Histopathological Spectrum of Atherosclerosis and its Occurrence in Coronary
Arteries in Autopsy Heart Specimens: A Record Based Study in a Tertiary Care
Hospital

■ ORIGINAL ARTICLE

Histopathological Spectrum of Atherosclerosis and its Occurrence in Coronary Arteries in Autopsy Heart Specimens: A Record Based Study in a Tertiary Care Hospital

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ABSTRACT

BACKGROUND: Cardiovascular disease is a leading cause of death in men and women worldwide. Atherosclerosisis the most important cause of cardiovascular disease. Based on the severity, atherosclerosis can be graded histopathologycally from Type I to Type VI. Cardiac autopsy is the main diagnostic tool to study various histopathological changes in autopsy heart specimens.

OBJECTIVES: To study the histopathological spectrum and determine the occurrence of atherosclerosis in coronary arteries in autopsy heart specimens.

MATERIALS AND METHODS: This is a retrospective record based study on autopsy heart specimens received at the department of pathology from January 2020 to December 2021. Gross and histopathological findings were recorded from autopsy register. The histopathological spectrum of atherosclerosis and its occurrence were studied and analyzed.

RESULTS: A total of 141 heart specimens were considered for the study out of which 131 cases (92.9%) showed coronary atherosclerosis ranging from Type I to Type VI lesions. Age of the deceased ranged from one month to ninety two years. One hundred four cases (79.38%) were males and twenty seven cases (20.62%) were females. Fifty four cases (41.2%) belonged to the age group of 41-60 years. Type III–VI lesions were considered significant. 70.87% of right coronary arteries, 76.8% of left circumflex arteries and 76.9% of left anterior descending arteries showed significant atherosclerosis. Left anterior descending artery was found to be the most commonly involved by atherosclerosis (79.4%).

CONCLUSION: Examination of coronary arteries in autopsy heart specimens plays an important role in determining the cause of cardiovascular diseases and gives an idea about the frequency at which atherosclerosis is encountered among the general population.

INTRODUCTION

Cardiovascular disease is one of the leading causes of death in men and women worldwide.[1] Atherosclerosis/Coronary artery disease (CAD) accounts for about one-third of all deaths in the country.[2] The major risk factors of atherosclerosis are broadly divided into non-modifiable (constitutional) and modifiable ones. The constitutional risk factors include family history, age and gender, whereas the modifiable ones are hyperlipidemia, hypertension, diabetes mellitus and cigarette smoking.

Atherosclerosis is a chronic inflammatory and healing response of the vessel wall to endothelial injury. It progresses in the following sequence:

- Endothelial injury and dysfunction
- Accumulation of lipoproteins, mainly Low Density Lipoprotein (LDL)
- Monocyte adhesion to endothelium
- Platelet adhesion
- Factor release from activated platelets, inducing smooth muscle cell recruitment
- Smooth muscle cell proliferation, extracellular matrix production and recruitment of T cells
- Lipid accumulation both extracellularly and intracellularly
- Calcification of extracellular matrix and necrotic debris

The key processes in atherosclerosis are intimal thickening and lipid accumulation which lead to the formation of plaques. Atheromatous plaques are yellow-tan and are raised above the surrounding vessel wall. A superimposed thrombus over an ulcerated plaque appears red brown. Plaques may vary in size and coalesce to form large masses.

Atherosclerotic lesions are patchy, involving only a portion of any given vessel wall and the lesions therefore appear eccentric. This is because local flow disturbances, like turbulence at branch points, make certain portions of a vessel wall more susceptible to plaque formation. Over time, these lesions enlarge, become more numerous and broadly distributed.

Atherosclerotic plaques have 4 principal components:

- Smooth muscle cells, macrophages and T cells
- Extracellular matrix including collagen, elastin and proteoglycans
- Intracellular and extracellular lipid
- Calcification in later stages of plaques

The periphery of the lesions displays neovascularization. Most plaques contain abundant lipid but few are composed exclusively of smooth muscle cells and fibrous tissue.

Atherosclerotic plaques are prone to the following pathological changes:

- Rupture, ulceration or erosion leading to thrombus formation
- Hemorrhage into plaque
- Atheroembolism
- Aneurysm formation

The major consequences of atherosclerosis are myocardial infarction, cerebral infarction, aortic aneurysms and peripheral vascular diseases.[3]

Hence the study was undertaken aiming to determine the occurrence of atherosclerosis as well as the histopathological spectrum of atherosclerotic lesions in autopsy heart specimens received at our hospital.

MATERIALS AND METHODS

All autopsy heart specimens referred to the Department of Pathology during the study period of 24 months from January 2020 to December 2021 were taken as study samples. Relevant data was collected from autopsy registers of Pathology department. The slides prepared from the specimens received in histopathology section following standard

procedure were studied and the data was analyzed.

A prior approval from Institutional Ethics Committee of MIMS, Mandya was obtained for the study (ethical code: MIMS/IEC/562 dated 30.03.2022).

Inclusion criteria:

All autopsy heart specimens with definitive diagnosis of coronary atherosclerosis were included in the study.

Exclusion criteria:

All autopsy heart specimens which were partially or completely autolyzed were excluded.

Histopathologically, atherosclerotic lesions were graded as follows:

– Type I (initial) lesion showing isolated macrophages and foam cells (Fig. 1).

– Type II (fatty streak) lesion showing predominantly intracellular lipid accumulation (Fig. 2).
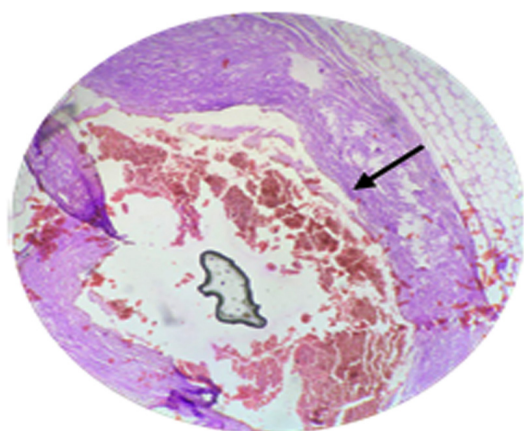

Fig. 2: Type II lesion showing intracellular lipid pool (H & E;10x)
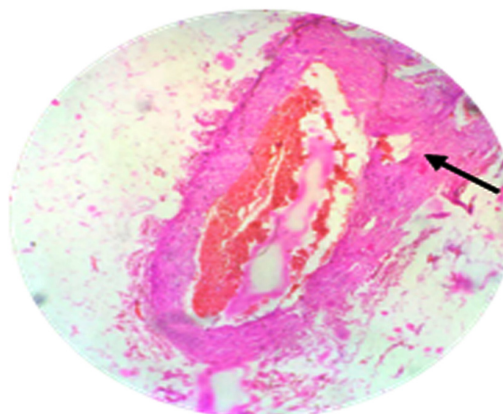

Fig. 1: Type I lesion showing foam cells and macrophages (H & E; 10x)

– Type III (intermediate) lesion showing type II changes and extracellular lipid pools (Fig. 3).

– Type IV (atheroma) lesion showing type II changes and core of extracellular lipid (Fig. 4).
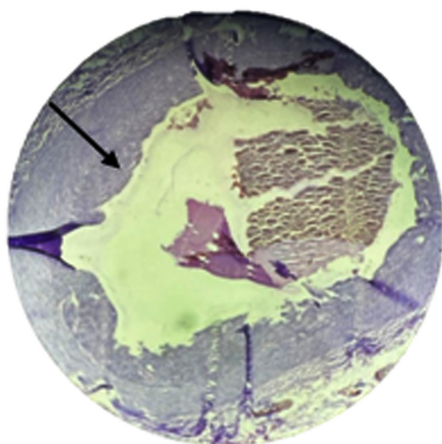

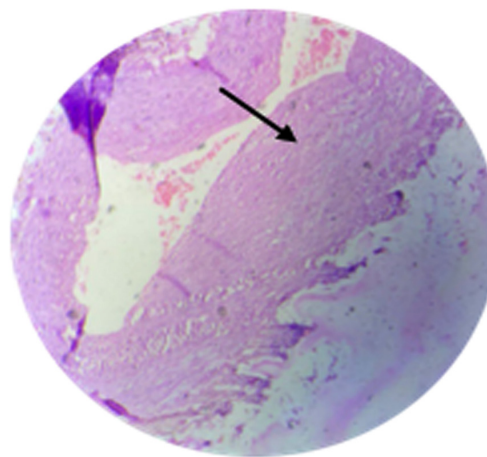**Fig. 3:** Type III lesion showing extracellular lipid pool (H & E; 10x)

Fig. 4: Type IV lesion showing extracellular lipid core (H & E; 10x)

– Type V (fibroatheroma) lesion showing a well developed lipid core covered by fibrous capsule, or predominantly calcification, or predominantly fibrosis (Fig. 5).

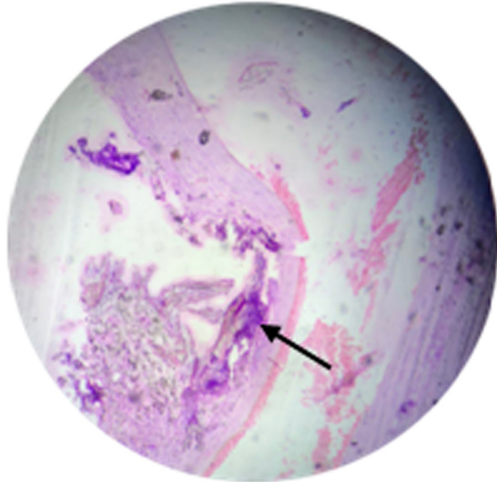– Type VI (complicated) lesion showing surface defect, hematoma or thrombosis. (Fig. 6).[4,5]

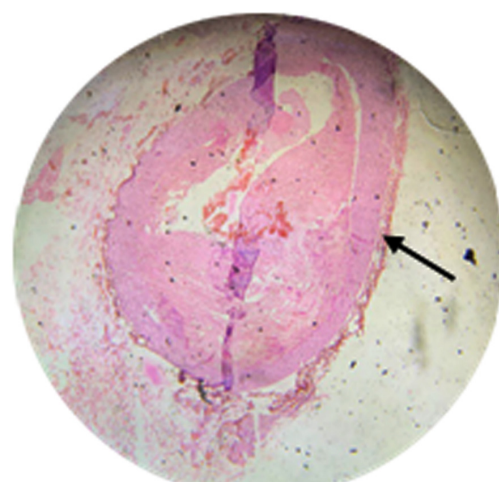**Fig. 5:** Type V lesion showing calcification of vessel wall (H & E; 10x)

Fig. 6: Type VI lesion showing thrombosis of the vessel (H & E; 10x)

RESULTS

A total of 149 autopsy heart specimens were received during the study period. Out of this, 8 specimens were autolyzed. The remaining 141 specimens showed intact coronary vessels, out of which 10 cases (7.1%) showed no specific pathology in all coronary arteries.

The study population constituted 104 (79.38%) males and 27 (20.62%) females. Age of the deceased ranged from one month to 92 years. (Fig. 7)
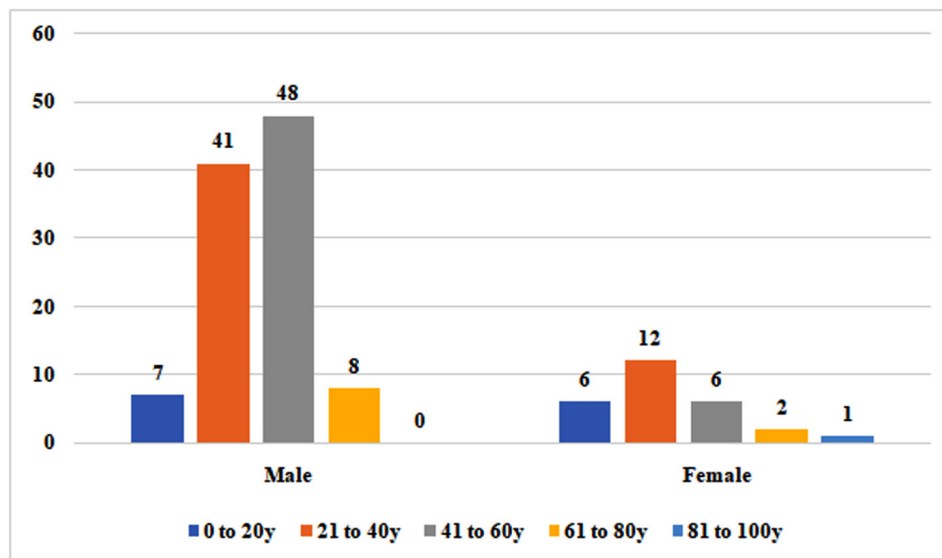

Fig. 7: Age distribution of males and females with coronary atherosclerosis

One hundred three cases of right coronary artery, ninety five cases of left circumflex artery and one hundred four cases of left anterior descending artery showed atherosclerotic lesions ranging from Type I – VI. The percentage-wise distribution of histopathological spectrum of atherosclerosis in right coronary artery (Fig. 8), left circumflex artery (Fig. 9) and left anterior descending artery (Fig. 10) was analyzed.
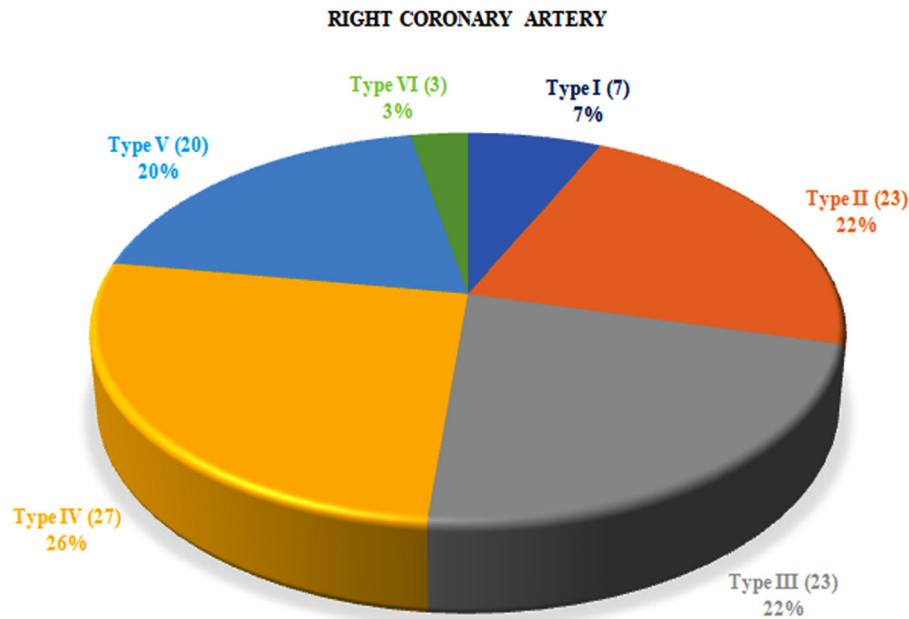

Fig. 8: Percentage-wise distribution of histopathological spectrum of atherosclerosis in right coronary artery
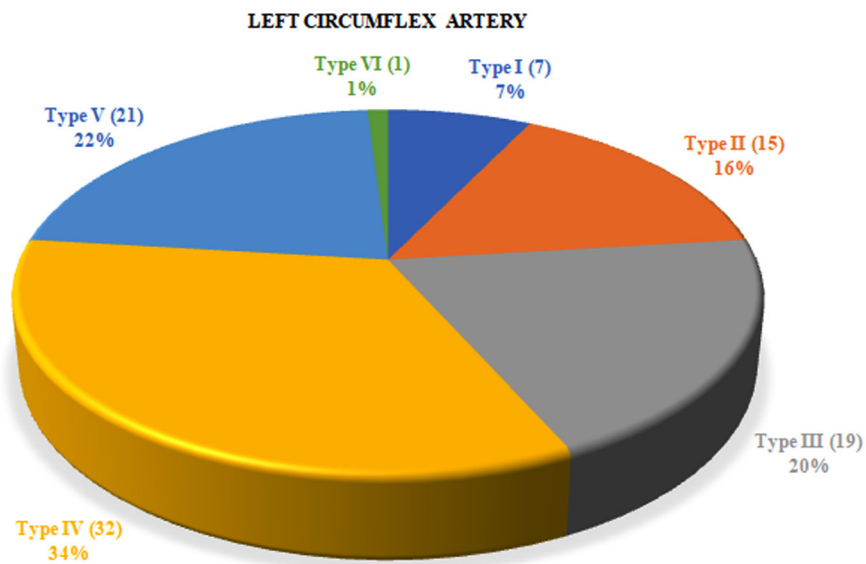

Fig. 9: Percentage-wise distribution of histopathological spectrum of atherosclerosis in left circumflex artery
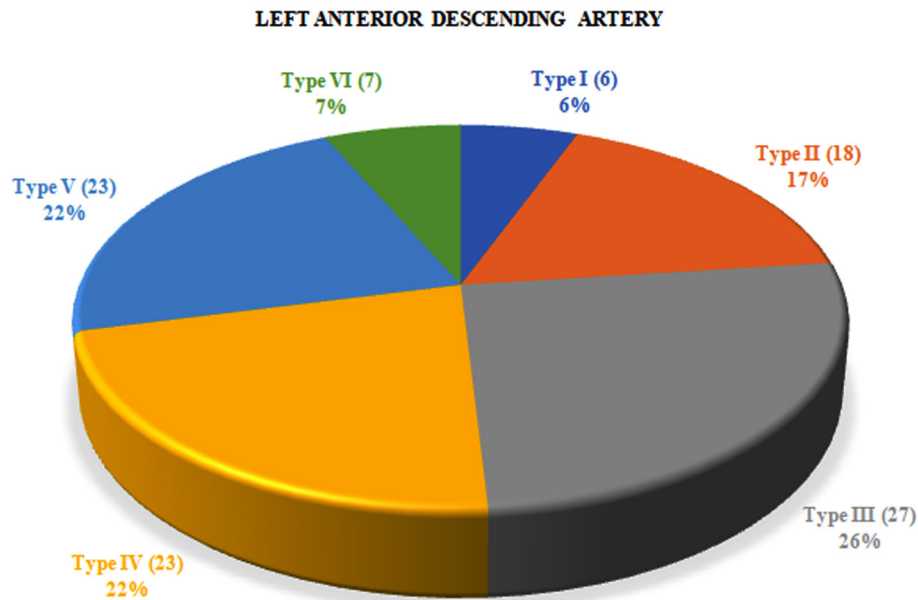
LEFT ANTERIOR DESCENDING ARTERY

Fig. 10: Percentage-wise distribution of histopathological spectrum of atherosclerosis in left anterior descending artery

The distribution of histopathological spectrum of atherosclerotic lesions in accordance with age and sex of the deceased in right coronary artery (Table 1), left circumflex artery (Table 2) and left anterior descending artery (Table 3) was studied.

The distribution of single vessel, double vessel and triple vessel involvement of atherosclerosis in terms of the age and sex of the deceased was determined. (Table 4)

Out of all the cases that showed significant atherosclerosis, the number of cases, in terms of percentage, that grossly showed greater than 50% of the lumen obstructed in all the three coronary arteries were also determined. (Table 5)

Table 1: Age wise and sex wise distribution of histopathological spectrum of atherosclerosis in right coronary artery

	Right Coronary Artery									
	Number of males					Number of females				
	0 to 20 years	21 to 40 years	41 to 60 years	61 to 80 years	81 to 100 years	0 to 20 years	21 to 40 years	41 to 60 years	61 to 80 years	81 to 100 years
Type I	3	2	1	Nil	Nil	1	Nil	Nil	Nil	Nil
Type II	2	8	8	1	Nil	1	2	1	Nil	Nil
Type III	1	9	5	2	Nil	1	3	1	1	Nil
Type IV	1	9	11	3	Nil	Nil	2	Nil	Nil	1
Type V	Nil	2	16	2	Nil	Nil	Nil	Nil	Nil	Nil
Type VI	Nil	2	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil

Table 2: Age wise and sex wise distribution of histopathological spectrum of atherosclerosis in left circumflex artery

	Left Circumflex Artery								
	Number of males					Number of females				
	0 to 20 years	21 to 40 years	41 to 60 years	61 to 80 years	81 to 100 years	0 to 20 years	21 to 40 years	41 to 60 years	61 to 80 years	81 to 100 years
Type I	1	1	Nil	Nil	Nil	1	3	1	Nil	Nil
Type II	1	5	4	1	Nil	2	1	Nil	Nil	1
Type III	1	7	4	1	Nil	Nil	3	2	1	Nil
Type IV	Nil	13	15	2	Nil	Nil	1	Nil	1	Nil
Type V	1	4	14	1	Nil	Nil	Nil	1	Nil	Nil
Type VI	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Table 3: Age wise and sex wise distribution of histopathological spectrum of atherosclerosis in left anterior descending artery

	Left Anterior Descending Artery								
	Number of males					Number of females				
	0 to 20 years	21 to 40 years	41 to 60 years	61 to 80 years	81 to 100 years	0 to 20 years	21 to 40 years	41 to 60 years	61 to 80 years	81 to 100 years
Type I	Nil	2	Nil	Nil	Nil	1	2	1	Nil	Nil
Type II	Nil	5	5	4	Nil	1	1	2	Nil	Nil
Type III	1	9	5	1	Nil	2	3	2	3	1
Type IV	Nil	9	10	2	Nil	1	1	Nil	Nil	Nil
Type V	Nil	4	18	1	Nil	Nil	Nil	Nil	Nil	Nil
Type VI	1	3	3	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Table 4: Age-wise and sex-wise distribution of pattern of involvement of vessels by atherosclerosis

	Pattern of Involvement								
	Number of males					Number of females				
	0 to 20 years	21 to 40 years	41 to 60 years	61 to 80 years	81 to 100 years	0 to 20 years	21 to 40 years	41 to 60 years	61 to 80 years	81 to 100 years
Single Vessel	4	10	9	Nil	Nil	4	6	2	Nil	Nil
Double Vessel	1	5	4	1	Nil	1	1	1	1	Nil
Triple Vessel	2	27	34	7	Nil	1	5	3	1	1

Table 5: Percentage wise distribution of degree of obstruction of lumen in coronary arteries with significant atherosclerosis

Artery involved	No. of cases with <50% lumen obstructed	No. of cases with >50% lumen obstructed
Right coronary artery	51.50%	48.50%
Left circumflex artery	43.20%	56.80%
Left anterior descending artery	49.10%	50.90%

DISCUSSION

Histopathological examination plays an important role in diagnosis and grading of atherosclerotic lesions.

The present study was a retrospective study in which all autopsy heart specimens received in Pathology department for a period of two years have been included. A total of 141 cases were included in the study.

The current study shows male predominance which is similar to the study conducted by Purushottam R et al.[6] Yogender Singh Bansal et al.[7] and J Golshahi M D et al.[8]

In our study, maximum number of cases belonged to 41 – 60 years of age, out of which majority were males (88.9%) which is similar to the study conducted by Renuka Verma et al (41-50 years)[1] and Md Ibrahim Siddiqui et al (51-60 years).[2]

The present study showed that left anterior descending artery was the most commonly involved by atherosclerosis (79.4%) which is similar to the study conducted by Renuka Verma et al.[1] Purushottam R et al.[6] Yogender Singh Bansal et al.[7] and Marwah Nisha et al.[9]

Type IV atherosclerotic lesion was more common in right coronary artery and left circumflex artery, whereas Type III lesion dominated in left anterior descending artery in the present study. Also, Type VI lesion was found to be of higher occurrence in left anterior descending artery.

In the present study, Type V lesion was found to be the most commonly occurring in the age group of 41-60 years, whereas Type III and Type IV dominated in the 3rd and 4th decades.

In the present study, triple vessel involvement was most common (61.8%) which was similar to the study conducted by Purushottam R et al.[6] Marwah Nisha et al.[9] and Pratima Khare et al.[10] This was followed by single vessel and double vessel involvement respectively. Triple vessel involvement was found to be of highest occurrence in the 5th and 6th decades in the present study.

Left circumflex artery showed highest occurrence of cases with >50% obstruction of lumen followed by left anterior descending artery and right coronary artery.

CONCLUSION

Histopathology plays a very important role in the diagnosis and grading of atherosclerotic lesions. This study has evaluated the occurrence of atherosclerotic lesions in autopsy heart specimens received at our hospital. Most of the cases were in the age group of 41-60 years with male predominance. The histopathological spectrum of lesions varied from Type I to Type VI as seen in our study. The grading of lesions, especially for the lower grades, is subjective and varies from pathologist to pathologist. Opinions from multiple pathologists on a single case can help to overcome this limitation.

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