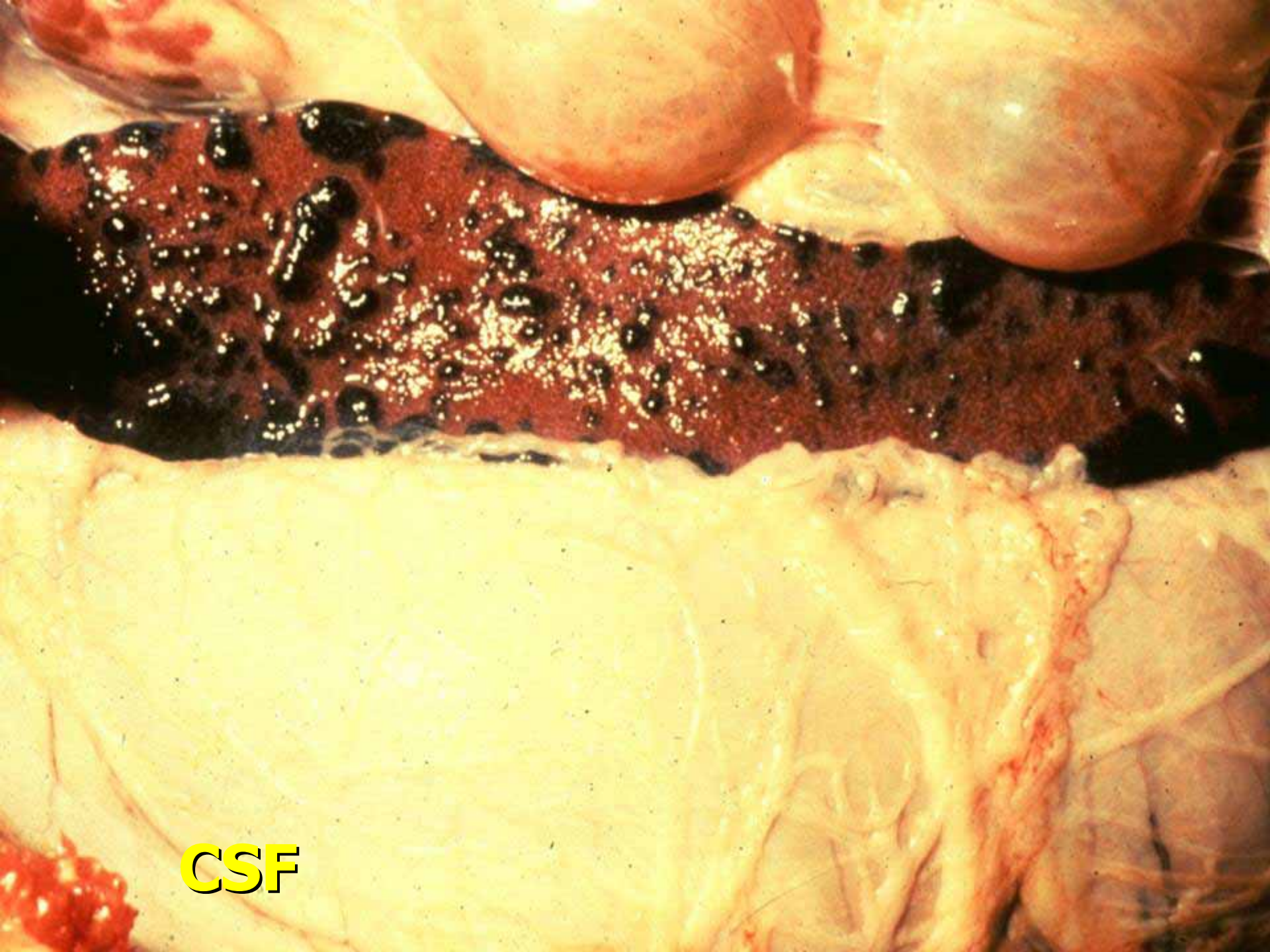
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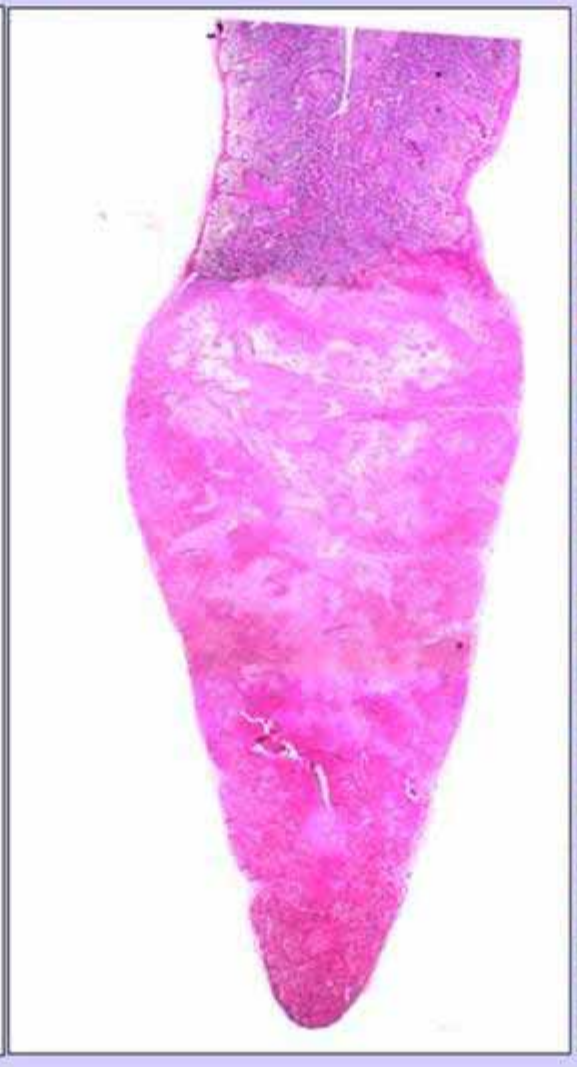

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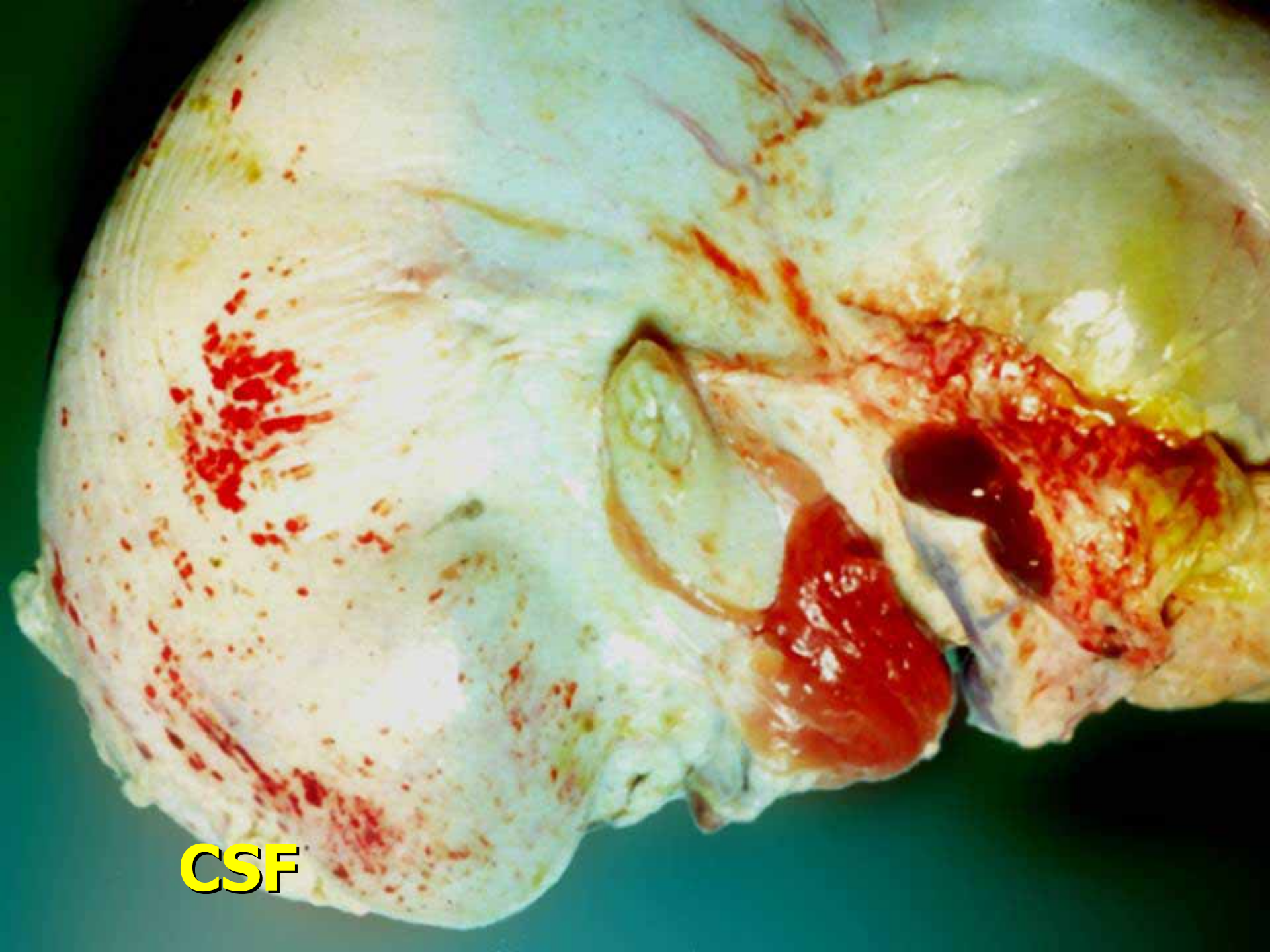
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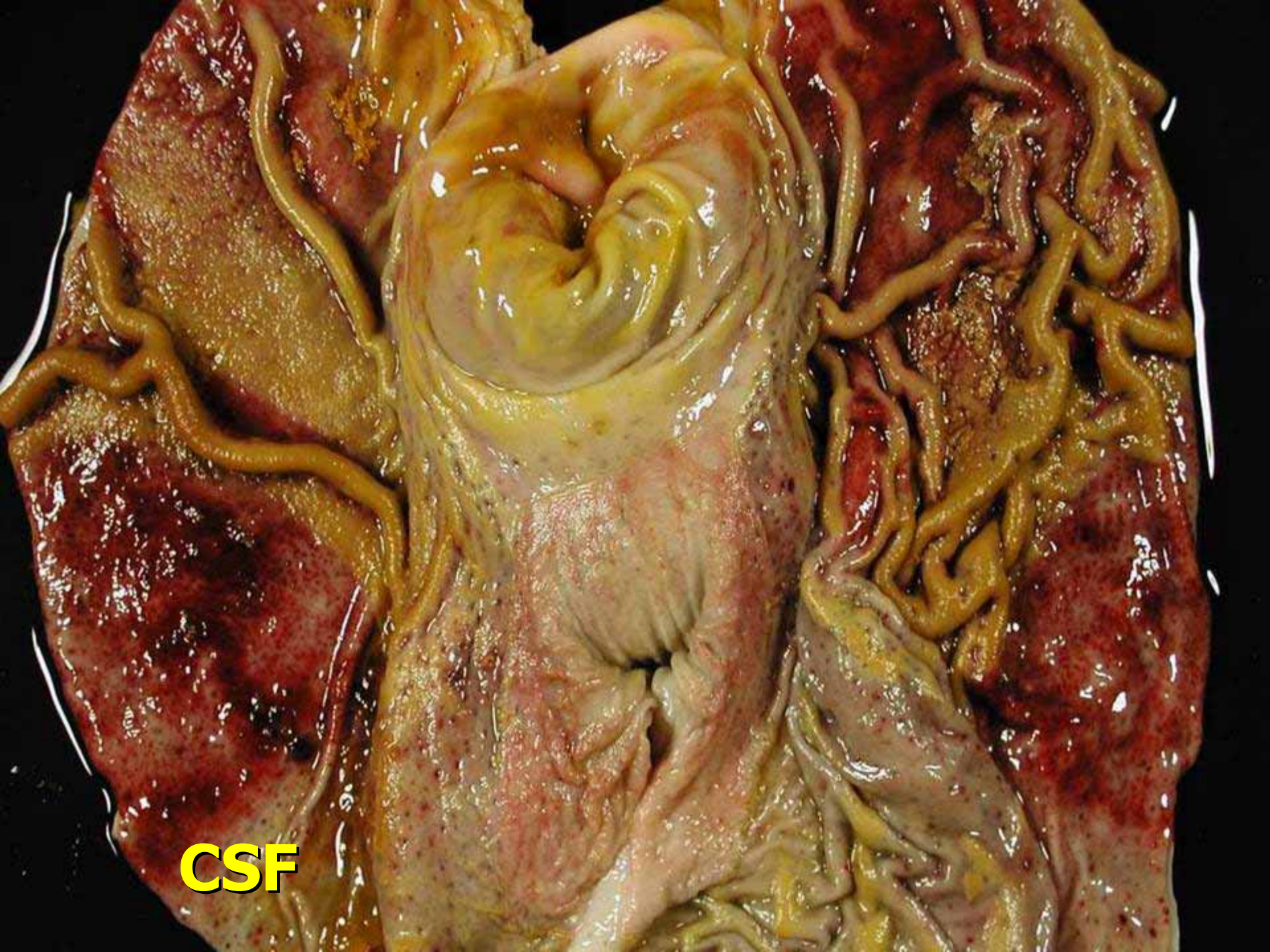
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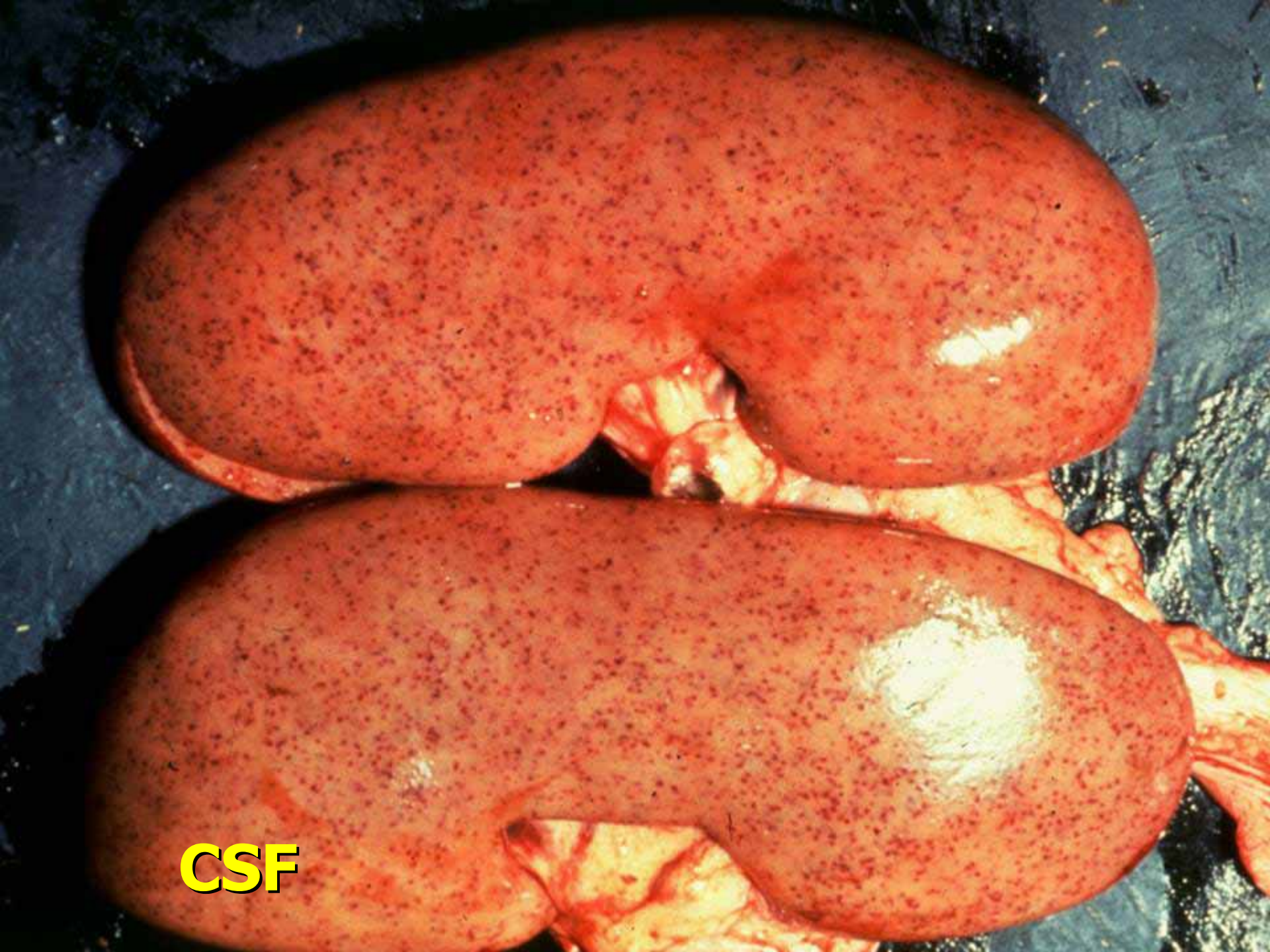
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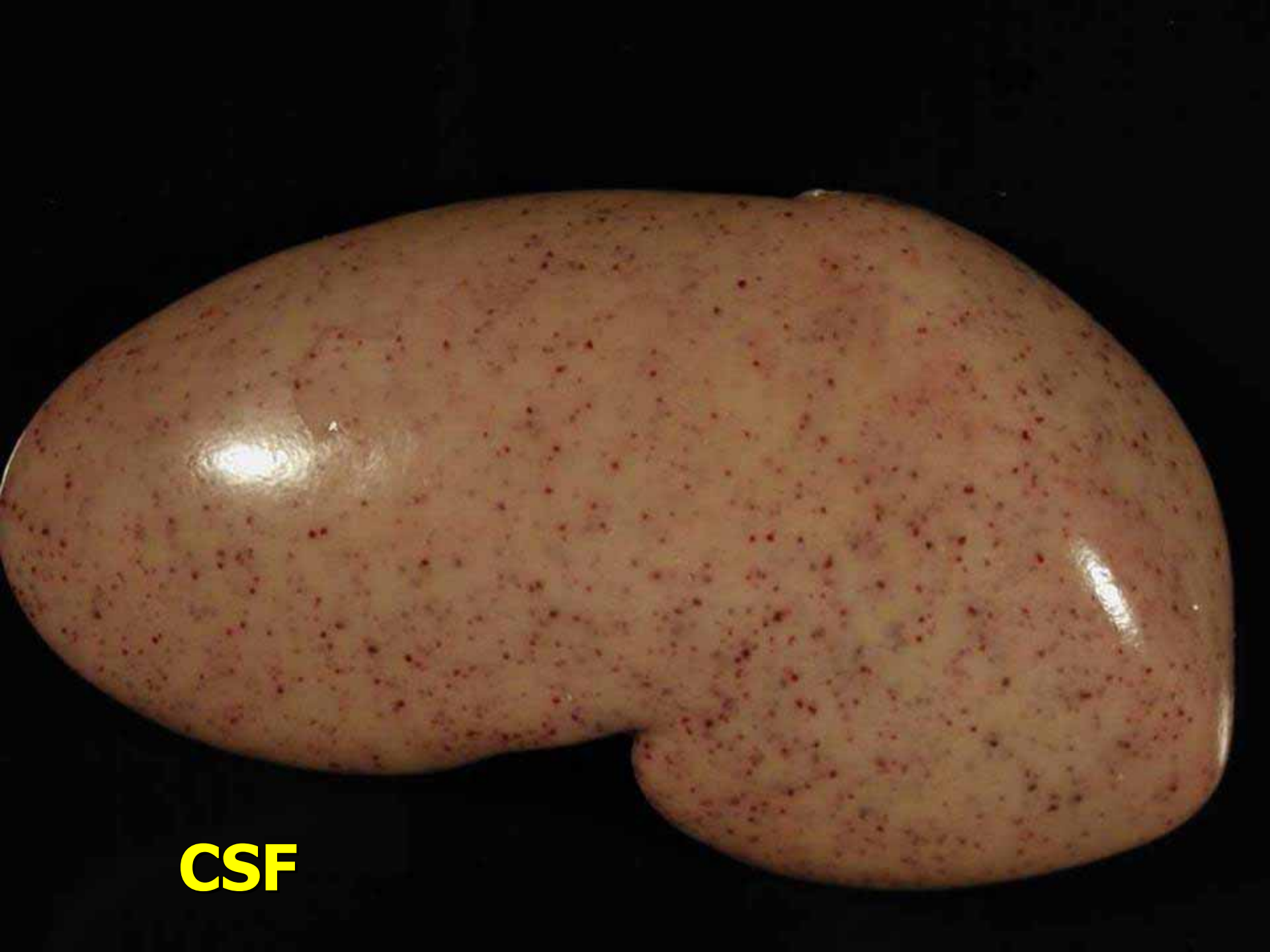
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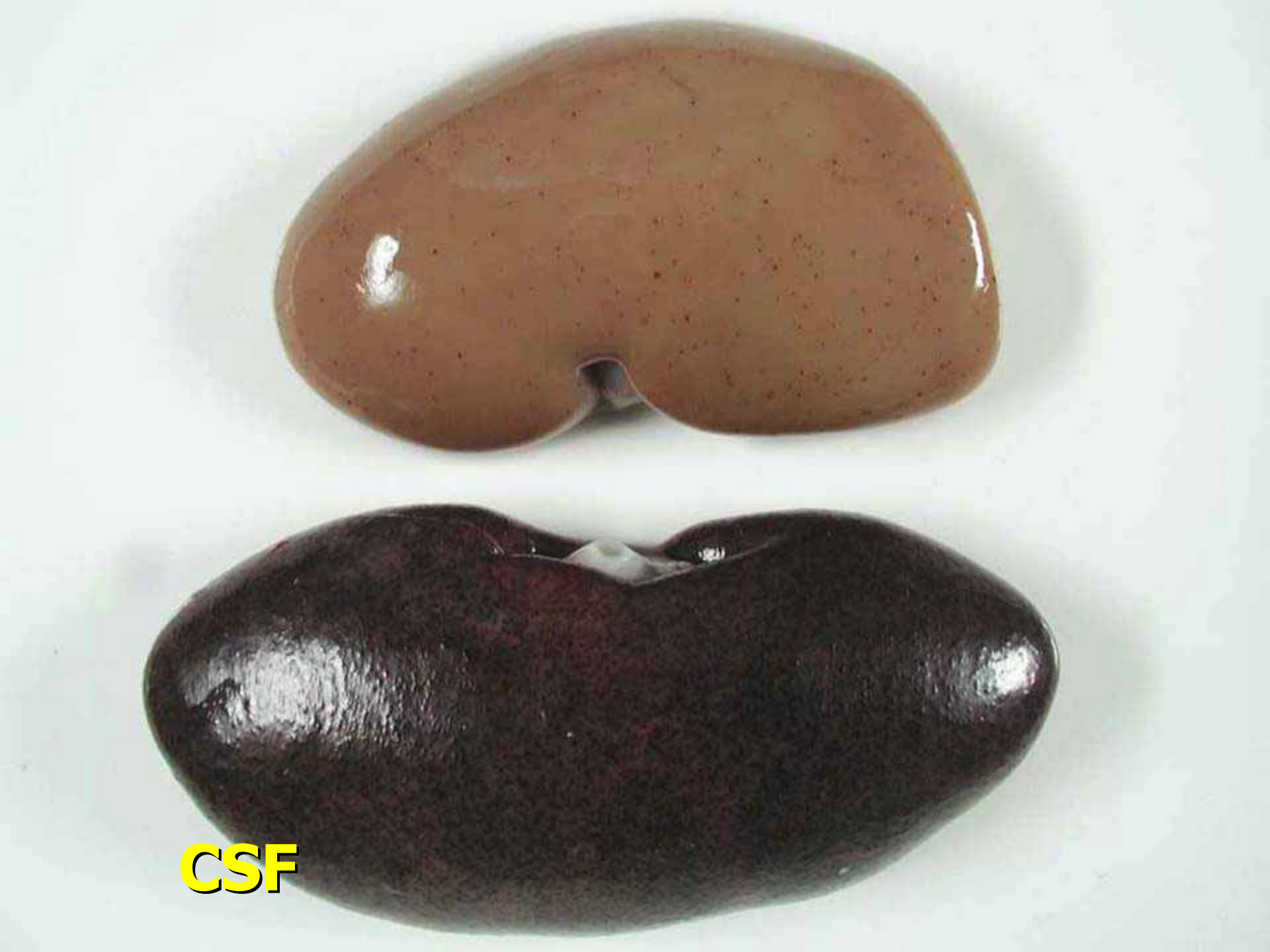
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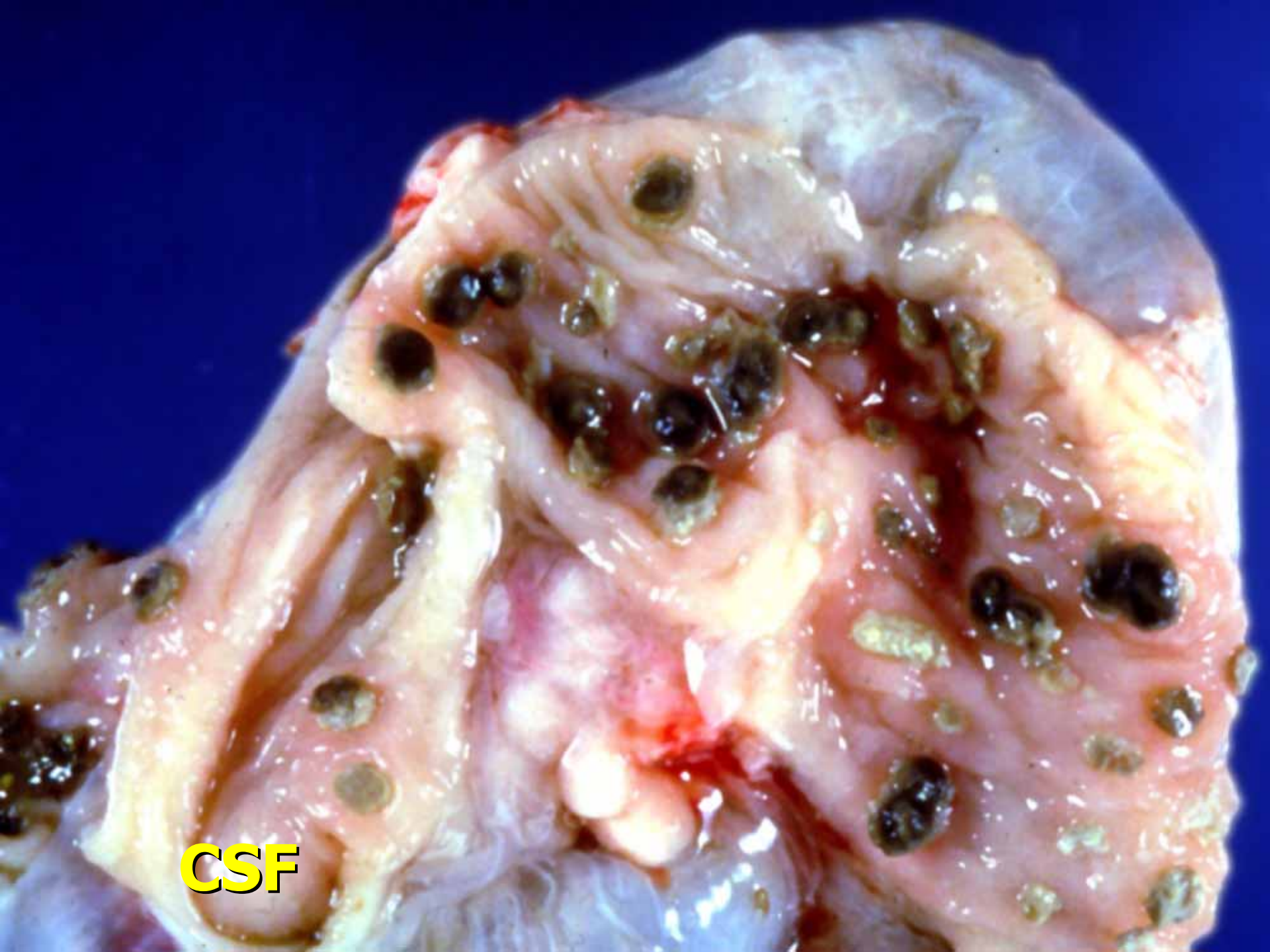
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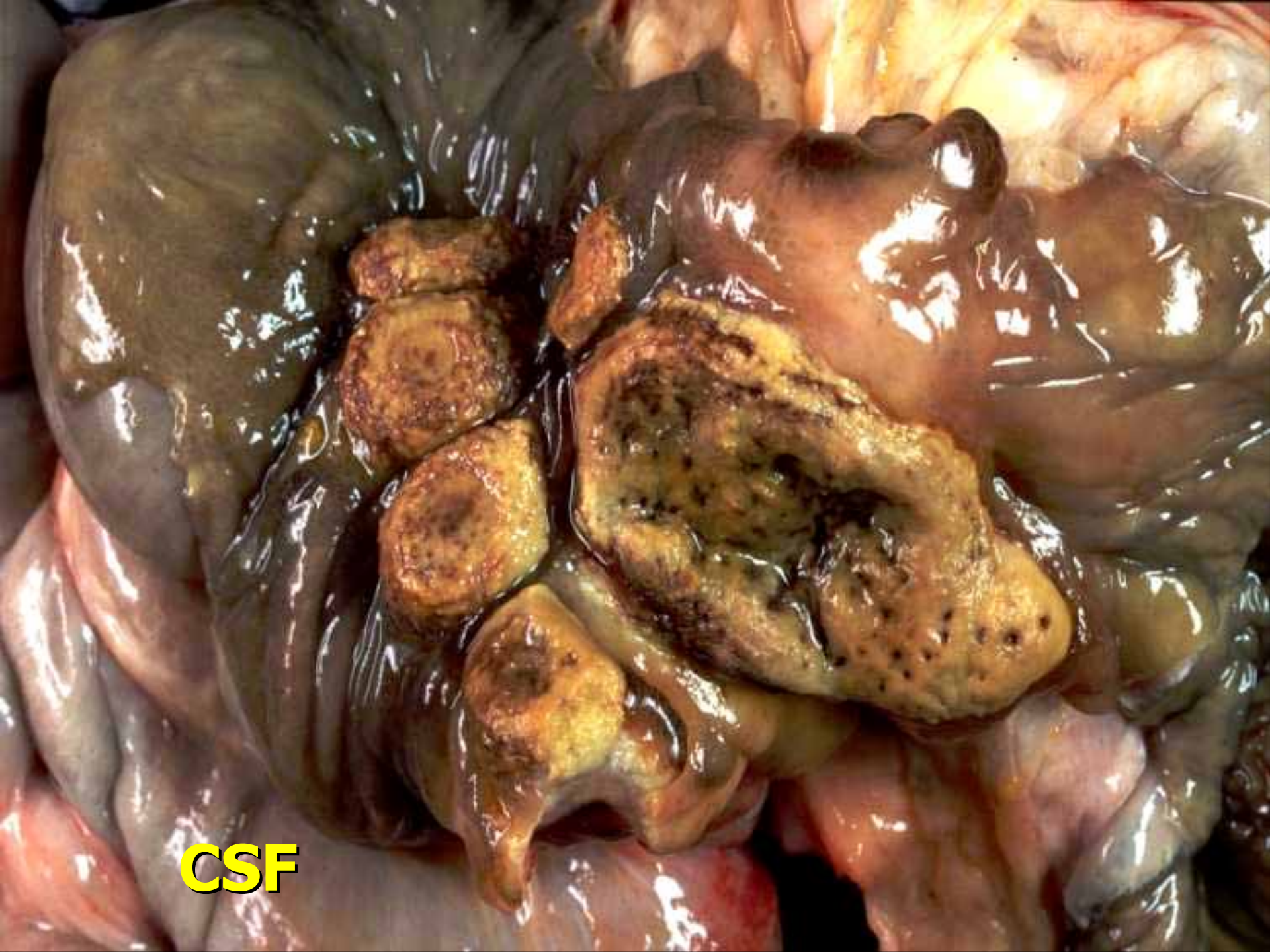
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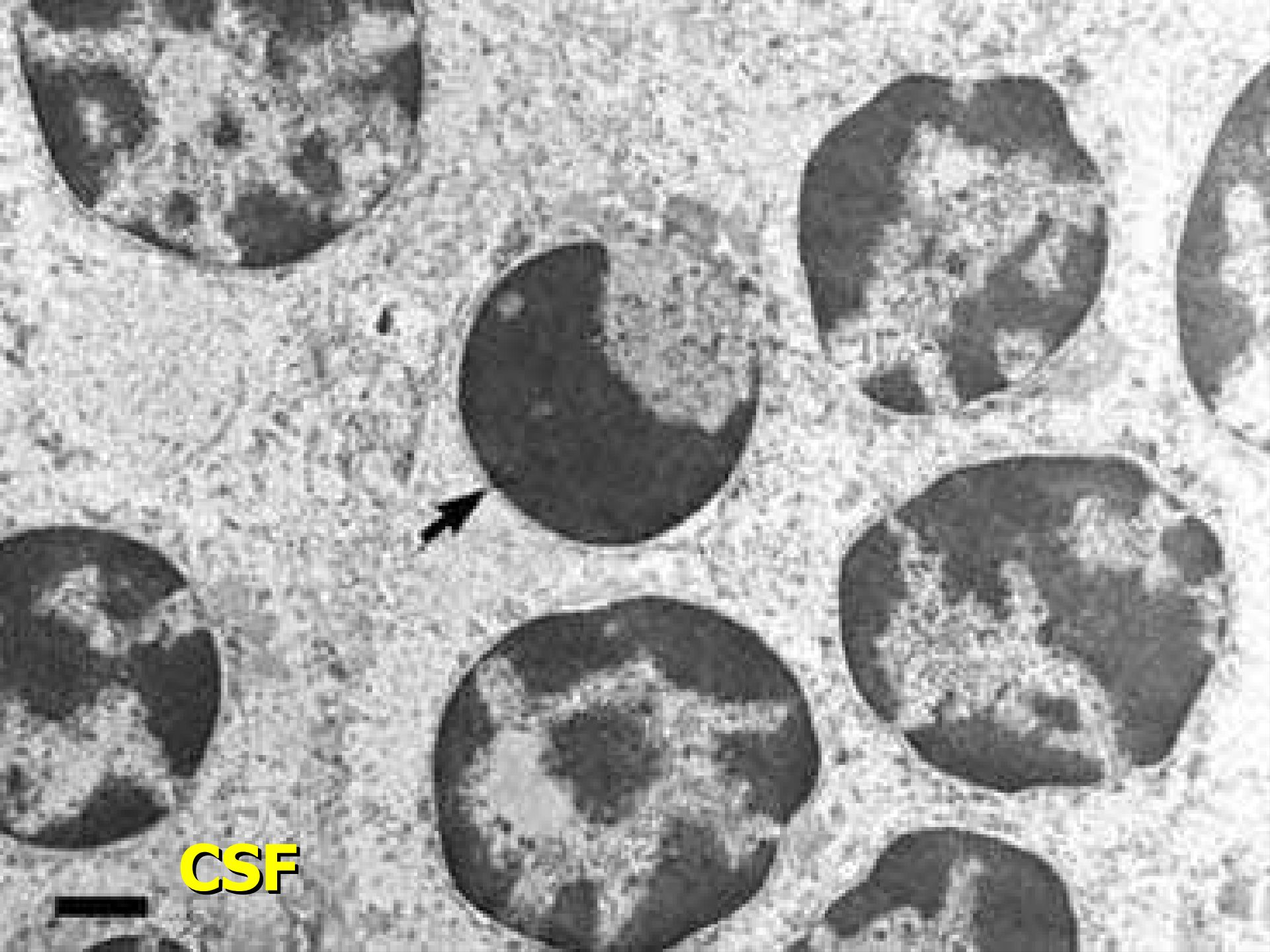
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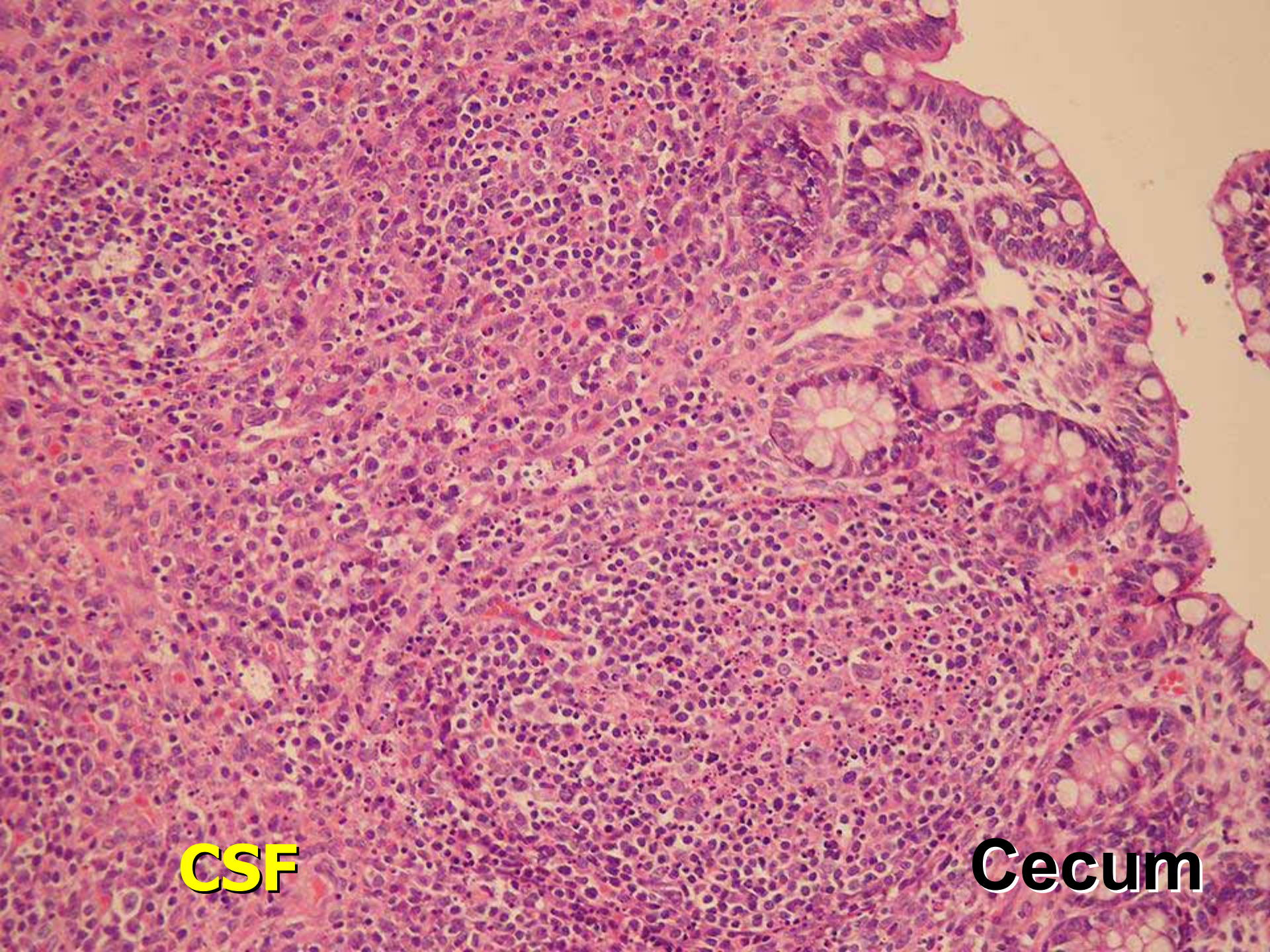
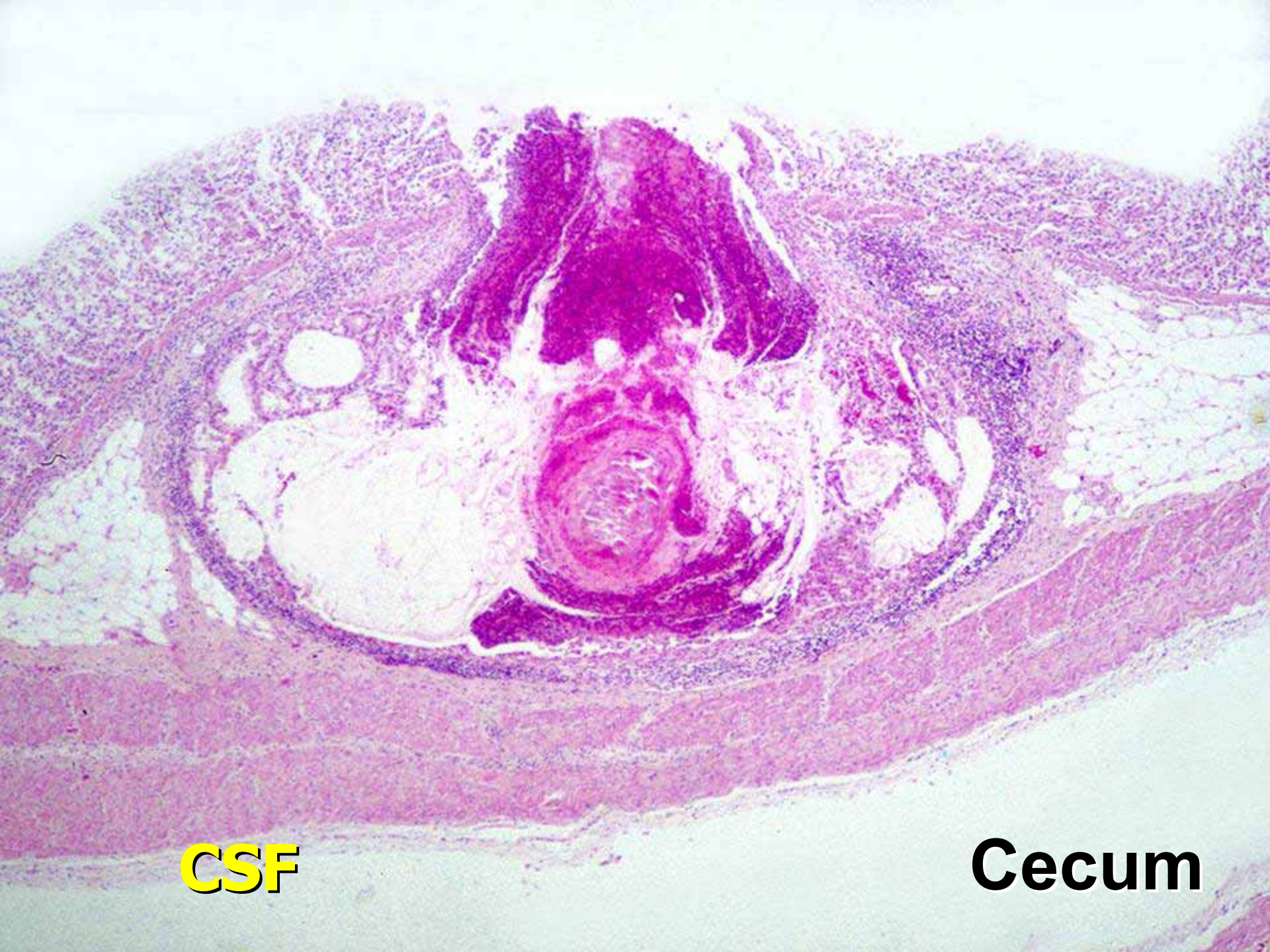

CSF
Cecum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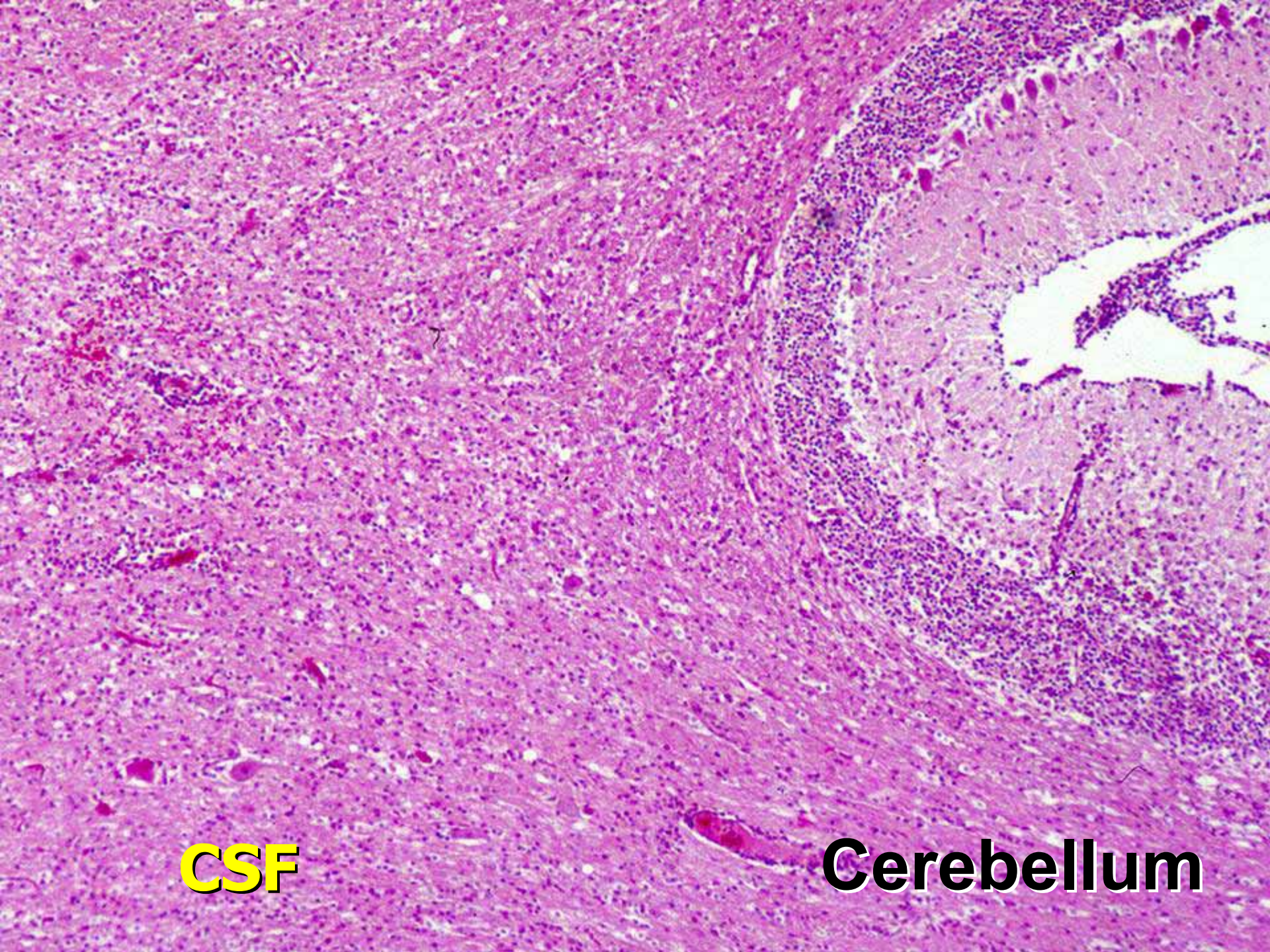
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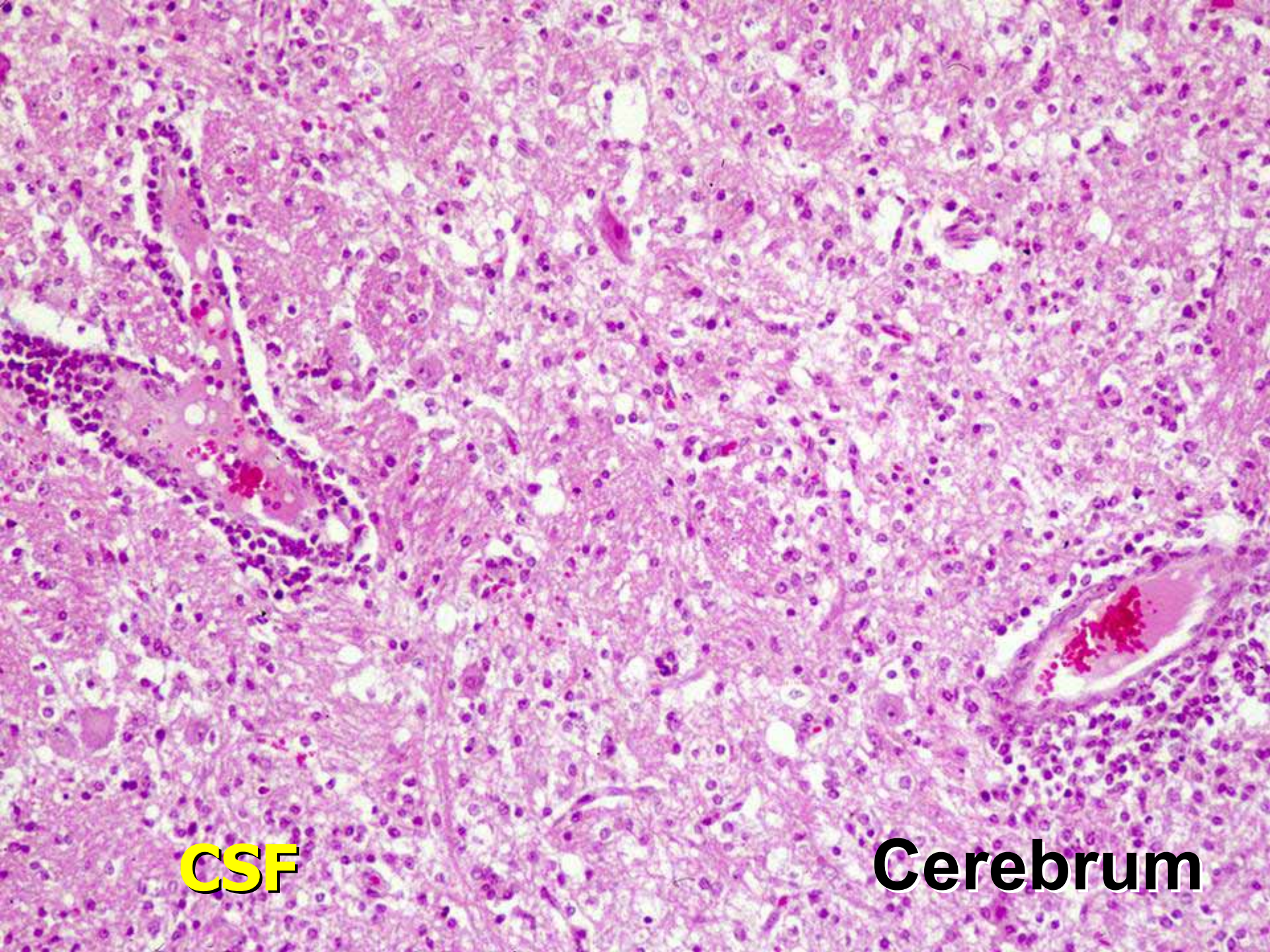
Cerebellum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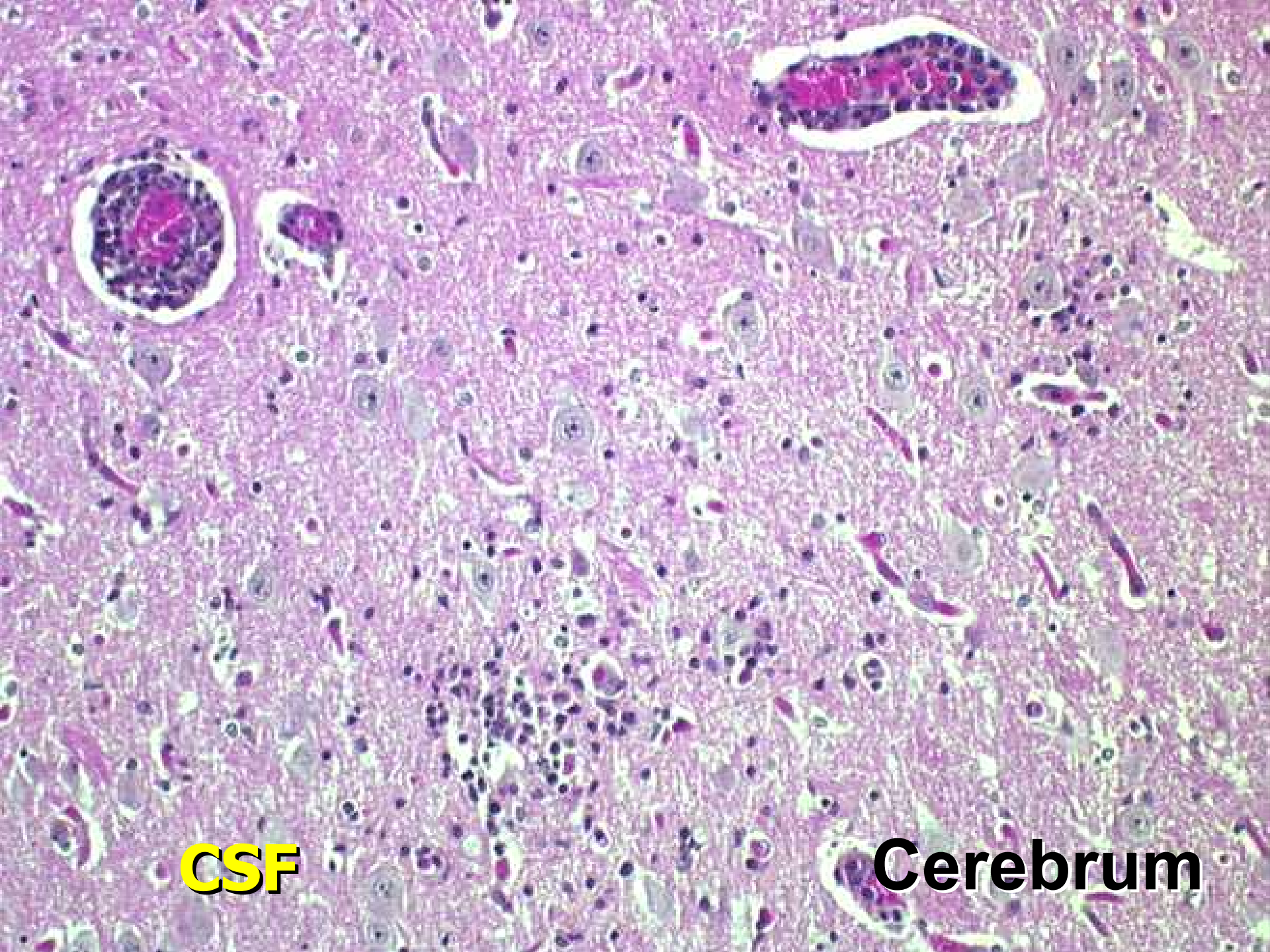
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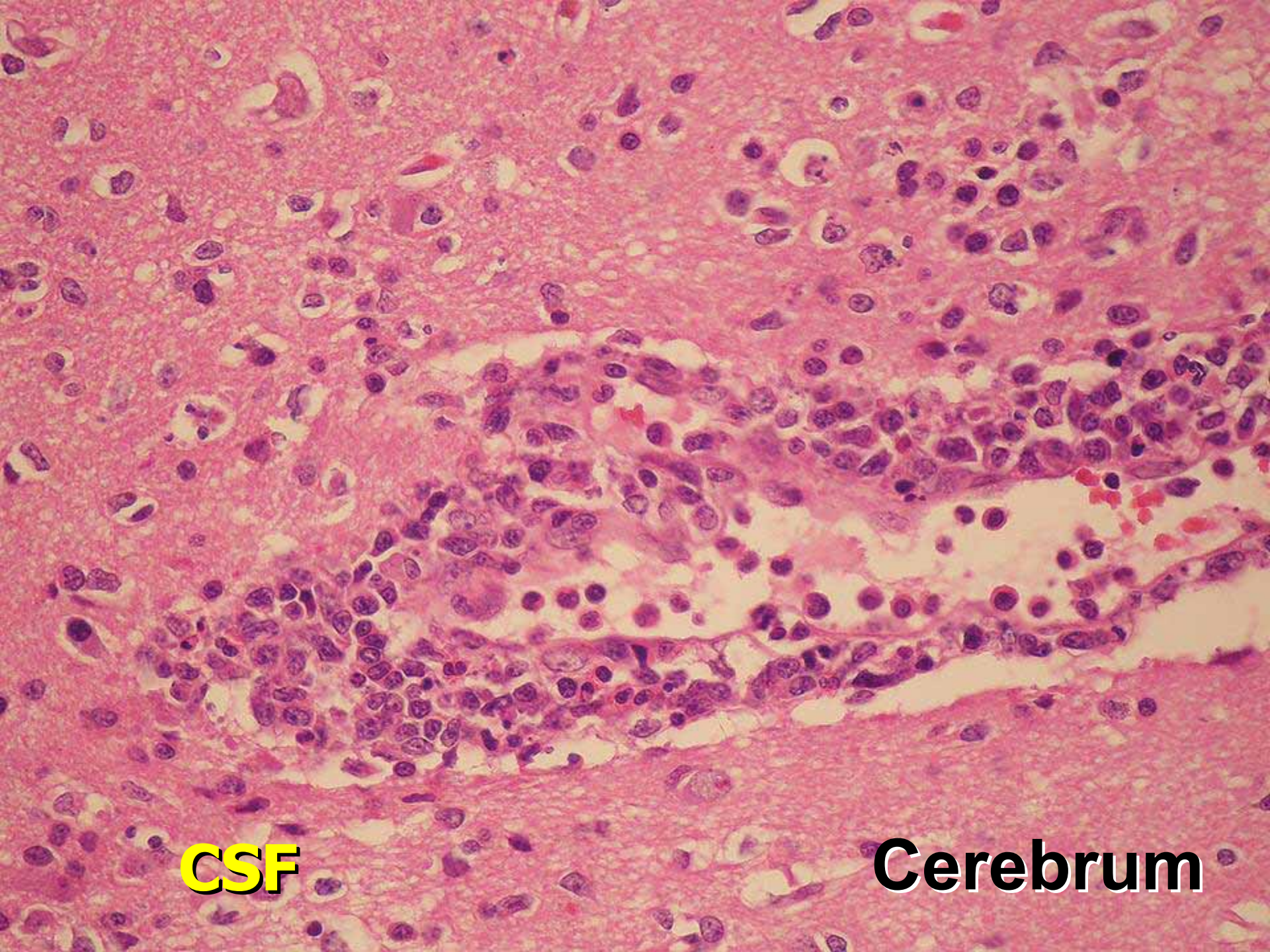
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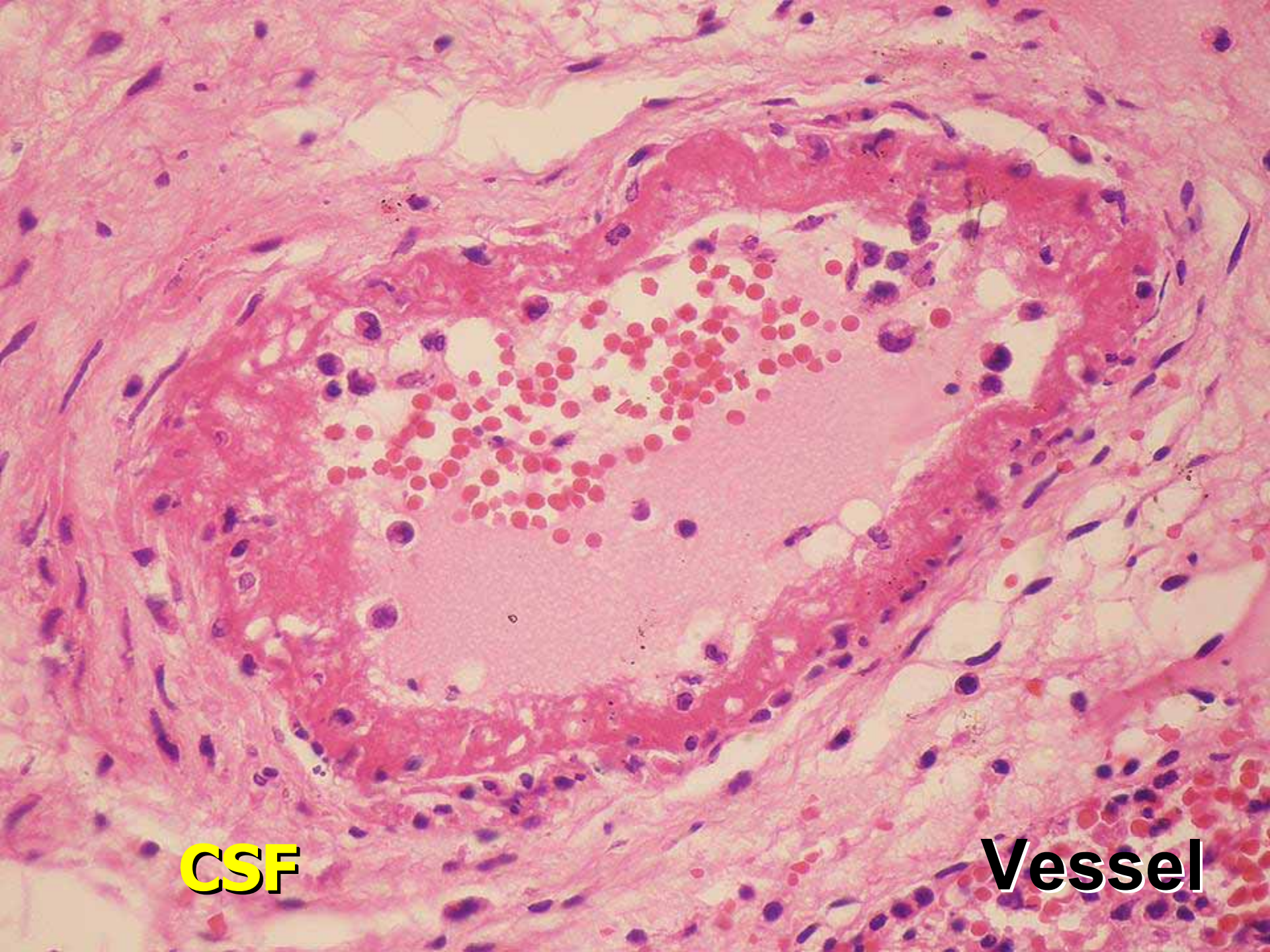
Cerebrum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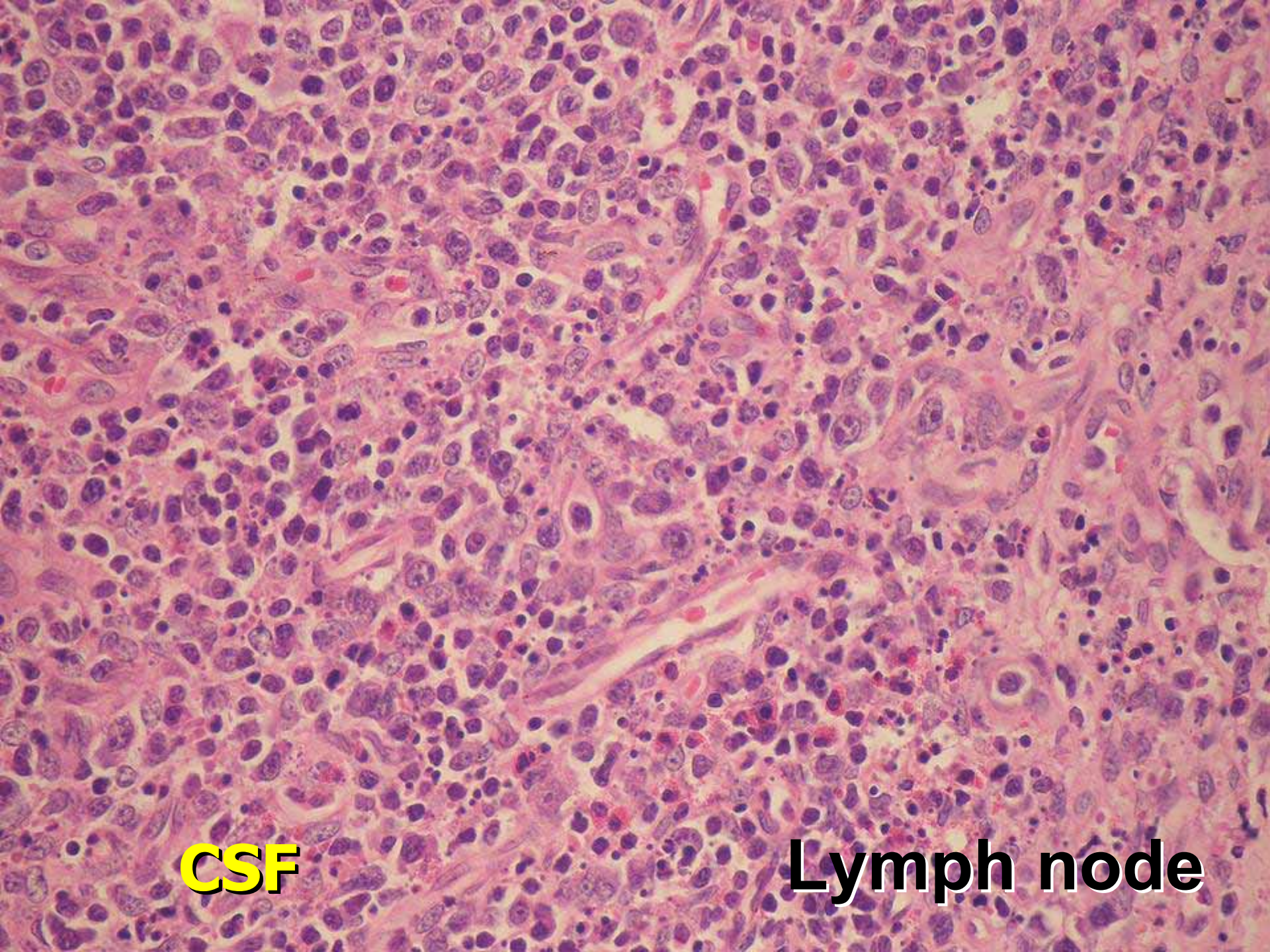
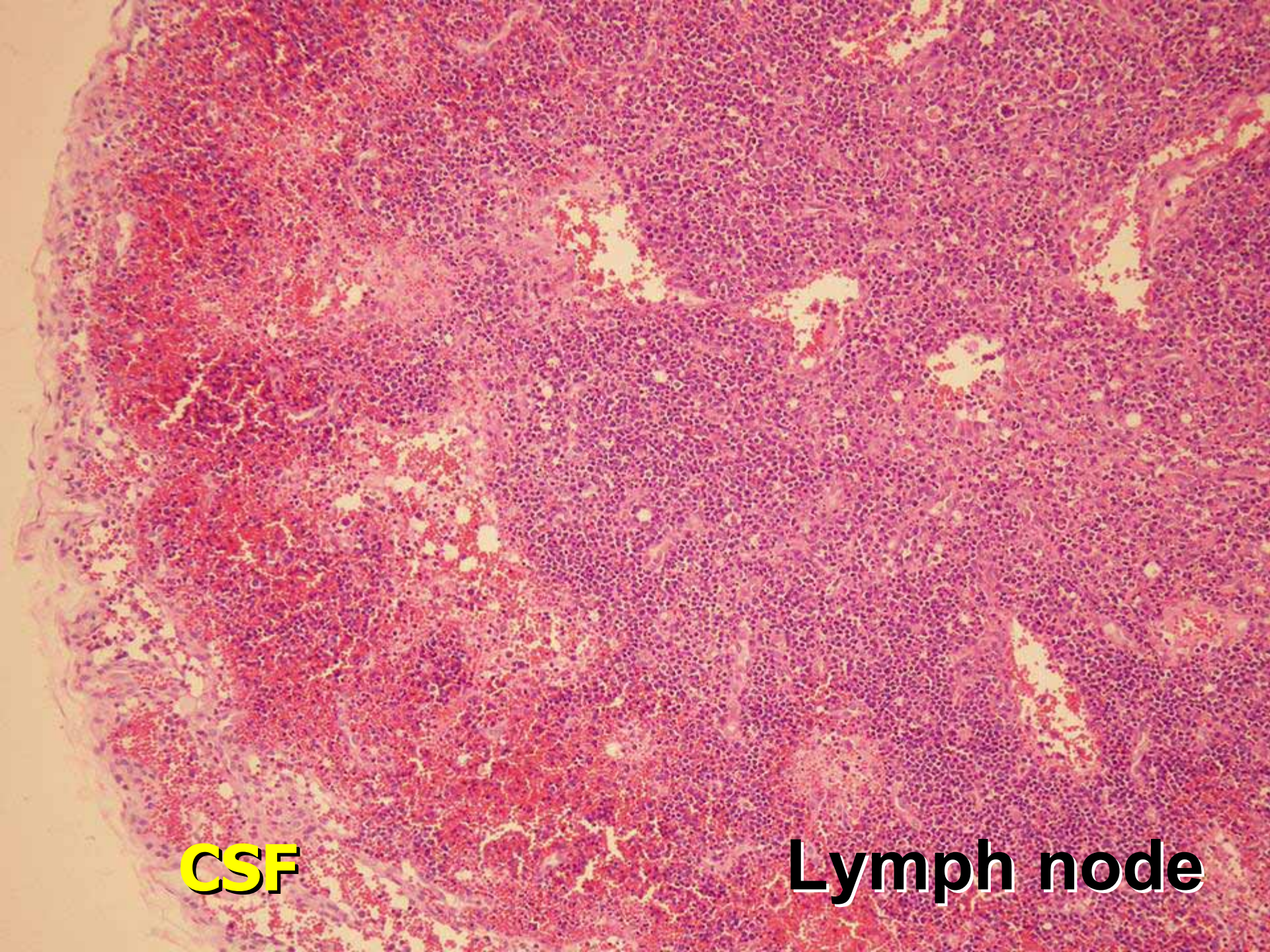
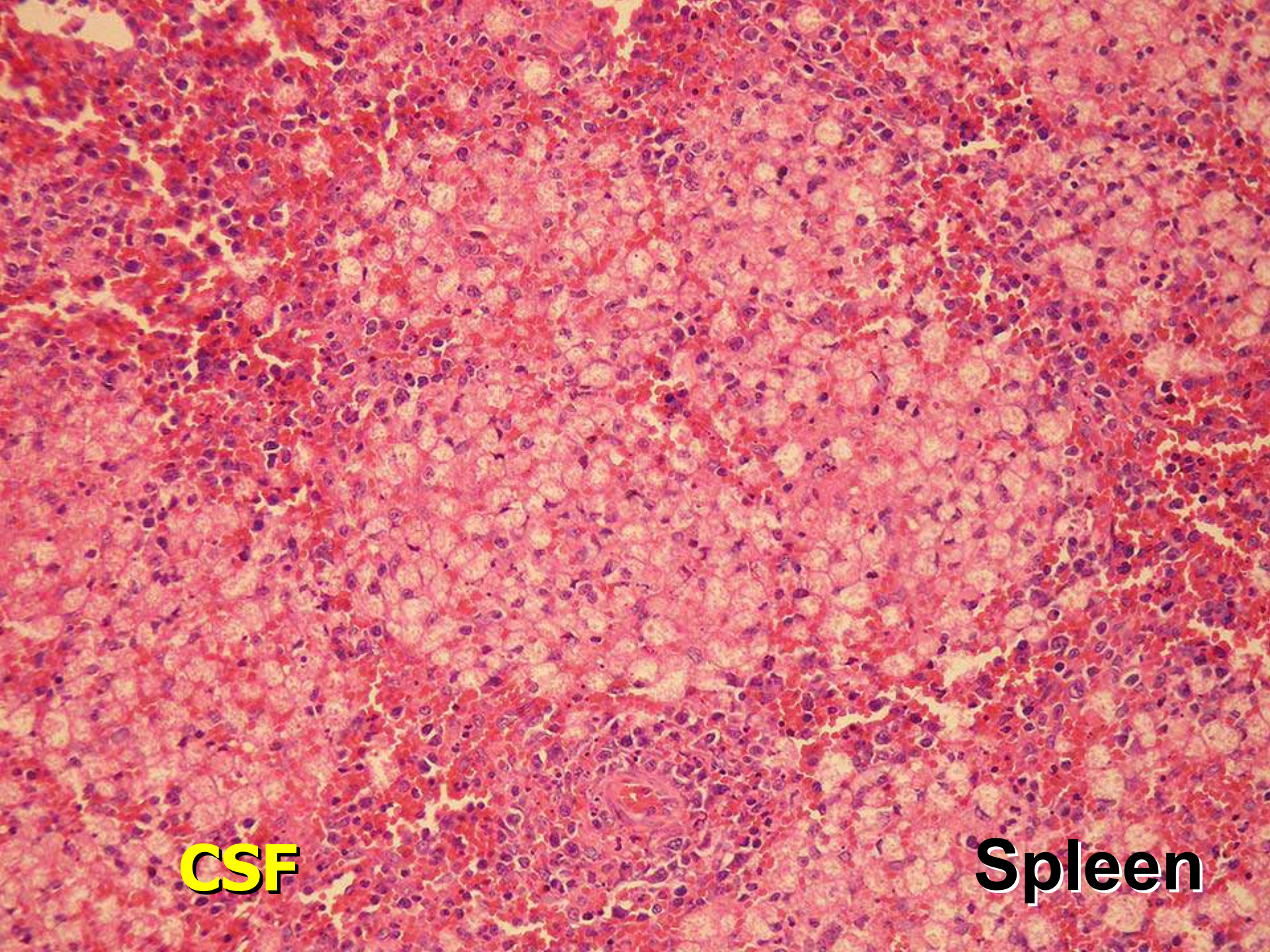
Vessel


CSF
Lymph node


CSF
Lymph node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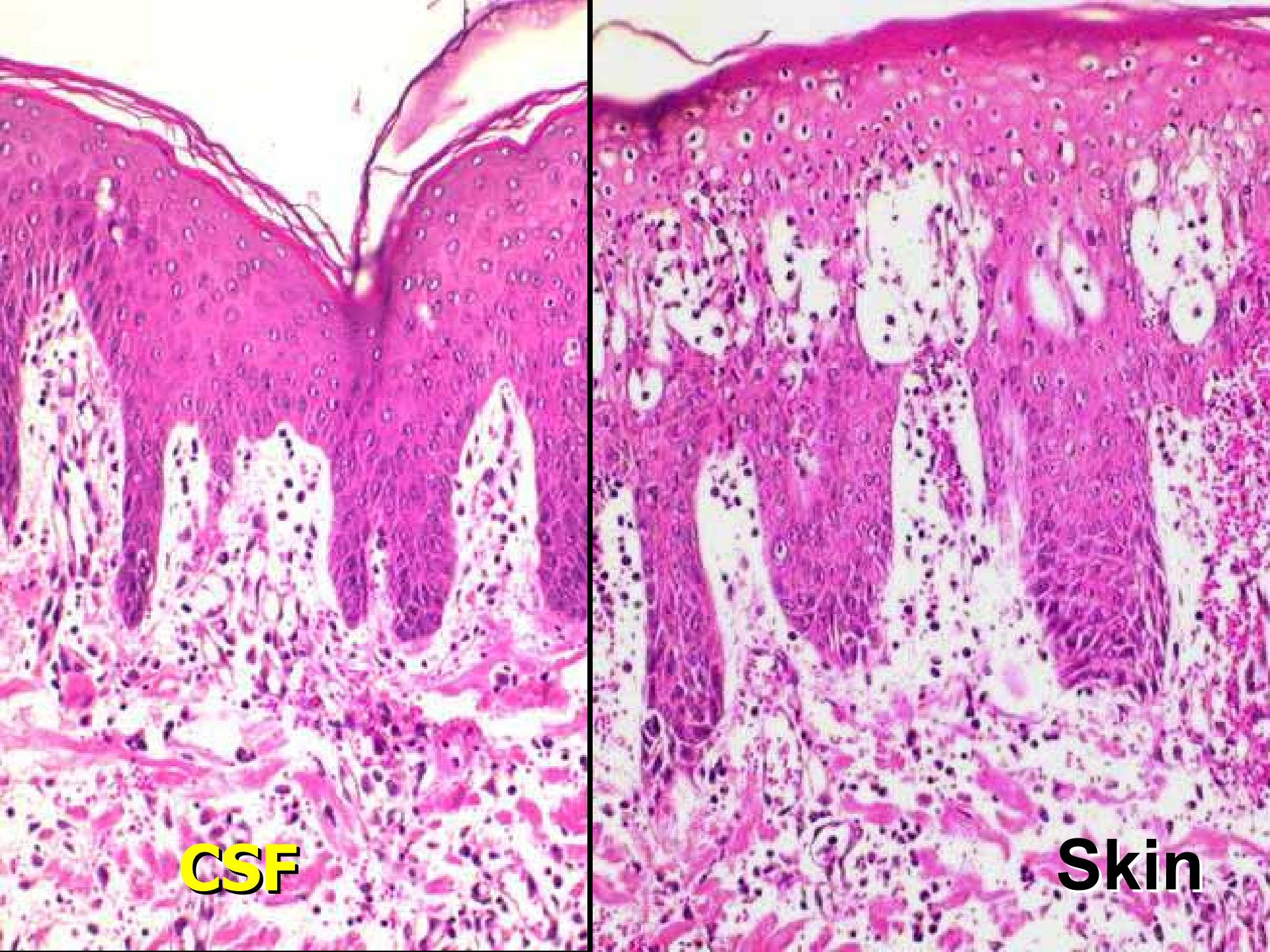
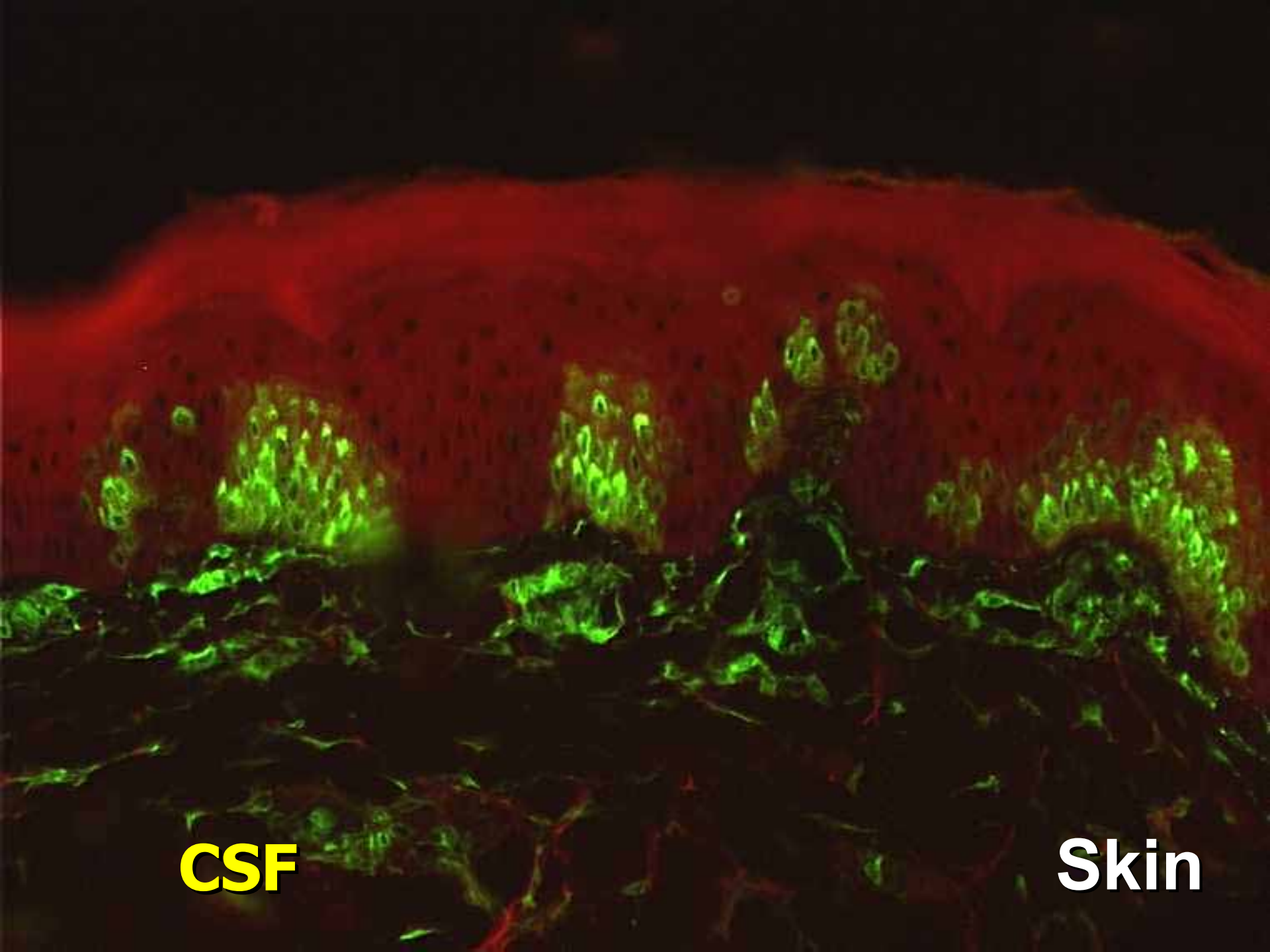

CSF
Skin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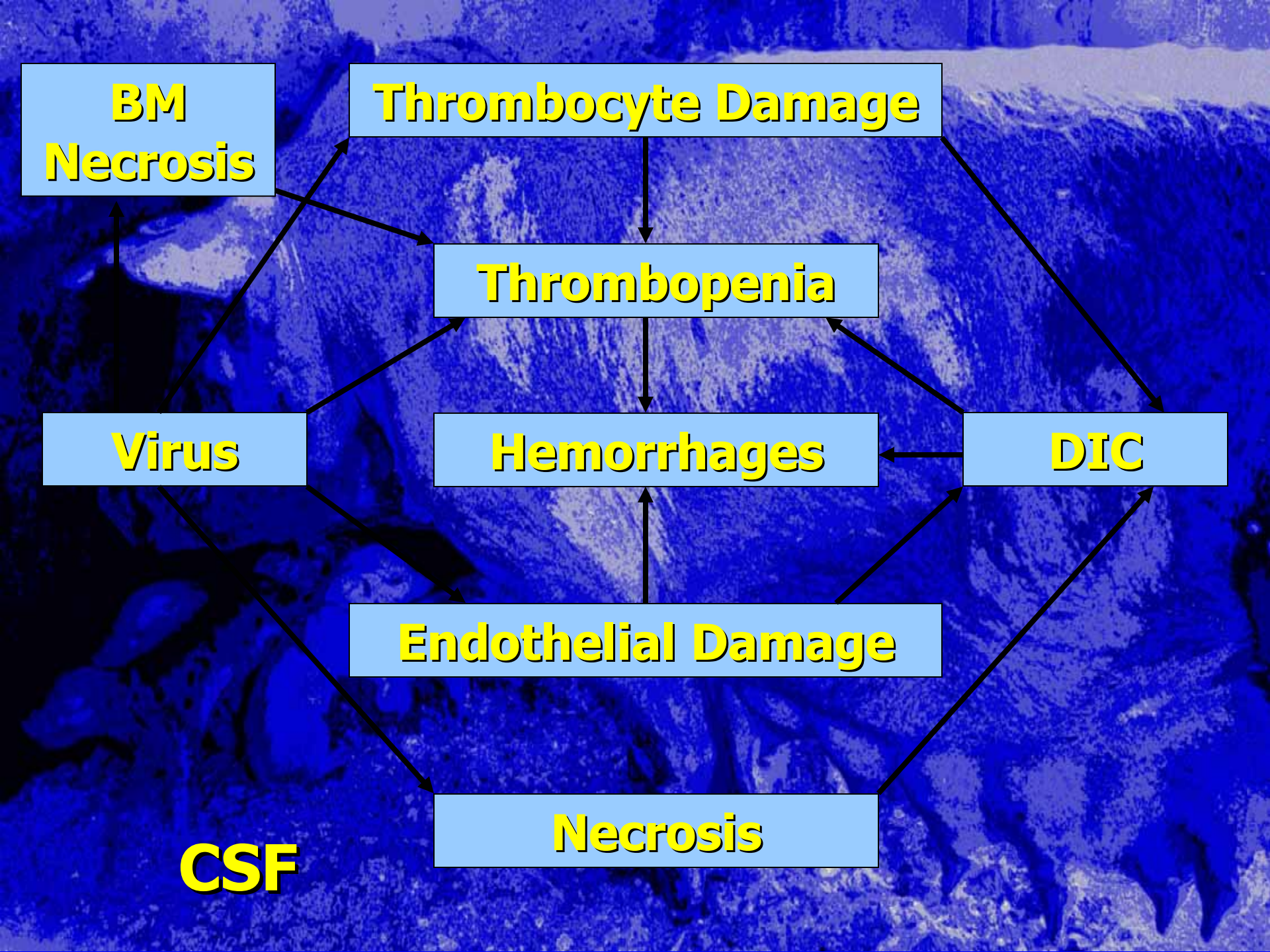
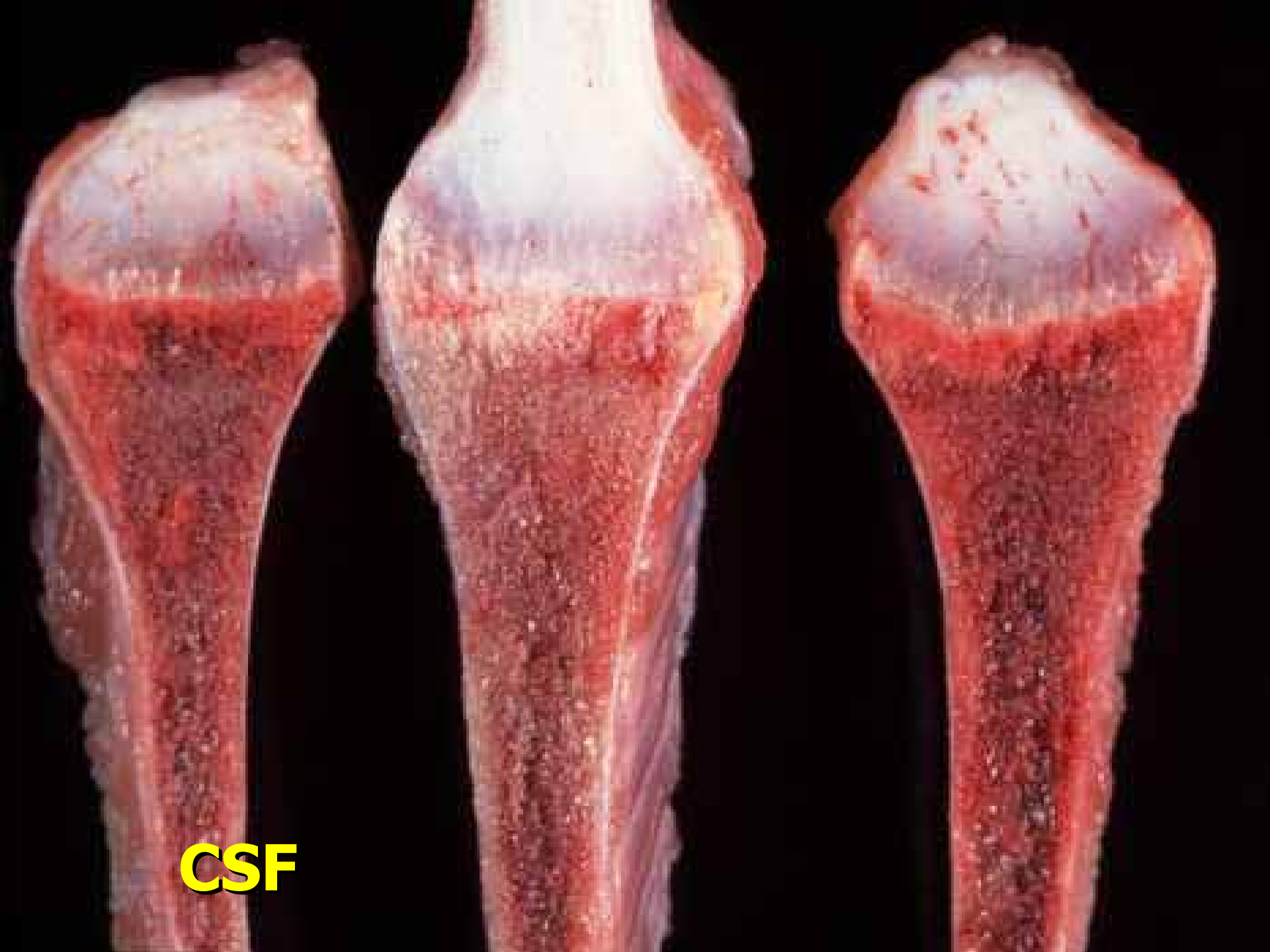
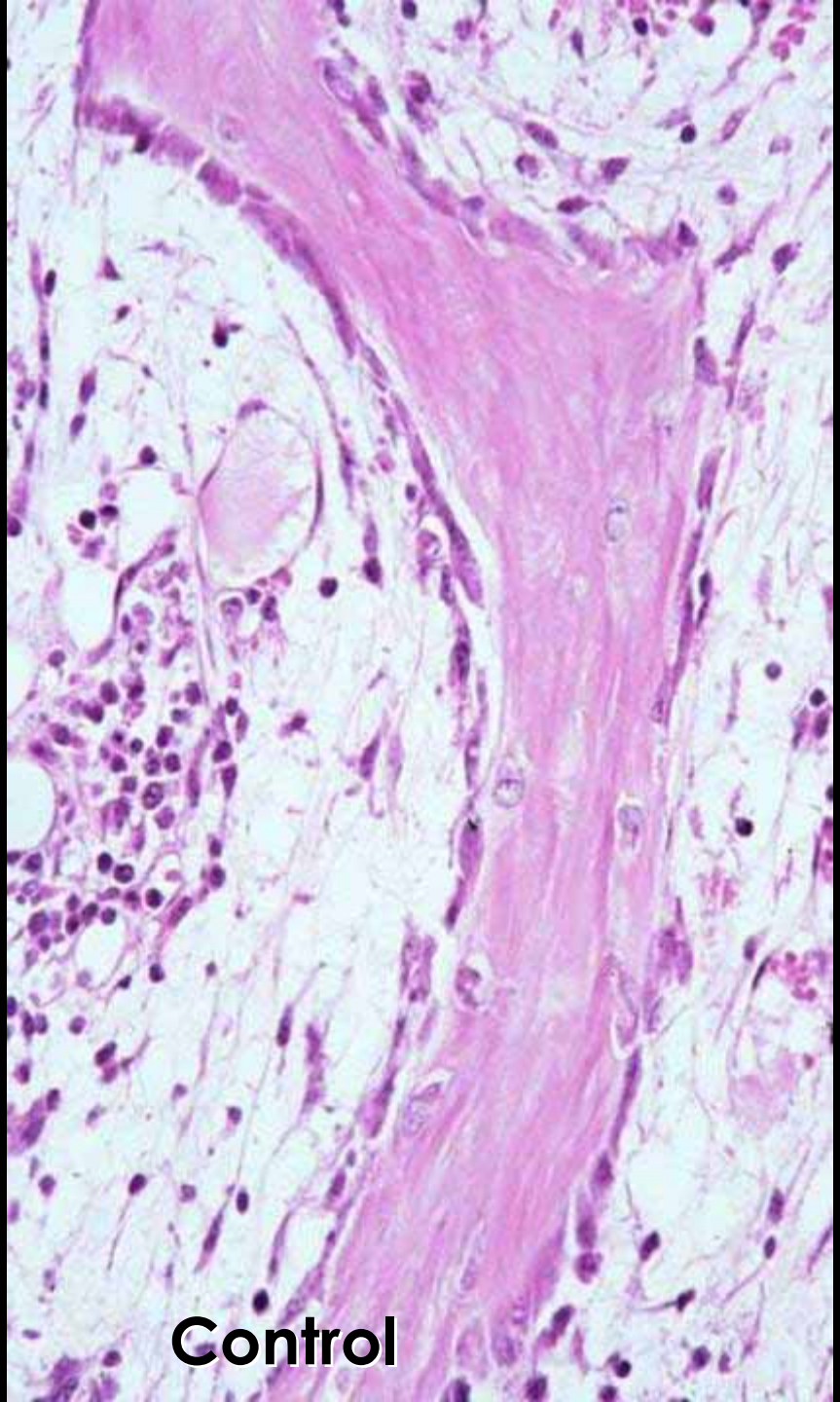
Skin


BM Necrosis
Thrombocyte Damage
Thrombopenia
Virus
Hemorrhages
DIC
Endothelial Damage
Necrosis
CSF


CSF


CSF


CSF
CSFV-infected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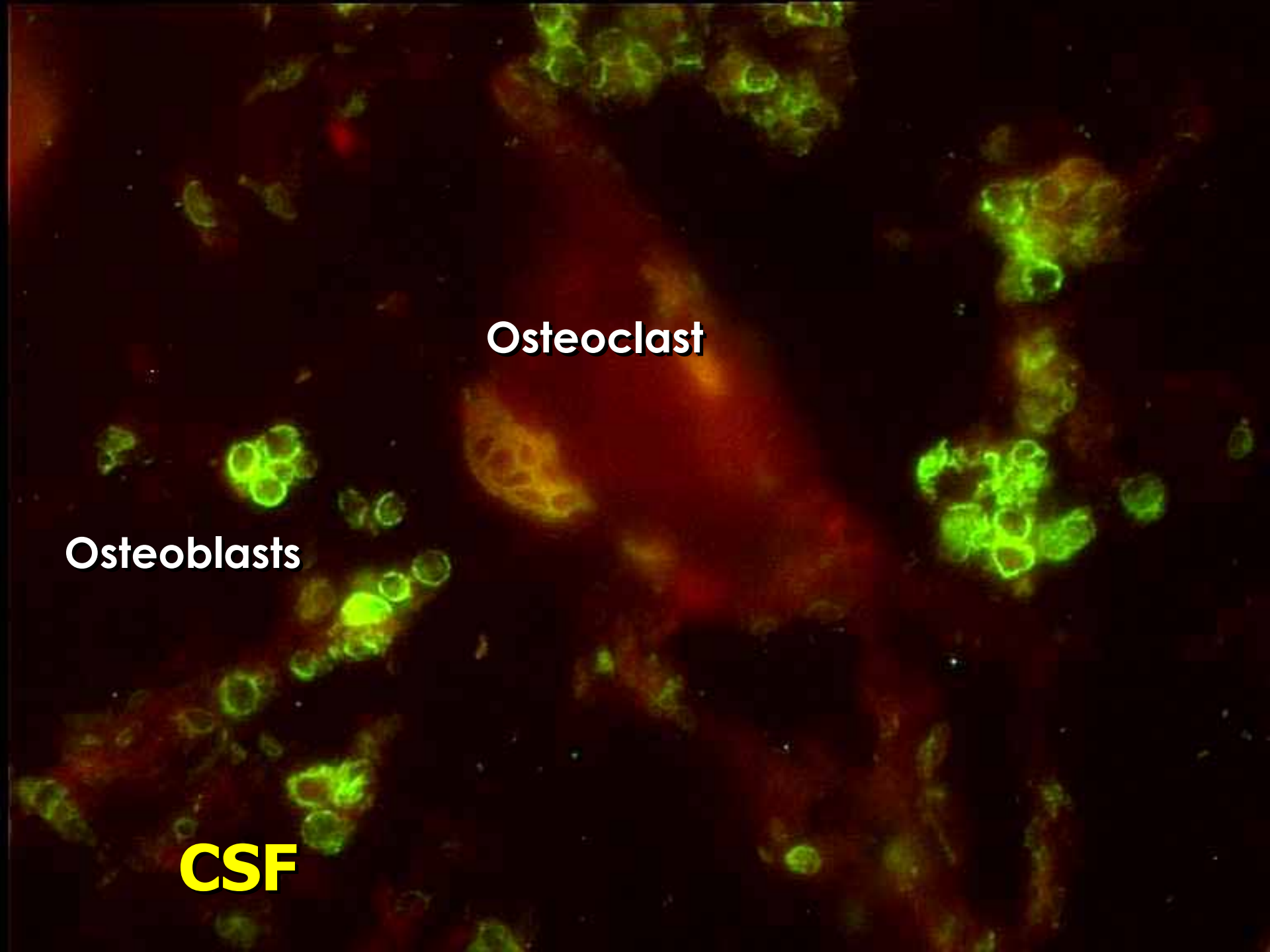
Osteoclast
Osteoblasts
CSF