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CLASSIFICATION OF AMYLOIDOSIS IN DIGITAL IMAGES OF KIDNEY BIOPSIES USING NON-SPECIFIC DYES

by

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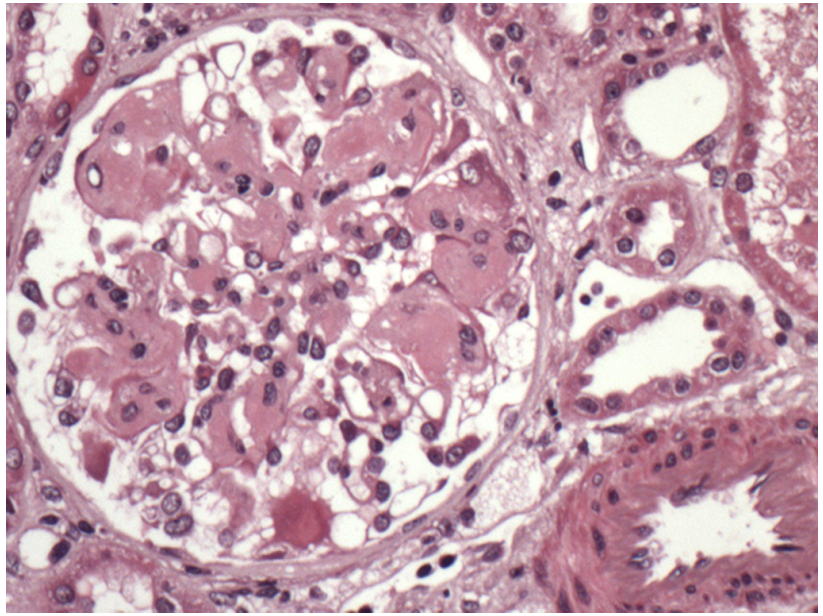
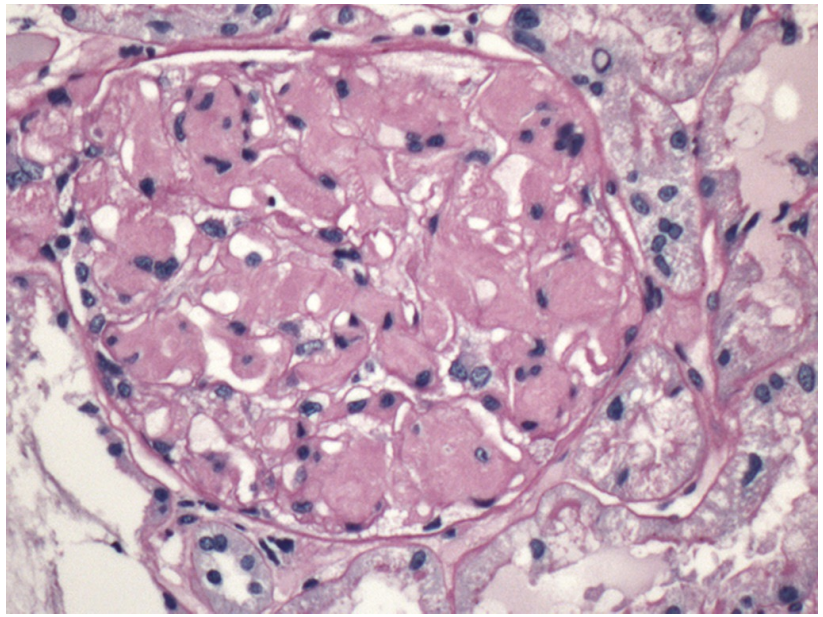
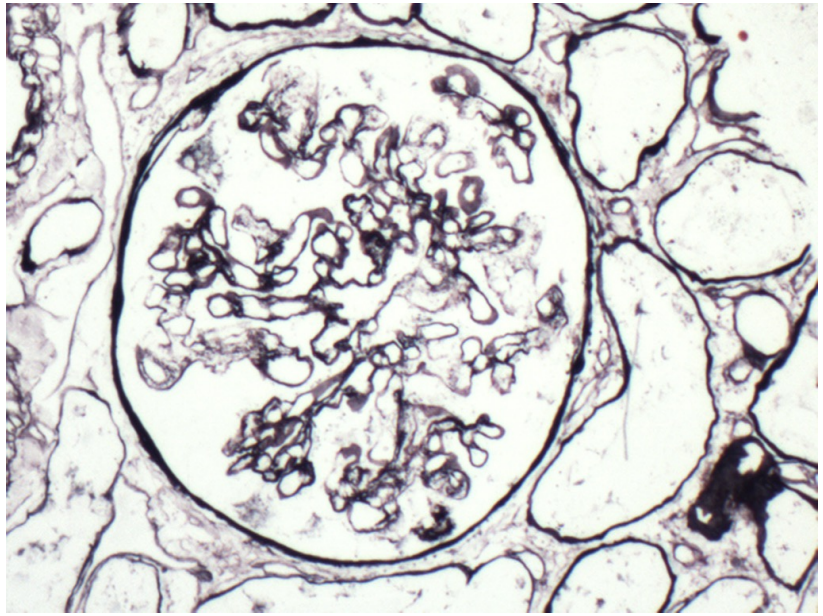
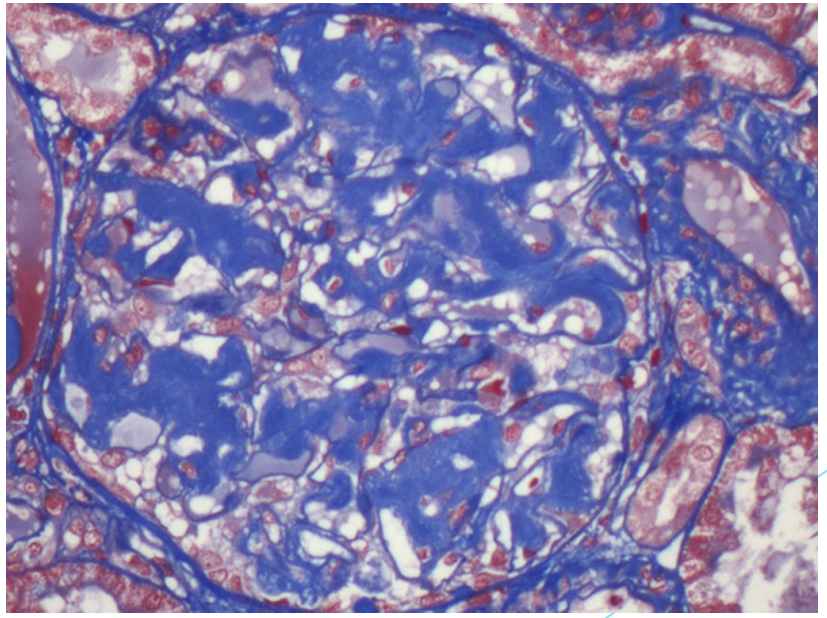
Examples of Amyloidosis









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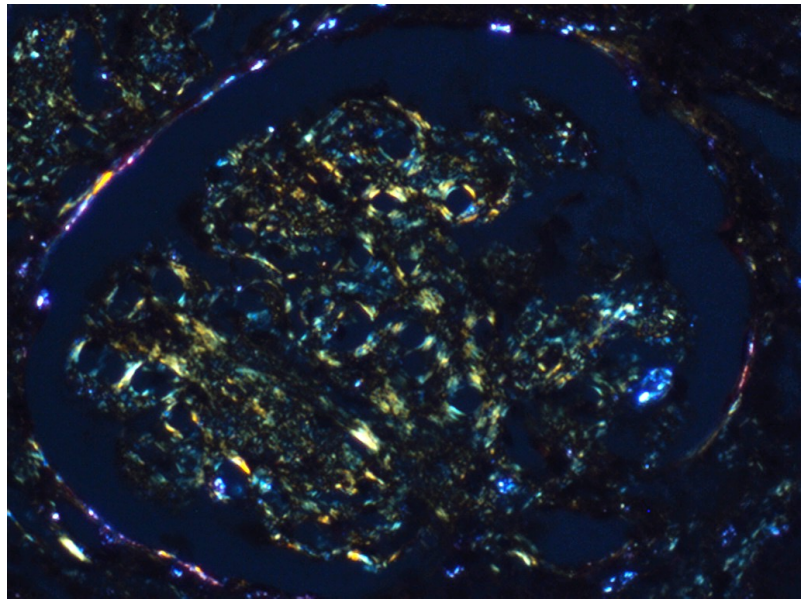

Introduction

- Diagnosis of amyloidosis requires:
  - Congo red stained sections and light polarization;
  - Additional techniques of molecular characterization;
- These requirements adds steps to pre-analytic and analytic phases;
- It would be desirable to have a system that could reduce the steps in the diagnosis of the disease.

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Aims

To create a computational model for:

- classifying glomerulus affected by amyloidosis using routine stained sections without light polarization;
- distinguish AL from AA amyloidosis.

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Methods

- 4389 images of glomeruli from histological sections stained with H&E, PAS or PAMS:
  - Of glomeruli with amyloidosis confirmed by staining with Congo red;
  - Of glomeruli either normal or with other lesions.

LESION	HE	AZAN	PAS	PAMS	Total
Amyloidosis	31	145	96	102	374
Normal	716	97	156	249	1218
Segmental sclerosis	672	234	472	104	1482
w/hypercellularity	653	153	509	0	1315

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Data imbalance

374 amiloidose

4.105 outras

HE+PAS

≈ 75% das amostras

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Dealing with imbalance

Data Resampling	Loss Weighting	Voting
Amyloidosis images are used more than once	Model more sensitive to error in amyloidosis	Combination of different models

Neural network architectures

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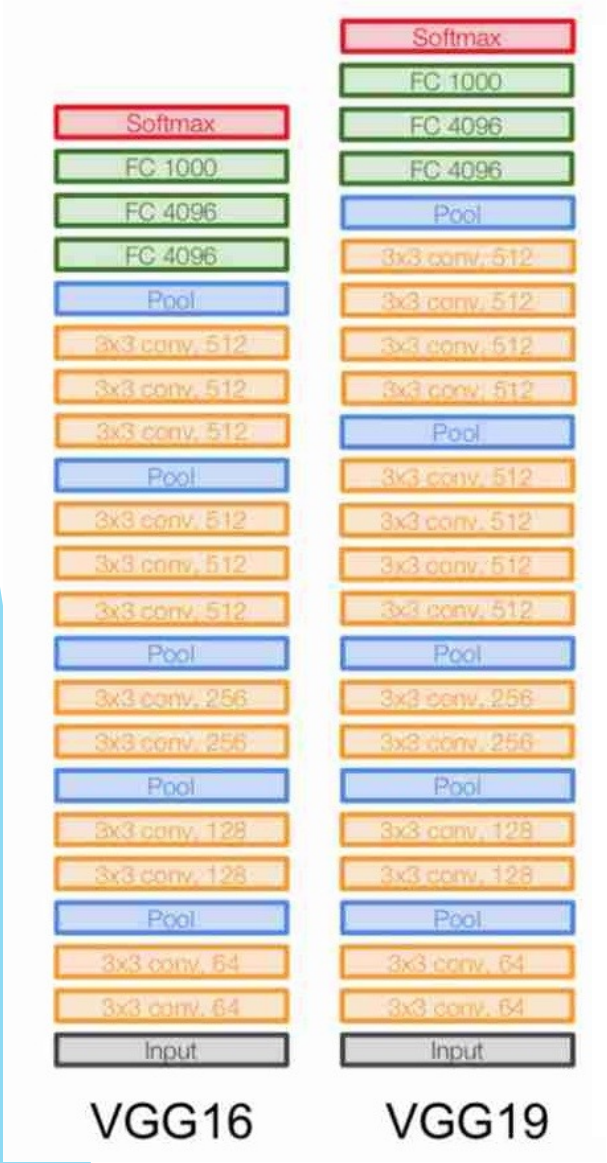

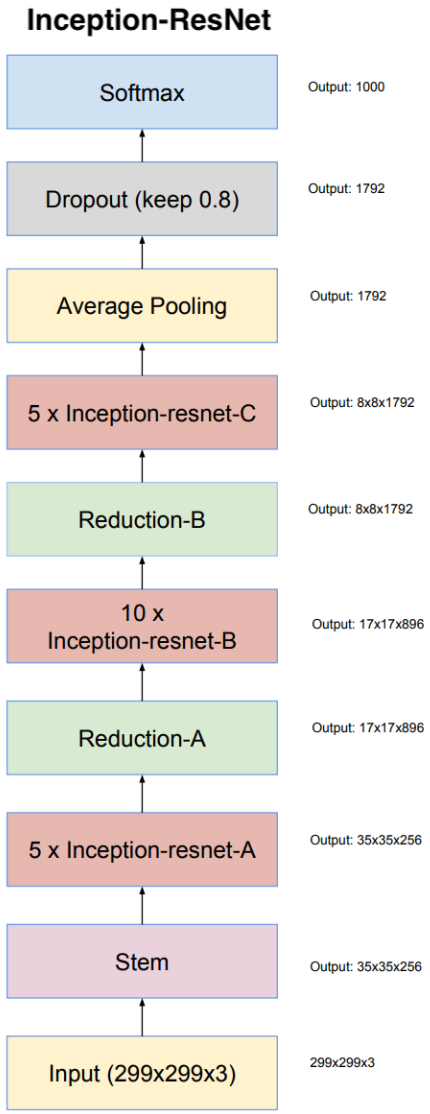

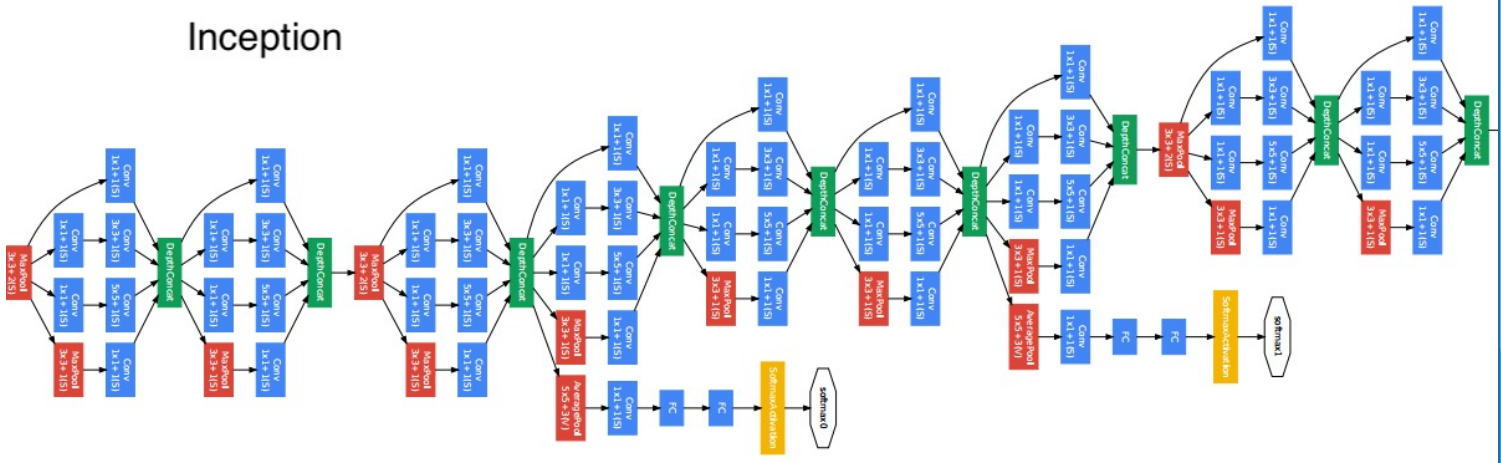

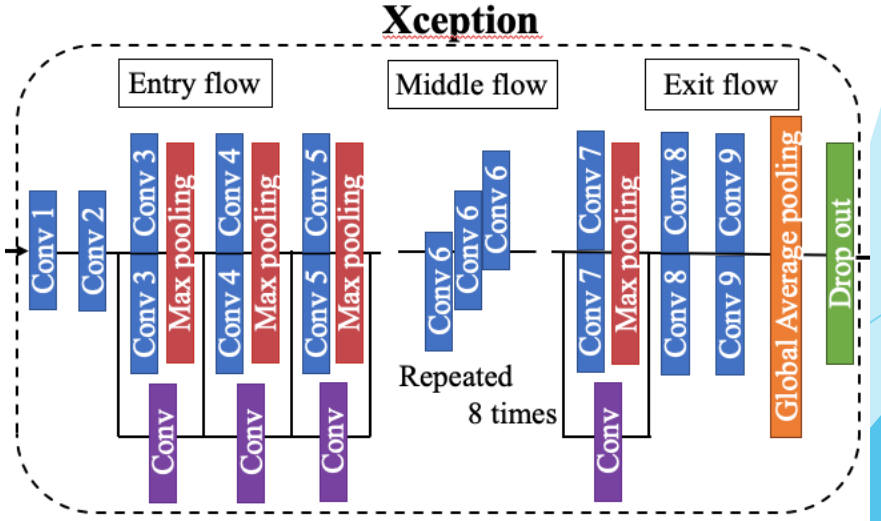

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Results with resampling

Model	Specificity	F1-Score
VGG-16	89,6%	59,8%
VGG-19	87,9%	54,2%
Xception	96,9%	72,8%
Inception	93,0%	69,6%
Inception-ResNet	96,4%	78,0%

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Conclusion

- Model based on Inception-Resnet had specificity (96.4%) close to the best model (96.9%), but with a higher F1-score (78.0% versus 72.8%)

Perspective

- To improve the performance of the system;
- To traine the system to classify cases with AA and AL amyloidosis.

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Thank you!

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