

Histologic and Immunohistochemical Features of Antemortem Thrombus Compared to Postmortem Clot

Supervised by Dr.Khaled Wissam
Done by Alaa Mohammad

OBJECTIVE:

- Identify features that distinguish AMT from PMC.
- Clarify the definition of lines of Zane.

Introduction:

- ❖ Thrombosis: is the pathologic opposite to hemostasis & it means an inappropriate activation of normal hemostatic process(i-e: the formation of blood “thrombus” within non traumatized,intact vessels).

Thrombi can develop anywhere in CVS.

- ❖ Arterial or cardiac thrombi typically arise at sites of endothelium injury or turbulence.
- ❖ Venous thrombi characteristically occur at sites of stasis.

- ❖ Thrombi are focally attached to the underlying vascular surface & tend to propagate toward the heart ,thus arterial thrombi grow in aretrograde direction from the point of attachment where as venous thrombi extend in the direction of blood flow.
- ❖ Thrombus consist of aggregated platelets & fibrin in which blood cells are trapped.

Arterial thrombi are usually occlusive, are firmly attached to the wall, and are gray-white and friable.

Venous thrombi are almost invariably occlusive, are less firmly attached to the wall, and are red.

Postmortem clots are gelatinous and have a dark red dependent portion and a yellow "chicken fat" upper portion, usually not attached to the wall and lack lines of Zahn.

- ❖ Distinguishing antemortem thrombus (AMT) from postmortem clot (PMC) is of critical importance for autopsy pathologists.
- ❖ True thrombi or thromboemboli can cause or contribute to death, while PMC has no clinical significance.

➤ There are certain features that distinguish **AMT** from **PMC** :

I. Histological features.

II. Immunohistochemical features.

Histological features:

❖ GROSSLY:

- The classic gross description of **PMCs** divides them into 2 subtypes:
 1. "chicken fat" was gelatinous, yellow red substance.
 2. Red cruor was soft moist very dark red substance with generally smooth surface that took the shape of the cavity from where the clot was retrieved.

- ❖ On cut sections, layering of RBCs and serum fibrin material could be appreciated in **PMC**.
- ❖ In contrast **AMT** showed granular surfaces with variable white tan to red coloration & were tubular or cylindrical in shape when uncoiled.
- ❖ The cut sections of **AMT** were more variable & more likely to show coarse, pale gray strips at the periphery of the thrombus while the core of the thrombus was mostly dark red.

Gross appearance of postmortem clot, arterial thrombi, and venous thrombi.

A, Postmortem clot showing “red cruor” (top image) layered with fibrin-rich “chicken fat” (lower image).

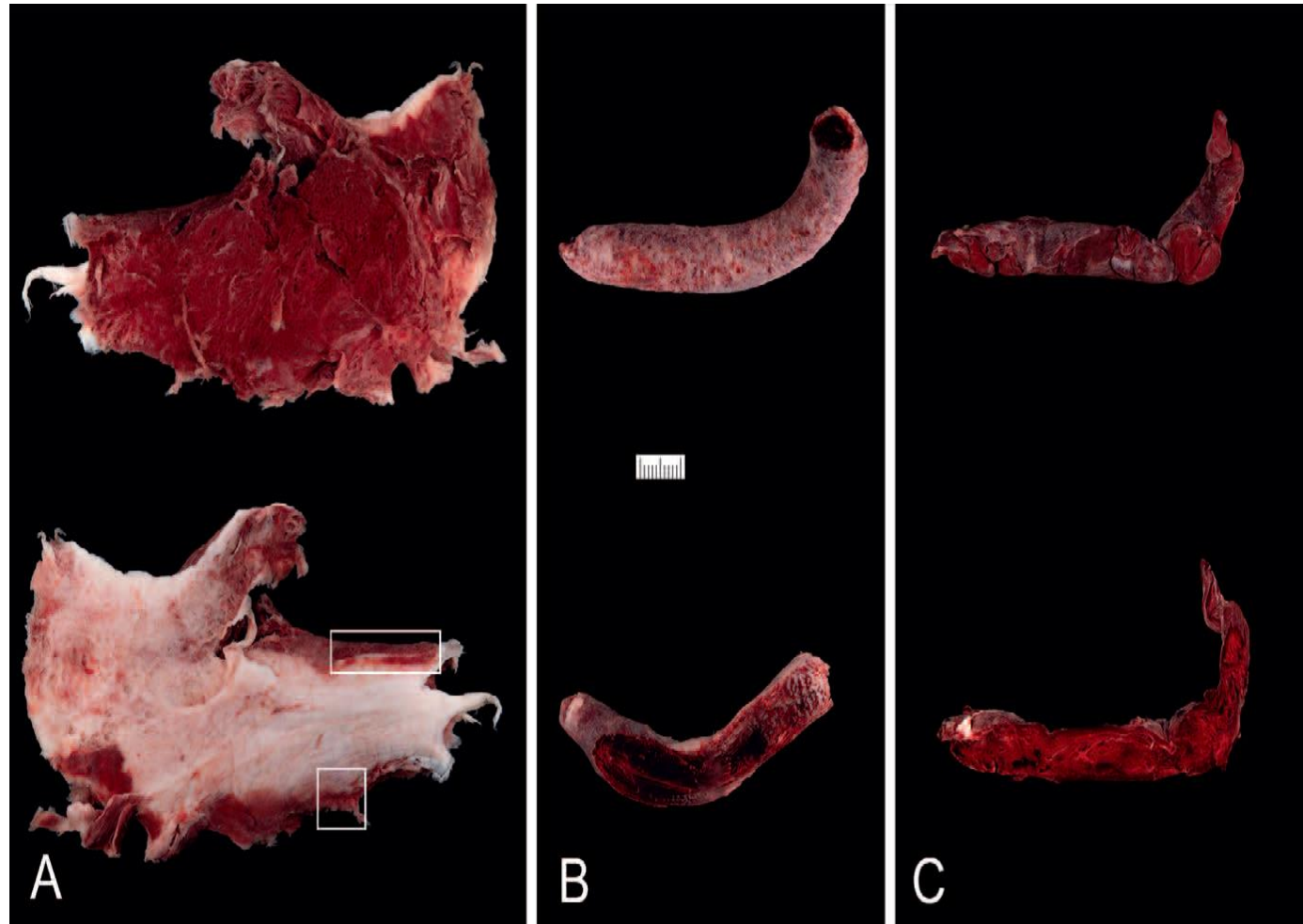
B, Arterial thrombus showing a fairly homogeneous distribution of tan-white fibrin imparting a granular surface appearance (top). The bottom image shows a longitudinal section.

C, Venous thrombus showing a coiled and compressed appearance on external examination.

postmortem clot

arterial thrombi

venous thrombi



❖ Microscopically:

❖ PMCs:

- **Red cruor** was composed of aggregated erythrocytes with scattered leukocytes admixed with clumps of BM elements & few dispersed platelets.
- BM elements consisting of immature myeloid precursors ,nucleated RBC& occasional megakaryocytes.

PMCs

- BM elements was not previously reported , it may be that this finding influenced by multiple factors:
 - The performance of caridopulmonary resuscitation.
 - Elevated WBC count may promote circulation of marrow elements.
 - It is also possible that as part of the dying process, chemokines are released that induce peripheralization of marrow cells.

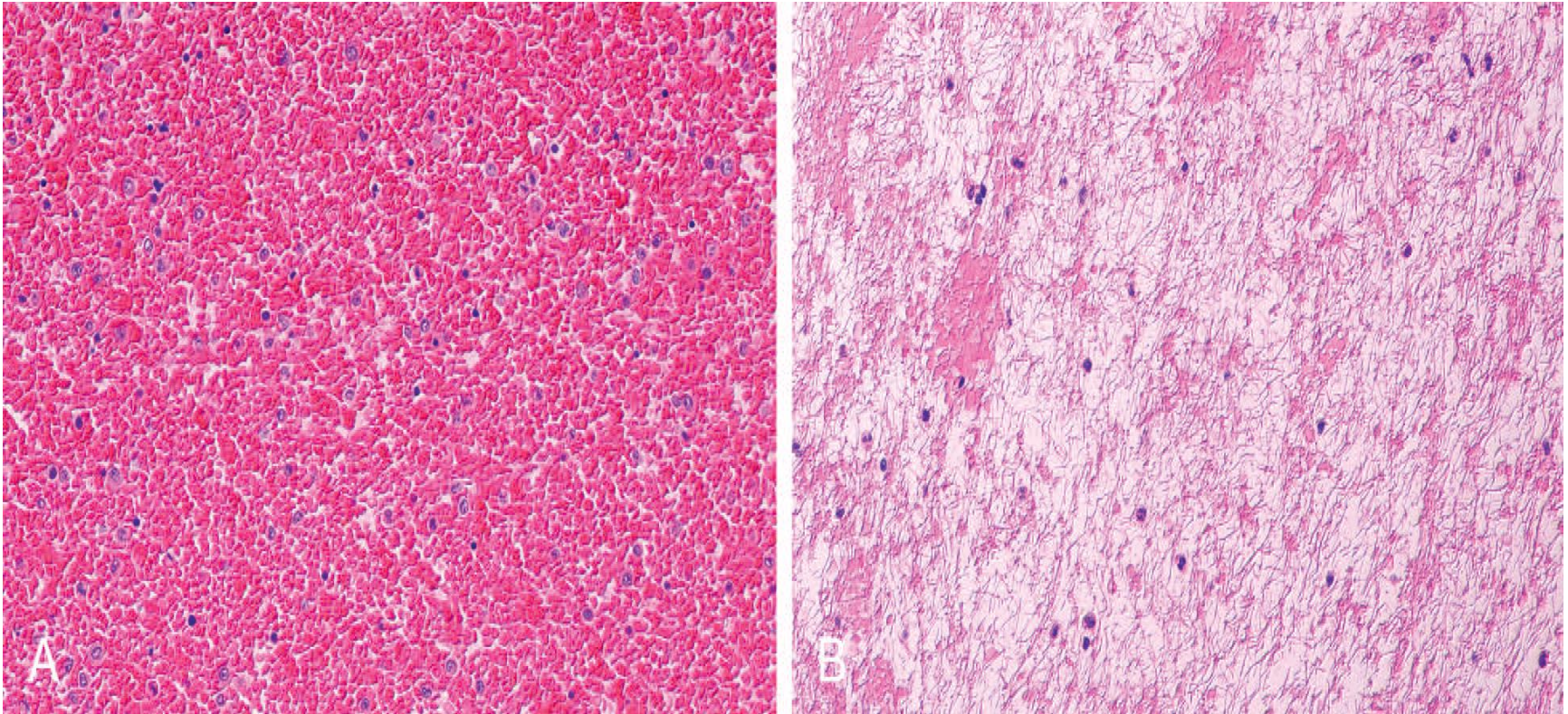
PMCs

- **Chicken fat** consisted of delicate meshwork of fibrin & platelets ,with scattered areas of dense aggregated fibrin.

Entrapped in the chicken fat clot were few erythrocytes & leukocytes.

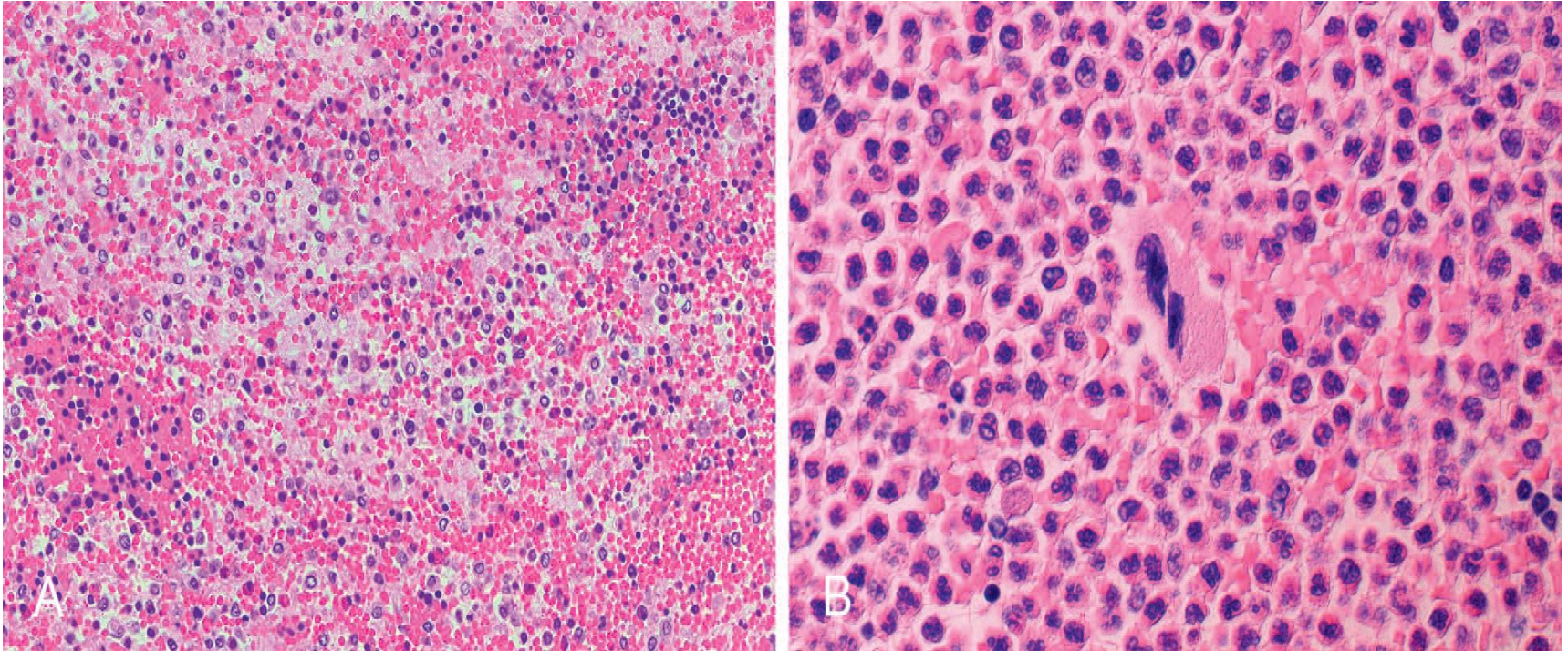
- When neutrophil karyorrhexis present was more often found at the periphery of the PMC & within BM elements.

PMCs



Postmortem clot—“red cruor” and “chicken fat.” A, Light microscopy of the red cruor shows uniform aggregates of red blood cells with scattered, single white blood cells in the mixture. B, The chicken fat on gross examination is predominantly composed of a delicate meshwork of fibrin and platelets.

PMCs



Bone marrow elements in postmortem clot. A, Bone marrow elements, including nucleated red cell precursors in clusters and immature granulocytes, are a common finding in postmortem clot. B, Occasional megakaryocytes are also noted in the areas with bone marrow elements.

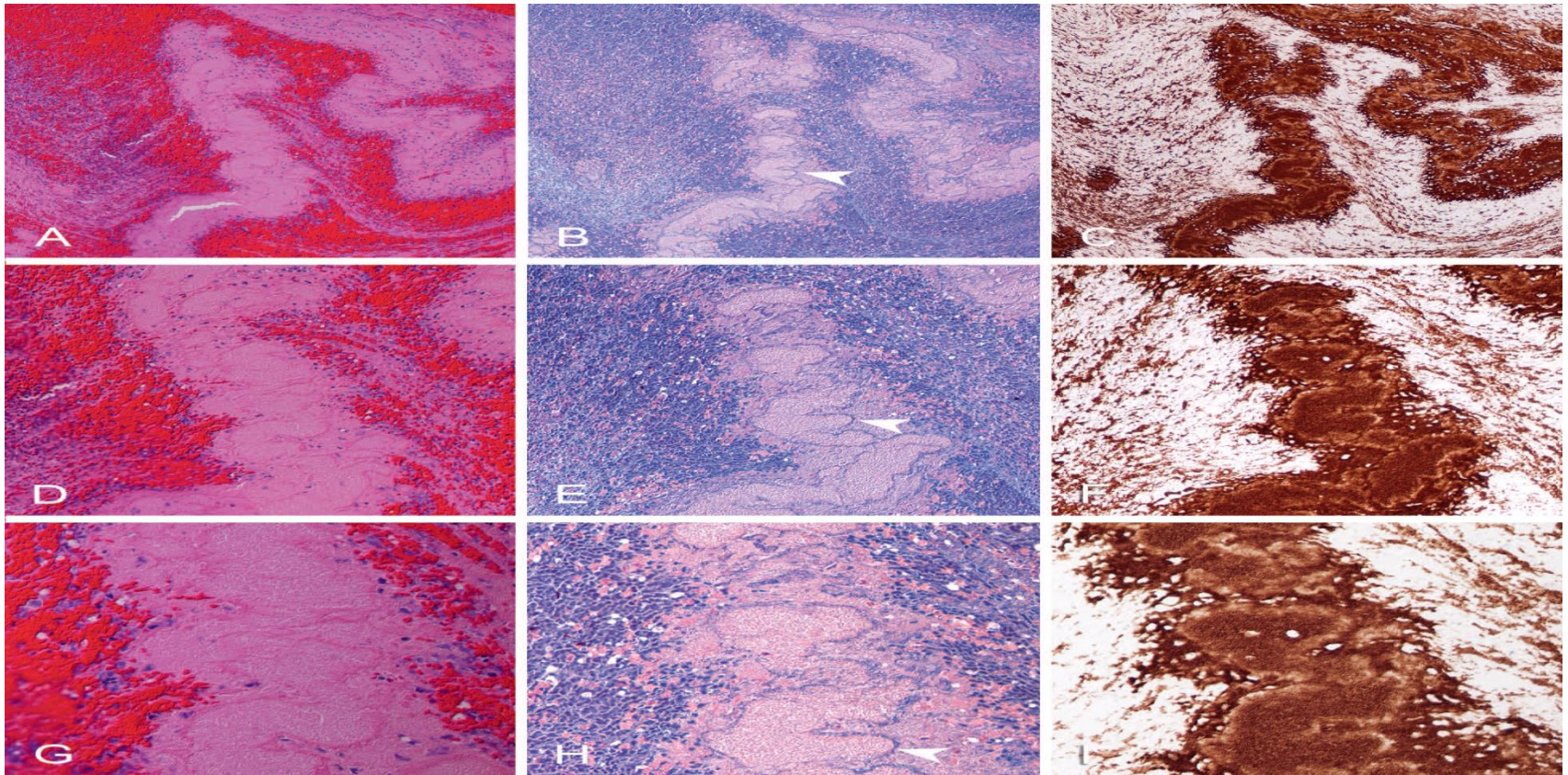
❖ AMT:

- Have apparent laminations (**lines of Zahn**) produced by alternating pale layers of Platelets admixed with some fibrin & darker layers containing more red cells.
- Neutrophil karyorrhexis wide spread of it (on low power) previously cited as definitive for AMT ,but now small foci of neutrophil karyorrhexis could be identified at high power in some of PMC.

AMT

- The explanation of wide spread neutrophil karyorrhexis in AMT is due to neutrophil is a factor in the formation of thrombi , activated platelets & endothelium in the area of thrombus can continue to chemoattract neutrophils in the presence of flowing blood. However without active circulation of blood , chemoattraction is limited .
- None of arterial or venous AMT had BM elements.

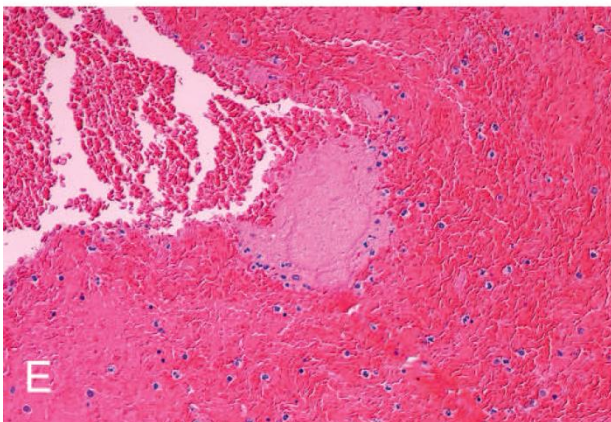
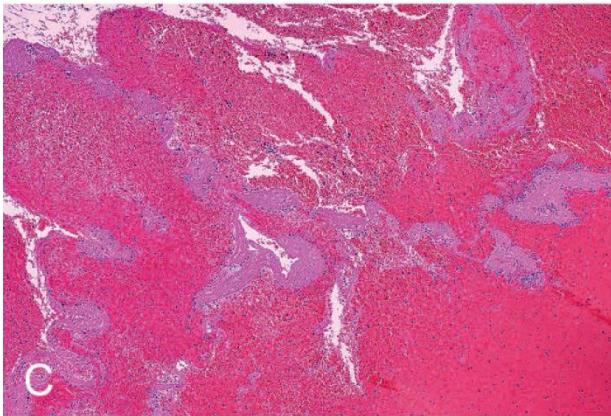
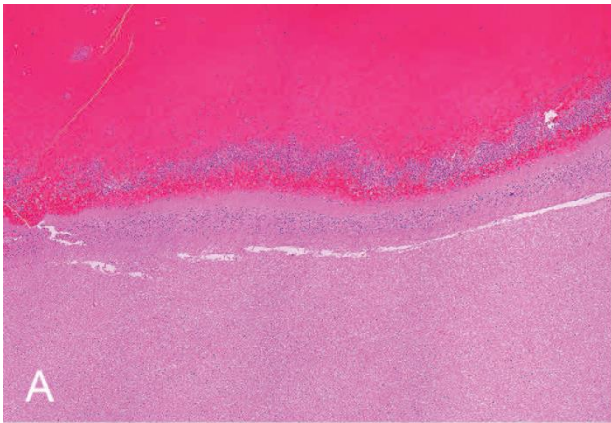
Lines of Zahn in antemortem thrombus



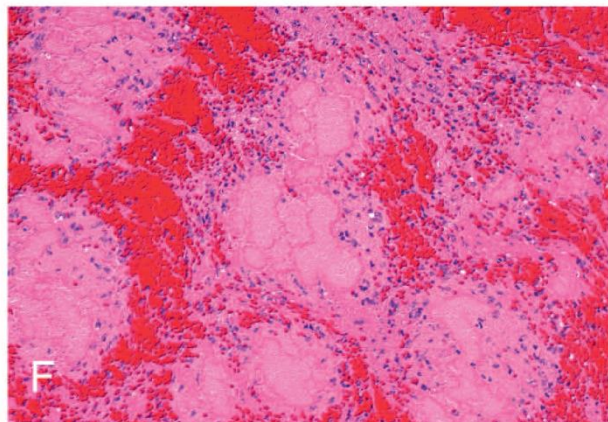
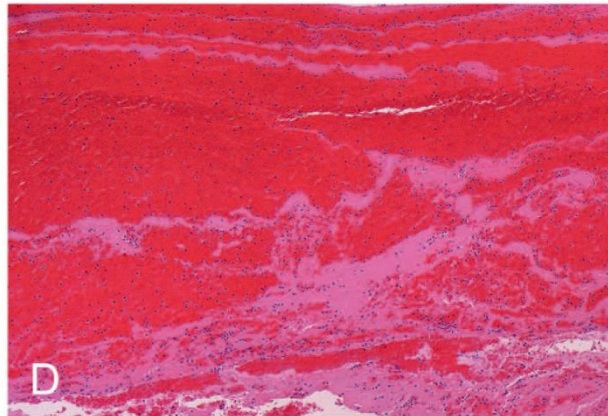
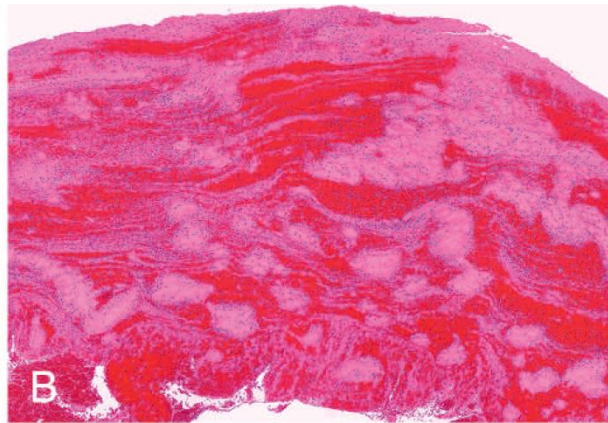
Lines of Zahn in antemortem thrombus. The first column in this panel shows linear and serpiginous patterns formed by alternating red and pink bands of blood components on hematoxylin-eosin staining (A, D, and G).

The second column shows the same area of the thrombus on phosphotungstic acid staining (B, E, and H). The finely granular aggregates of platelets surrounded by the thin fibrin strands are intensely stained brown with CD61.

postmortem clot



Antemortem thrombus



Comparison of postmortem clot (A, C, and E) to Antemortem thrombus (B, D, and F).

A, Postmortem clot showing a transition between red blood cell-rich area ("red cruor") and fibrin-rich area ("chicken fat")

B, Antemortem thrombus showing characteristic thick stripes of nested platelet and fibrin clumps as well as fine strands of fibrin alternating with a conglomerate of red blood cells.

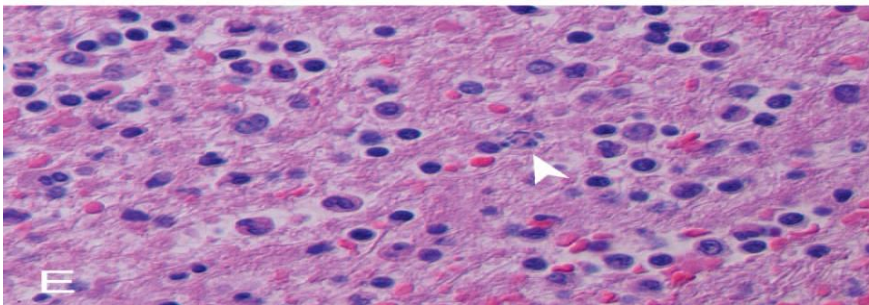
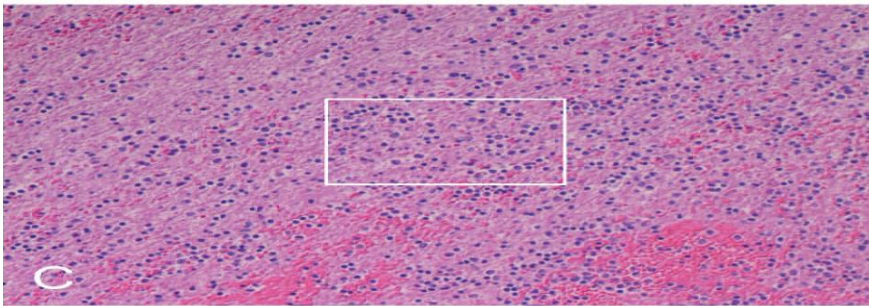
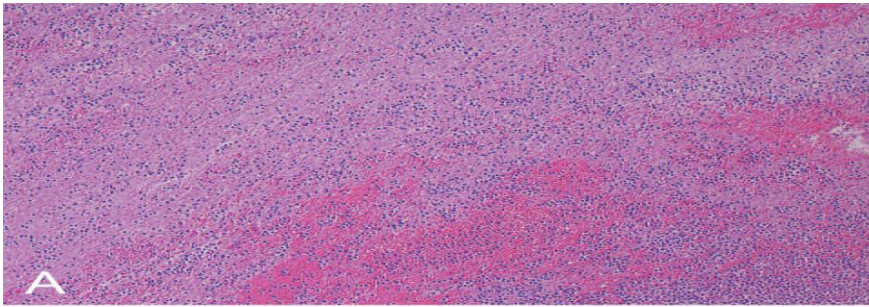
C, Postmortem clot occasionally shows focal clumps of fibrin.

D, While not a distinguishing feature, layered fibrin strands are abundant and more readily identified in antemortem thrombus.

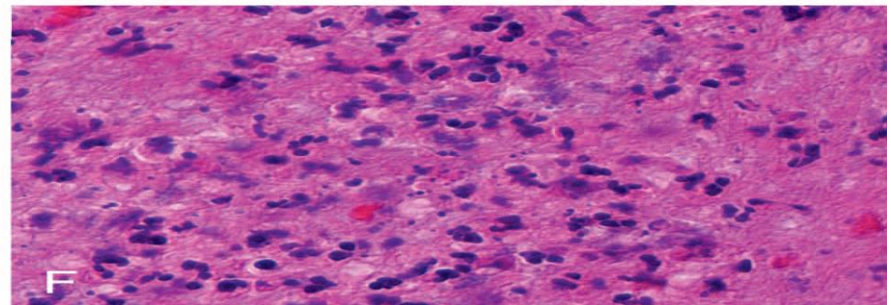
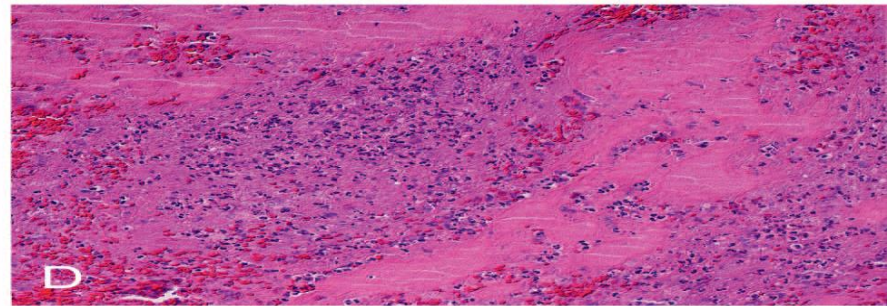
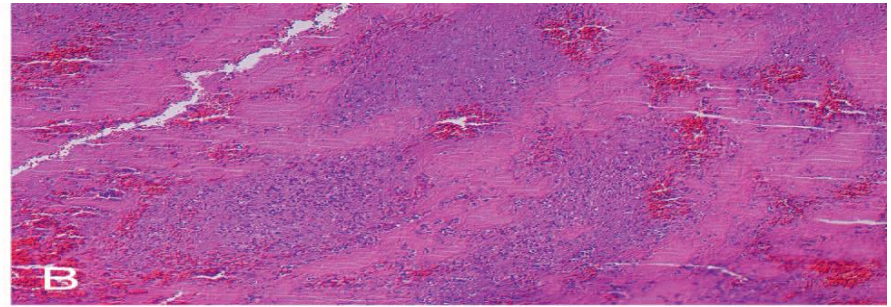
E, A postmortem clot showing a single clump of platelets wrapped in fibrin. This is a rare finding in postmortem clot .

F, Antemortem thrombus showing multiple clumps of platelets wrapped in fibrin, typically surrounded by neutrophils

postmortem clot



Antemortem thrombus



Karyorrhexis in postmortem clot (A, C, and E) compared to thrombus (B, D, and F). A, Karyorrhexis can be occasionally seen in single cells of polymorphonuclear leukocytes in postmortem clots . If present, it is usually seen within areas of bone marrow elements. Karyorrhexis of polymorphonuclear leukocytes in antemortem thrombi is easily suspected at low-magnification examination

Immunohistochemical features:

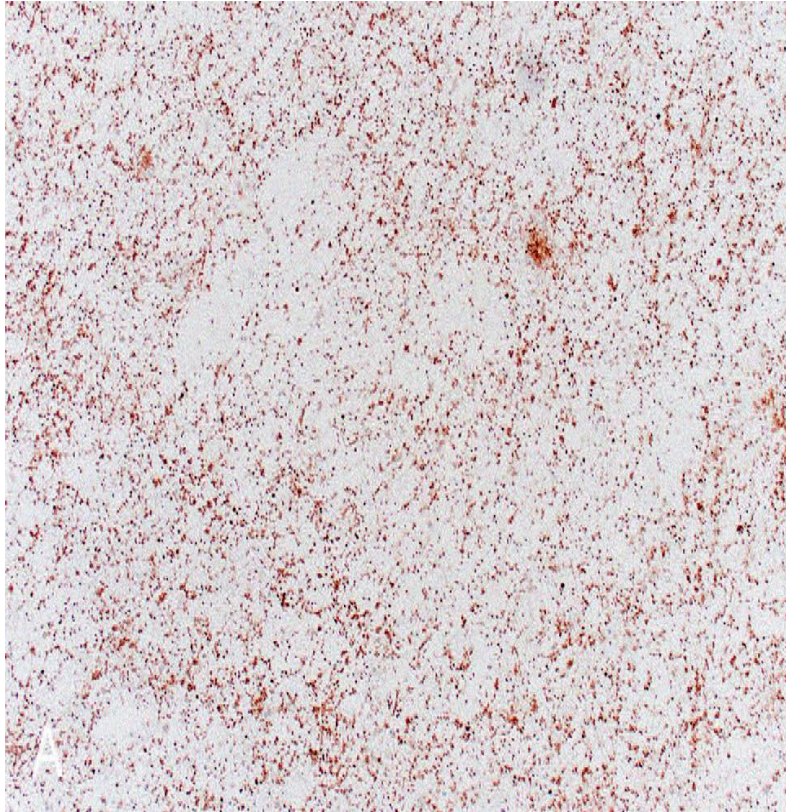
Immunohistochemical stain for platelets (CD61,integrin,CD42b).

CD61 immunohistochemistry was performed to assess platelet distribution.

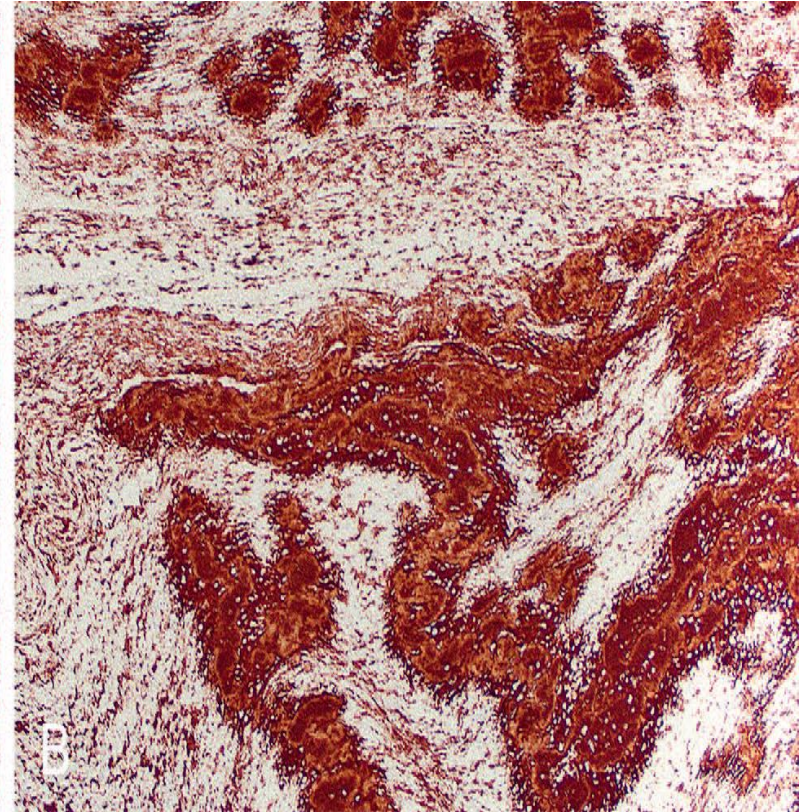
It can be divided into 2 categories:

1. Aspeckled or sparse pattern of loosely arranged platelets (seen in PMC).
2. Geographic stripes with aspeckled background (seen in AMT).

postmortem clot



Antemortem thrombus



Immunohistochemical staining of platelets with CD61. A, aspeckled or sparse pattern in PMC . B, geographic stripes pattern in AMT

The geographic stripes in AMT representing the platelets wrapped in fibrin pattern can be appreciated alternating with fine strands & aspeckled arrangement of platelets.

NOTE:

- ❖ Neutrophil karyorrhexis & CD61 immunohistochemistry can also be used to define AMT, but there has been no systemic study determining the specificity of these features.

SUMMARY:

Table 2. Features to Consider in the Microscopic Evaluation of Possible Thrombi

Favors Postmortem Clot	Favors Antemortem Thrombus
Presence of bone marrow elements	Thick bands of nested platelets wrapped by fibrin
Speckled pattern of CD61 staining	Geographic pattern of CD61 staining
Complete absence of neutrophil karyorrhexis	Diffuse neutrophil karyorrhexis at low power

References:

1. Robbins Basic pathology.
2. Kumar V, Abbas AK, Aster JC. Hemodynamic disorders, thromboembolic disease, and shock.
3. Husain AN, pulmonary embolism and infarction. In: High-yield Thoracic pathology.

Thank you