#FigTag

Find Papers with the Data You’re Looking For!

The Team

- Meng Cheng
- Ryan Connor
- Marie Gallagher
- Alex Kotliarov
- David Shao
- Ricardo Villamarin

The Problem

- ***As a researcher***:
    - I look for articles in pubmed
        - That have data that speak to a hypothesis or problem I have

BUUUUUUT …

- ***What I get***
    - Lots of articles that contain my keywords but with few figures about data “with” all my keywords

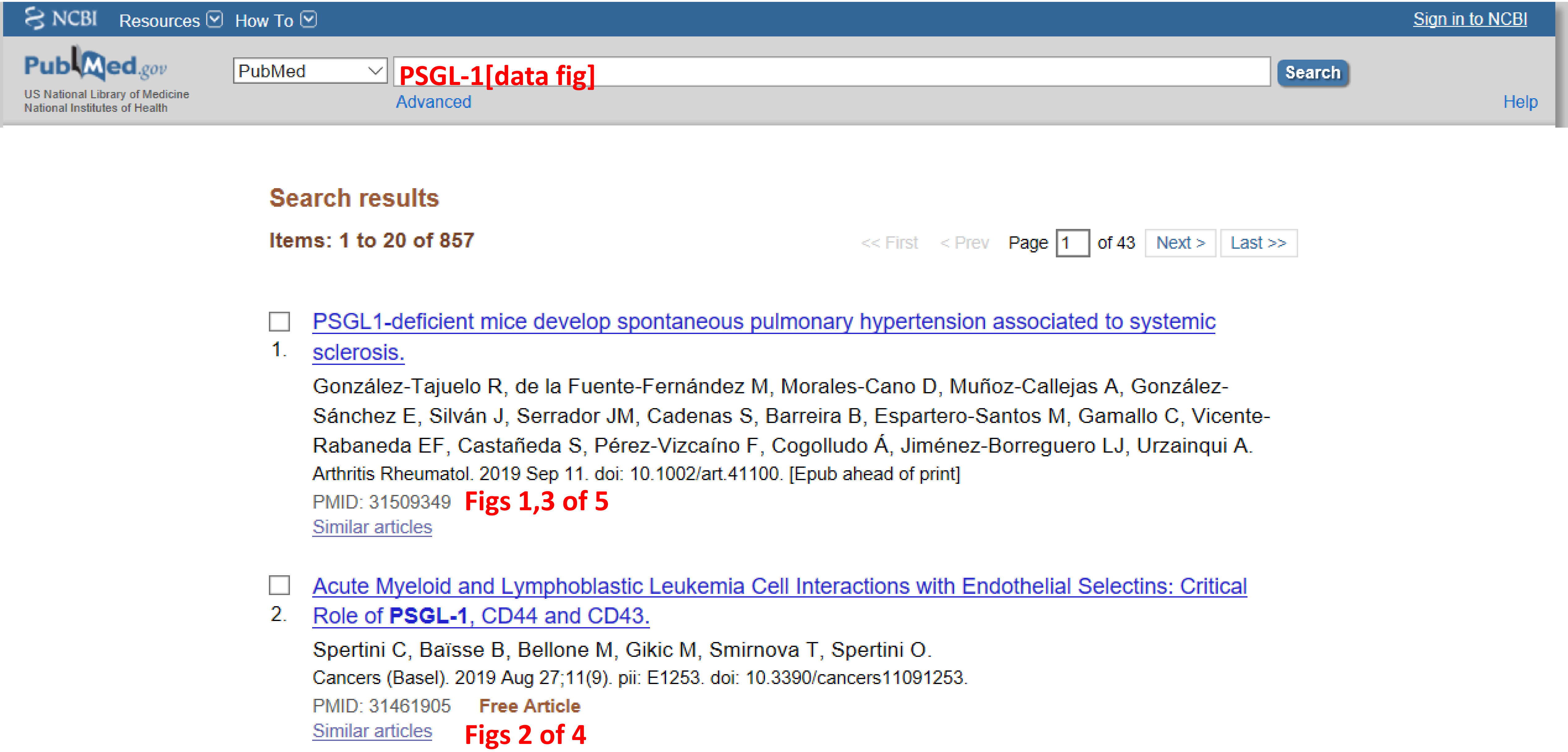
The Solution:
Index Papers based on Figure Attributes

Image Processing

- Split Multipanel Figures
- Extract Text from Figures
- Cluster and Classify Figures

Text Mining

- Map text to MeSH Hierarchy
- Sources
  - Figure Legend
  - Related Material & Methods
  - Relevant Results



PSGL-1[data fig]

Search results

Items: 1 to 20 of 857

<< First < Prev Page 1 of 43 Next > Last >>

□ 1. PSGL1-deficient mice develop spontaneous pulmonary hypertension associated to systemic sclerosis.

González-Tajuelo R, de la Fuente-Fernández M, Morales-Cano D, Muñoz-Callejas A, González-Sánchez E, Silván J, Serrador JM, Cadenas S, Barreira B, Espartero-Santos M, Gamallo C, Vicente-Rabaneda EF, Castañeda S, Pérez-Vizcaíno F, Cogolludo Á, Jiménez-Borreguero LJ, Urzainqui A.

Arthritis Rheumatol. 2019 Sep 11. doi: 10.1002/art.41100. [Epub ahead of print]

PMID: 31509349 **Figs 1,3 of 5**

Similar articles

□ 2. Acute Myeloid and Lymphoblastic Leukemia Cell Interactions with Endothelial Selectins: Critical Role of **PSGL-1**, CD44 and CD43.

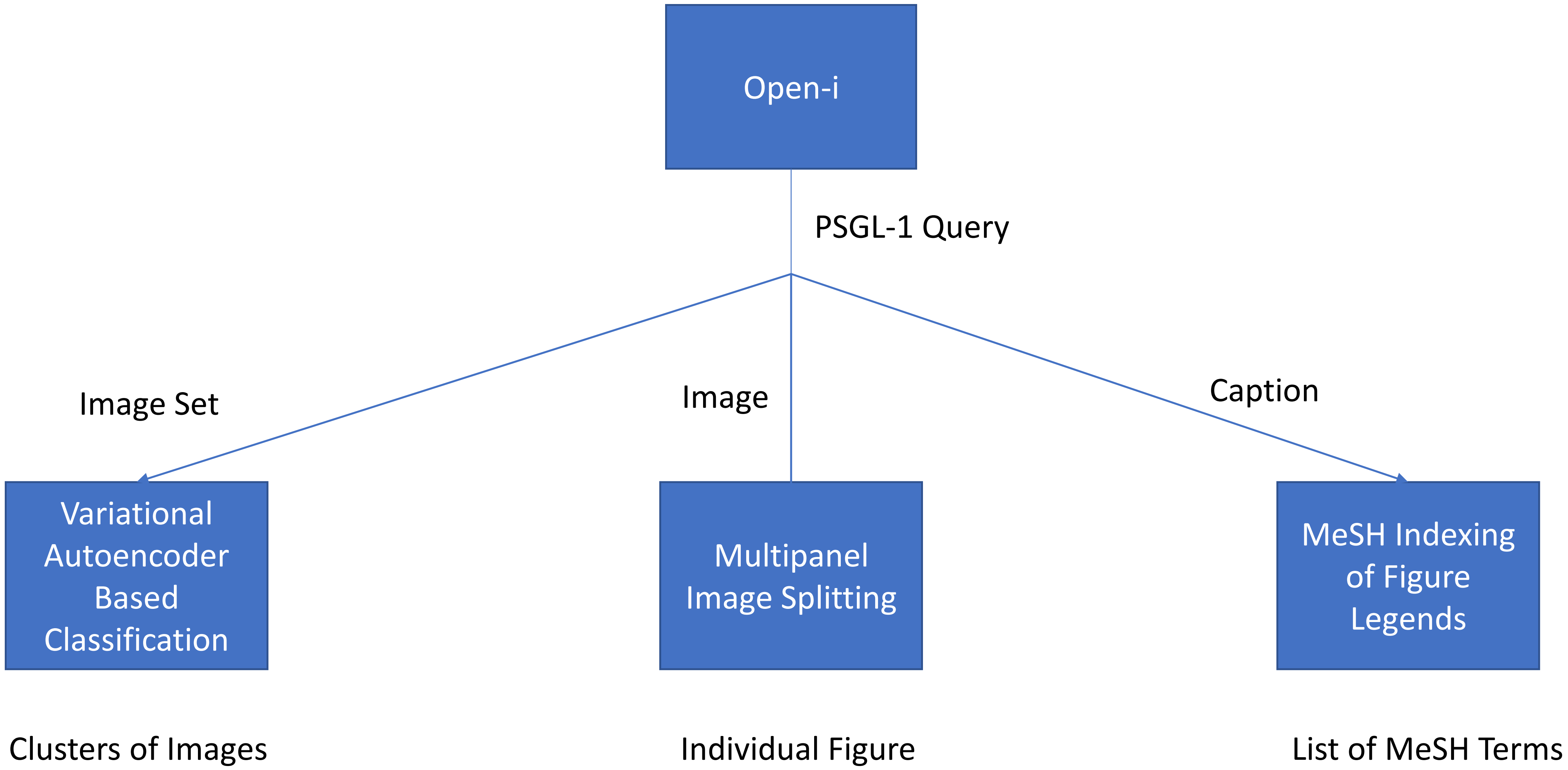
Spertini C, Baïsse B, Bellone M, Gikic M, Smirnova T, Spertini O.

Cancers (Basel). 2019 Aug 27;11(9). pii: E1253. doi: 10.3390/cancers11091253.

PMID: 31461905 **Free Article**

Similar articles **Figs 2 of 4**

Development Pipeline



Open-i

PSGL-1 Query

Image Set

Image

Caption

Variational Autoencoder Based Classification

Multipanel Image Splitting

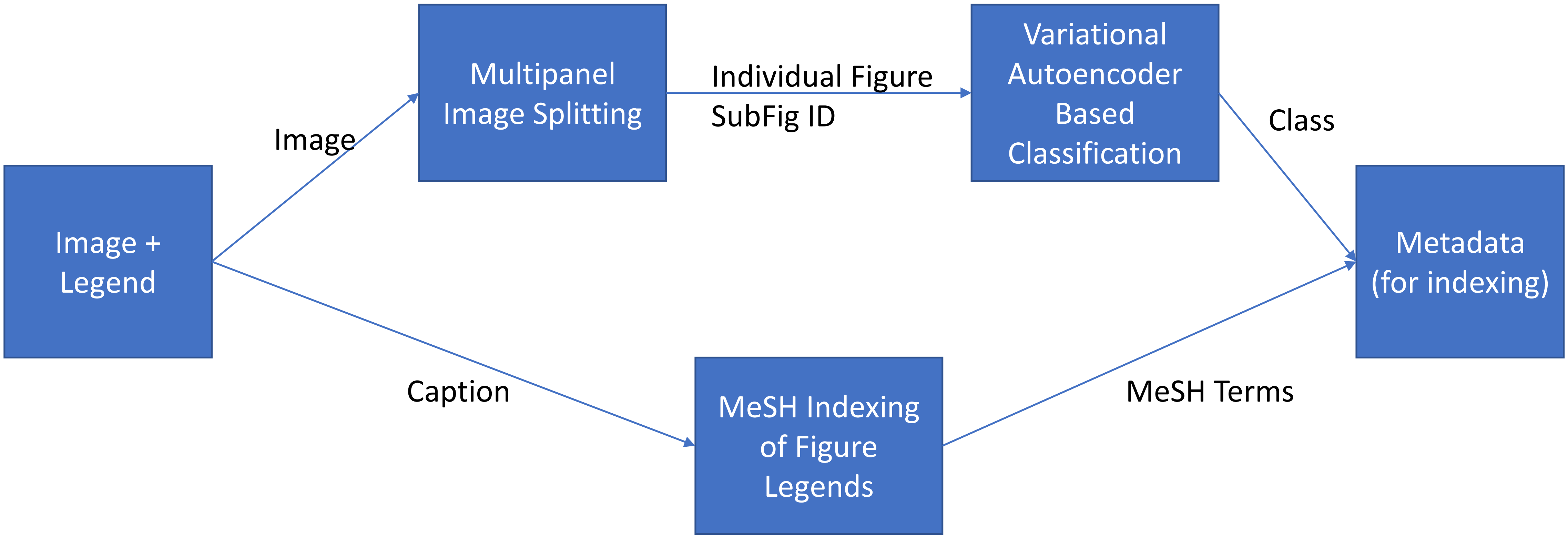
MeSH Indexing of Figure Legends

Clusters of Images

Individual Figure

List of MeSH Terms

Product Pipeline



Split multi-panel figure

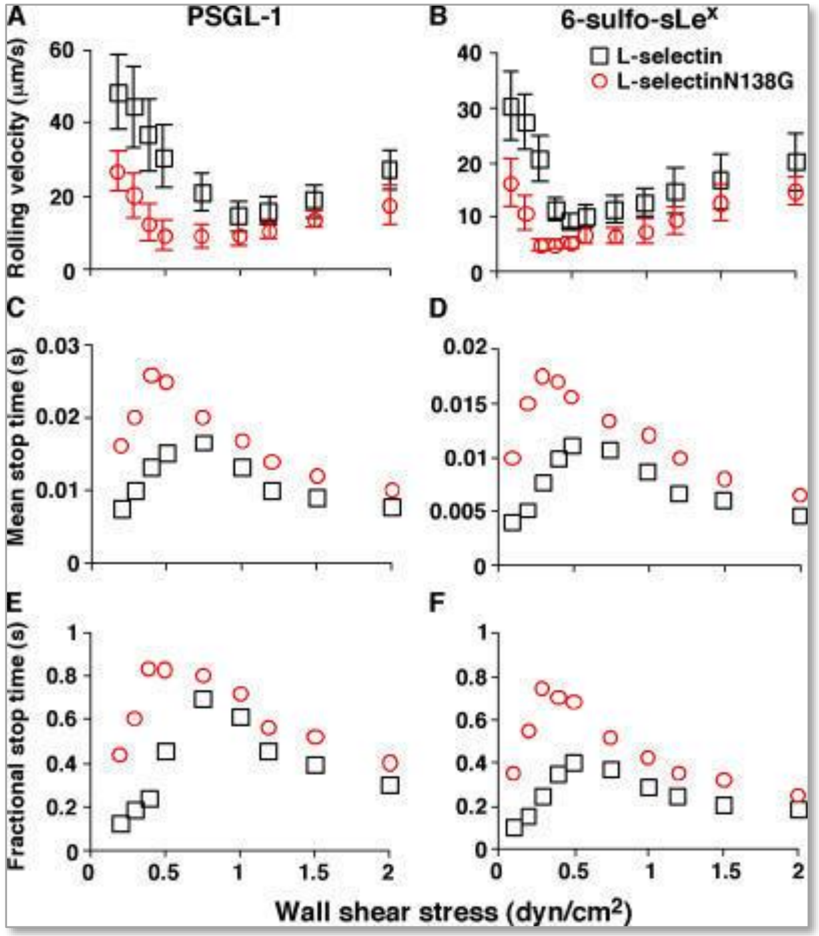
Why?

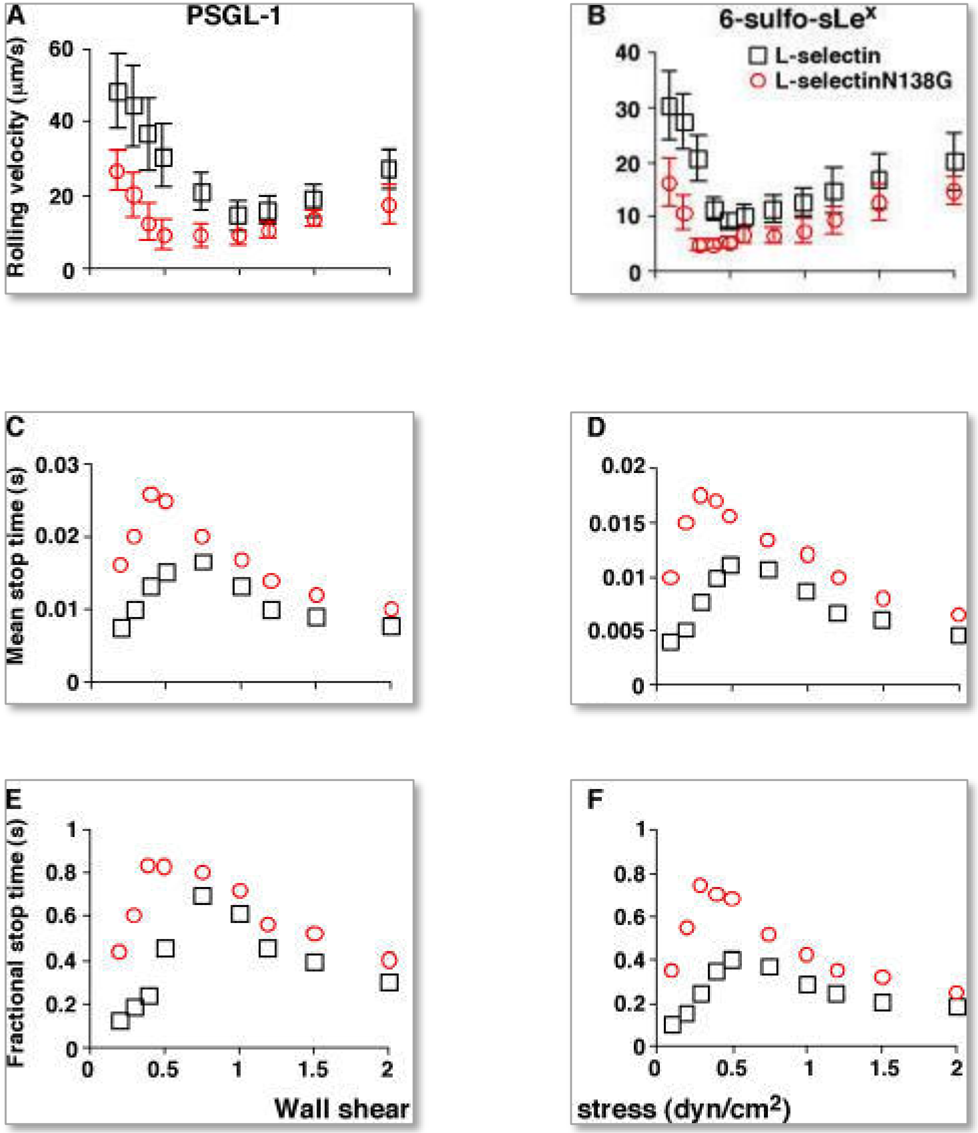
- Better input for image clustering
- More granular mesh indexing for individual sub image

How?

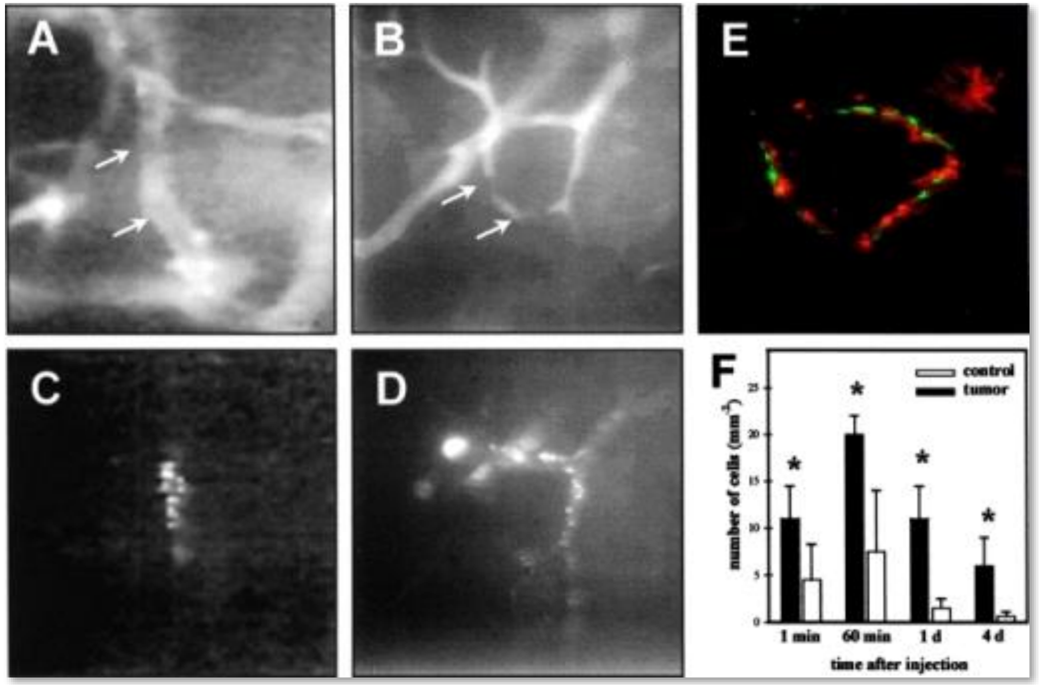
- Use OpenCV library
- Horizontal/Vertical projection
- Assume sub panels are arranged in grid

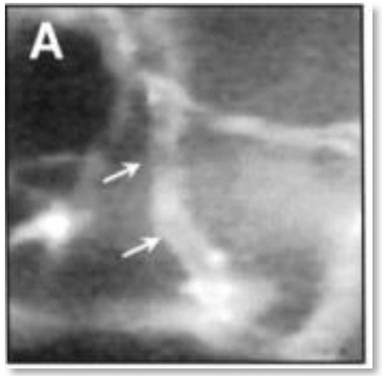
Work when sub panels are arranged in grid

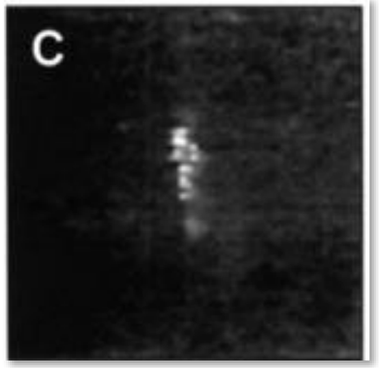


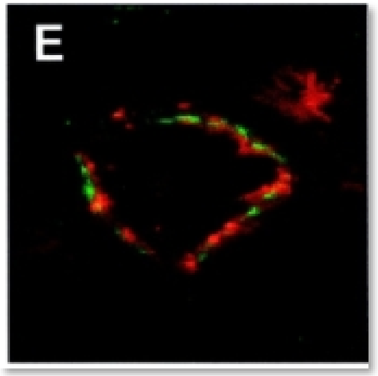


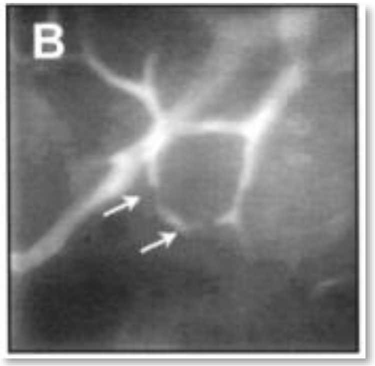
Heterogeneous sub panels

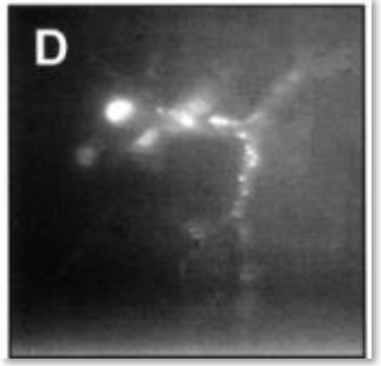


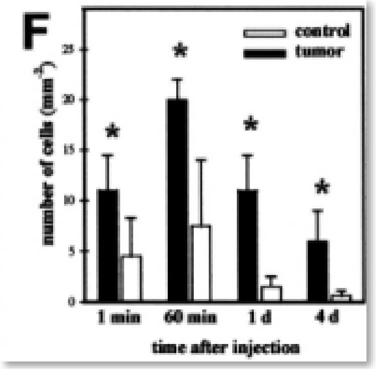








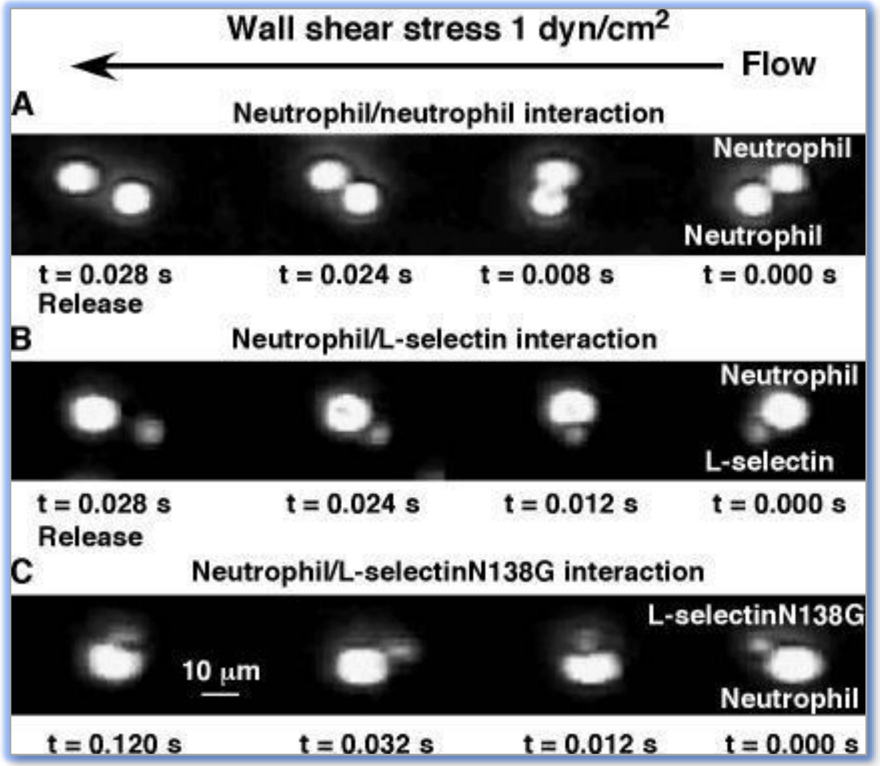


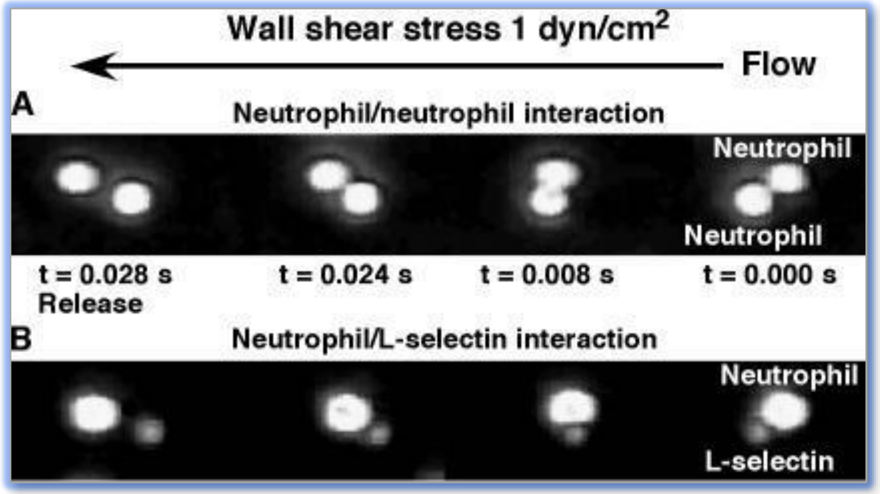


Notice now the bar chart F is a separate image

Cut at the wrong places!

- Sub panels and labels are not well separated





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Release
t = 0.024 s
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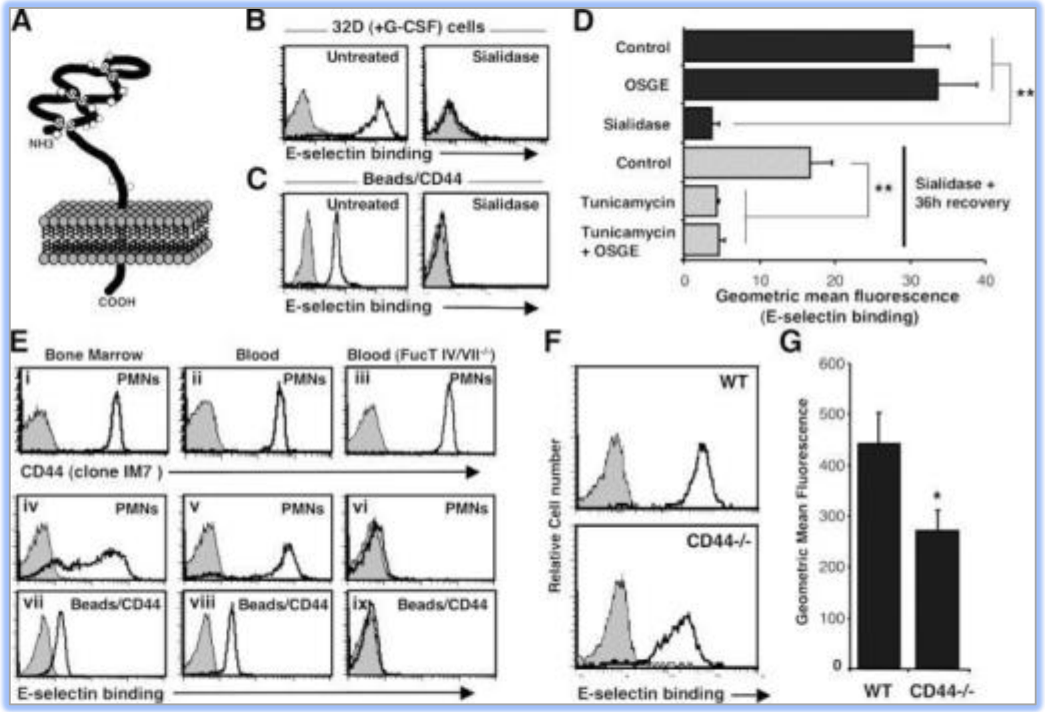
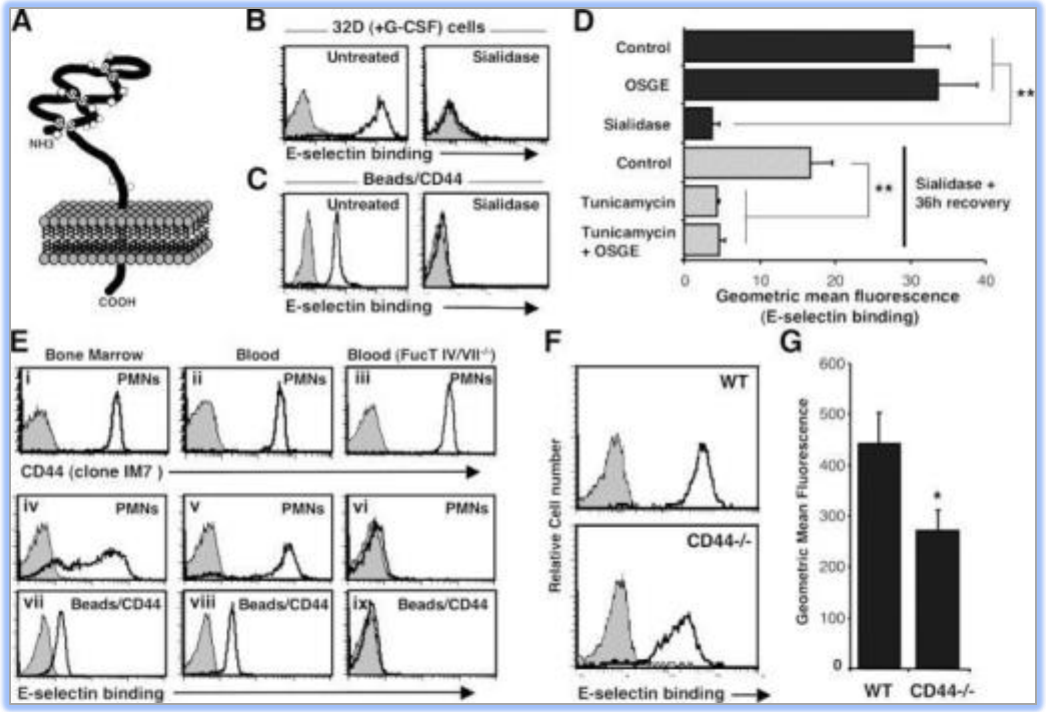
t = 0.000 s
C
Neutrophil/L-selectinN138G interaction

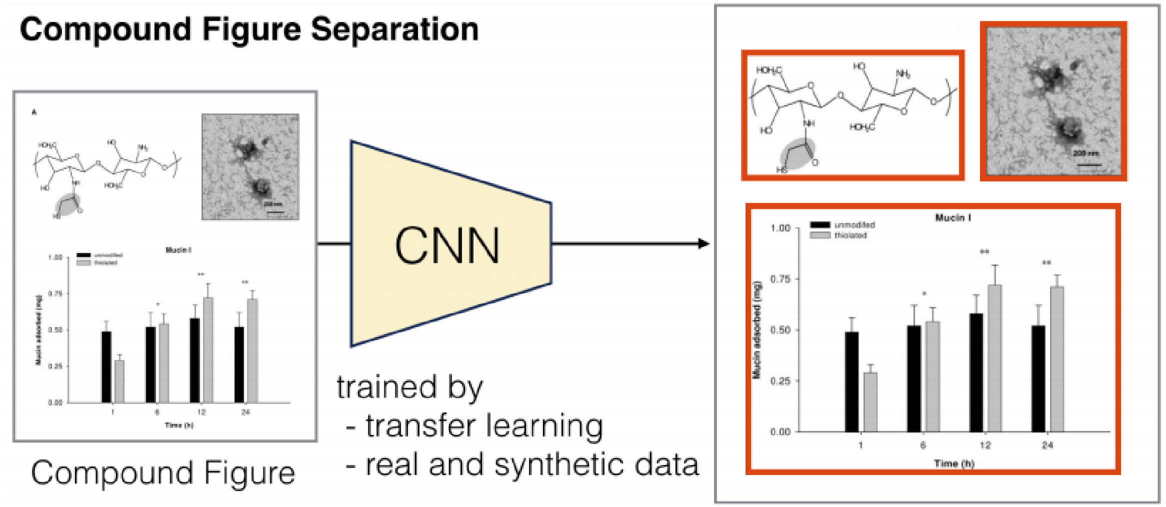
Does not detect sub panels if they are not aligned





Potential Improvement

- Use AI/ML methods to detect and split multi-panel figures.
  - E.g. *A Data Driven Approach for Compound Figure Separation Using Convolutional Neural Networks (Tsutsui, et al, 2017)*



Compound Figure Separation

CNN

trained by
- transfer learning
- real and synthetic data

Compound Figure

Mesh term indexer

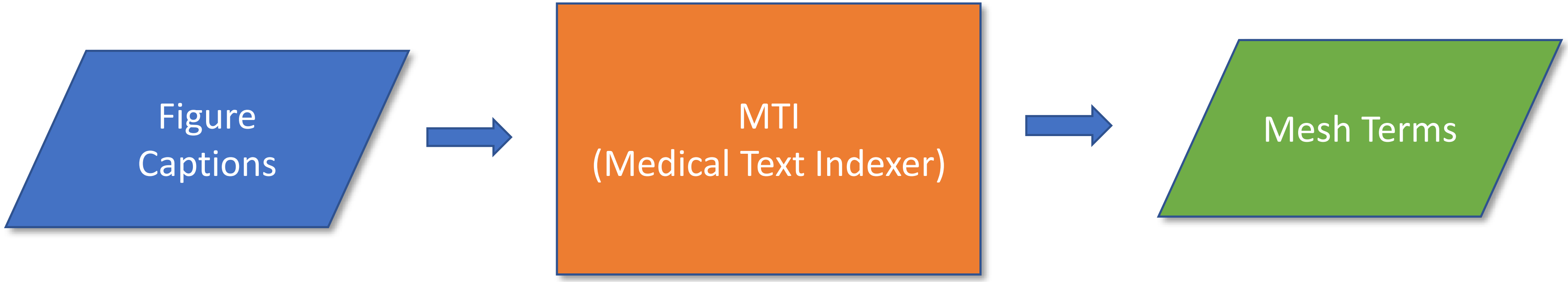


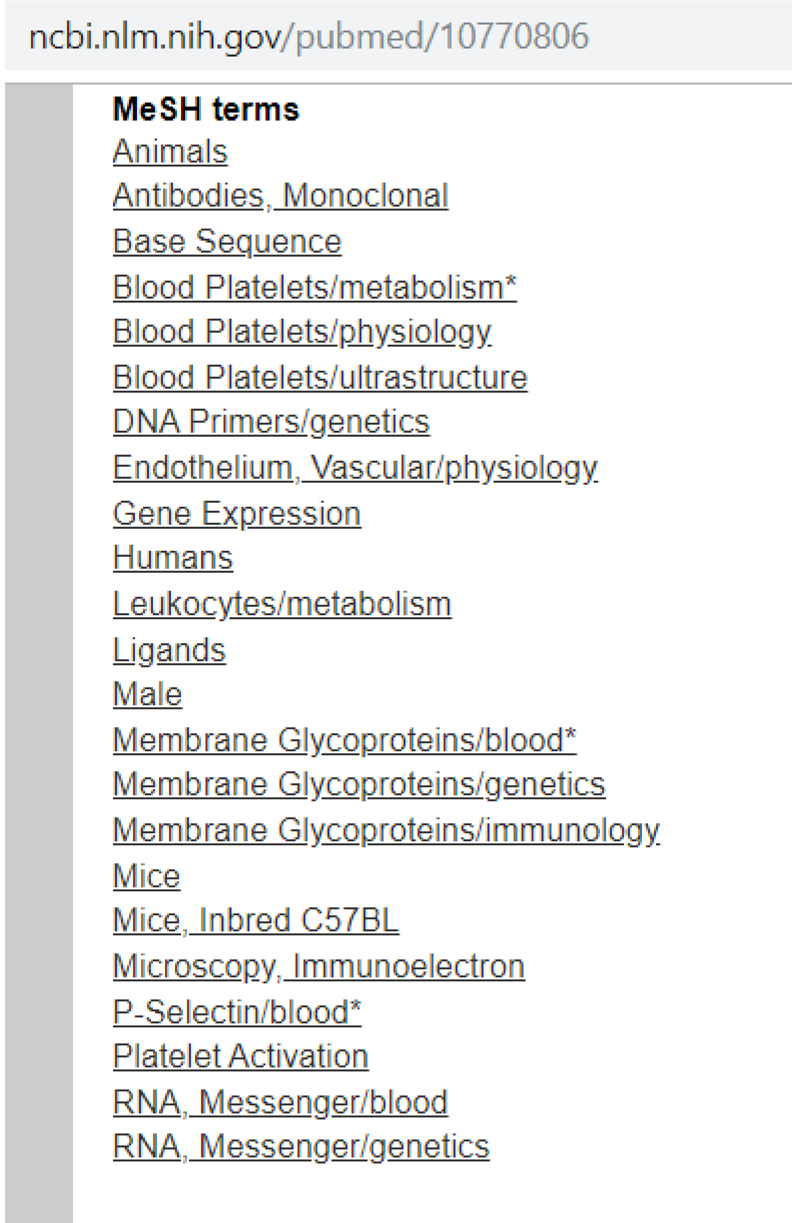
Figure Captions

MTI
(Medical Text Indexer)

Mesh Terms

Affinity isolation of PSGL-1 glycoprotein from platelets and neutrophils. (A) Purified preparations of neutrophils or platelets were biotinylated and lysed. Cell lysates were incubated with P-selectinIgG … …

Male
Mice
Animals
Humans
SELP protein, human
P-Selectin
Blood Platelets
DNA Primers
Ligands
Membrane Glycoproteins
… …

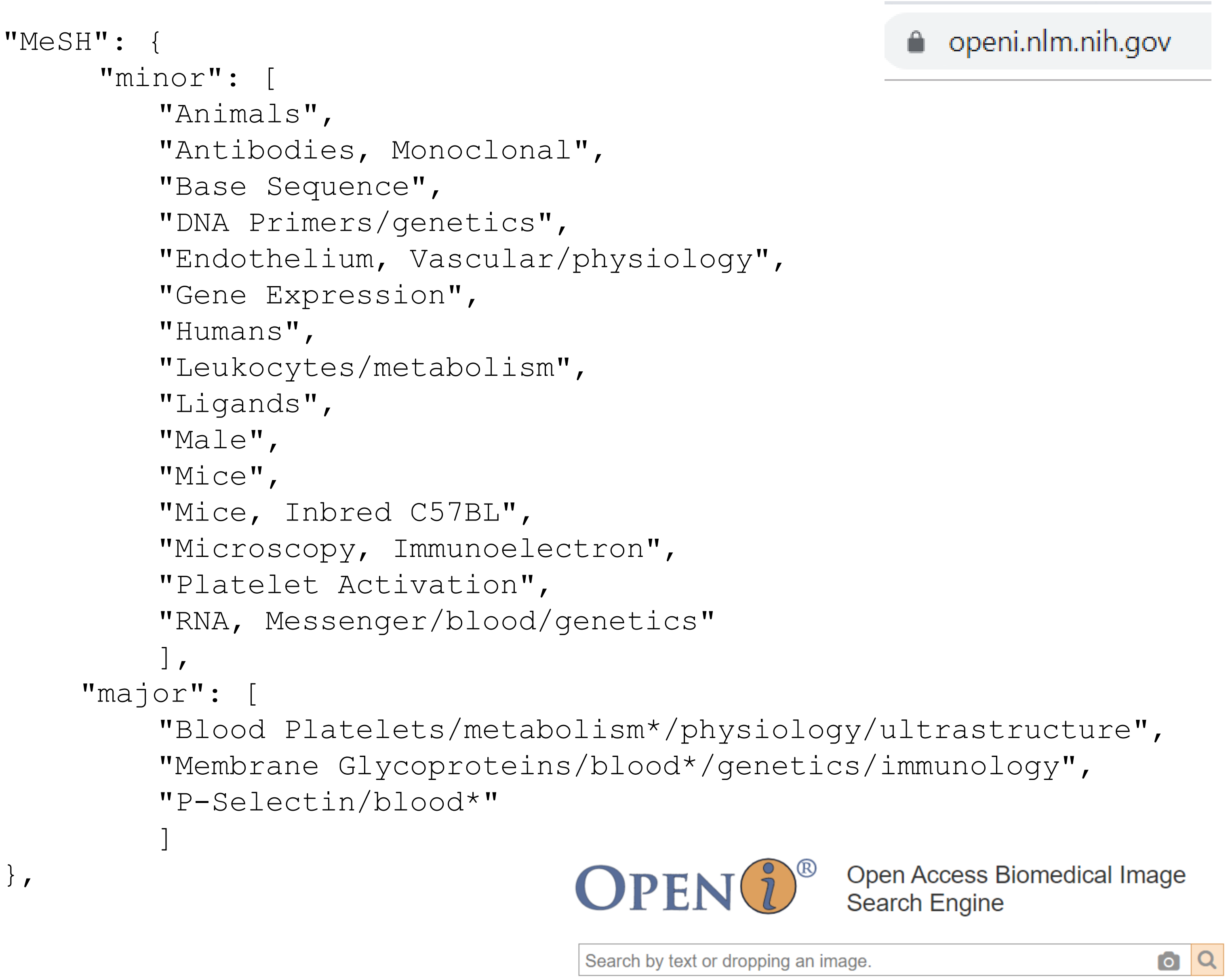


ncbi.nlm.nih.gov/pubmed/10770806

MeSH terms

Animals
Antibodies, Monoclonal
Base Sequence
Blood Platelets/metabolism*
Blood Platelets/physiology
Blood Platelets/ultrastructure
DNA Primers/genetics
Endothelium, Vascular/physiology
Gene Expression
Humans
Leukocytes/metabolism
Ligands
Male
Membrane Glycoproteins/blood*
Membrane Glycoproteins/genetics
Membrane Glycoproteins/immunology
Mice
Mice, Inbred C57BL
Microscopy, Immunoelectron
P-Selectin/blood*
Platelet Activation
RNA, Messenger/blood
RNA, Messenger/genetics

MeSH terms associated with article



openi.nlm.nih.gov

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         "Leukocytes/metabolism",
         "Ligands",
         "Male",
         "Mice",
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         "Microscopy, Immunoelectron",
         "Platelet Activation",
         "RNA, Messenger/blood/genetics"
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         "Membrane Glycoproteins/blood*/genetics/immunology",
         "P-Selectin/blood*"
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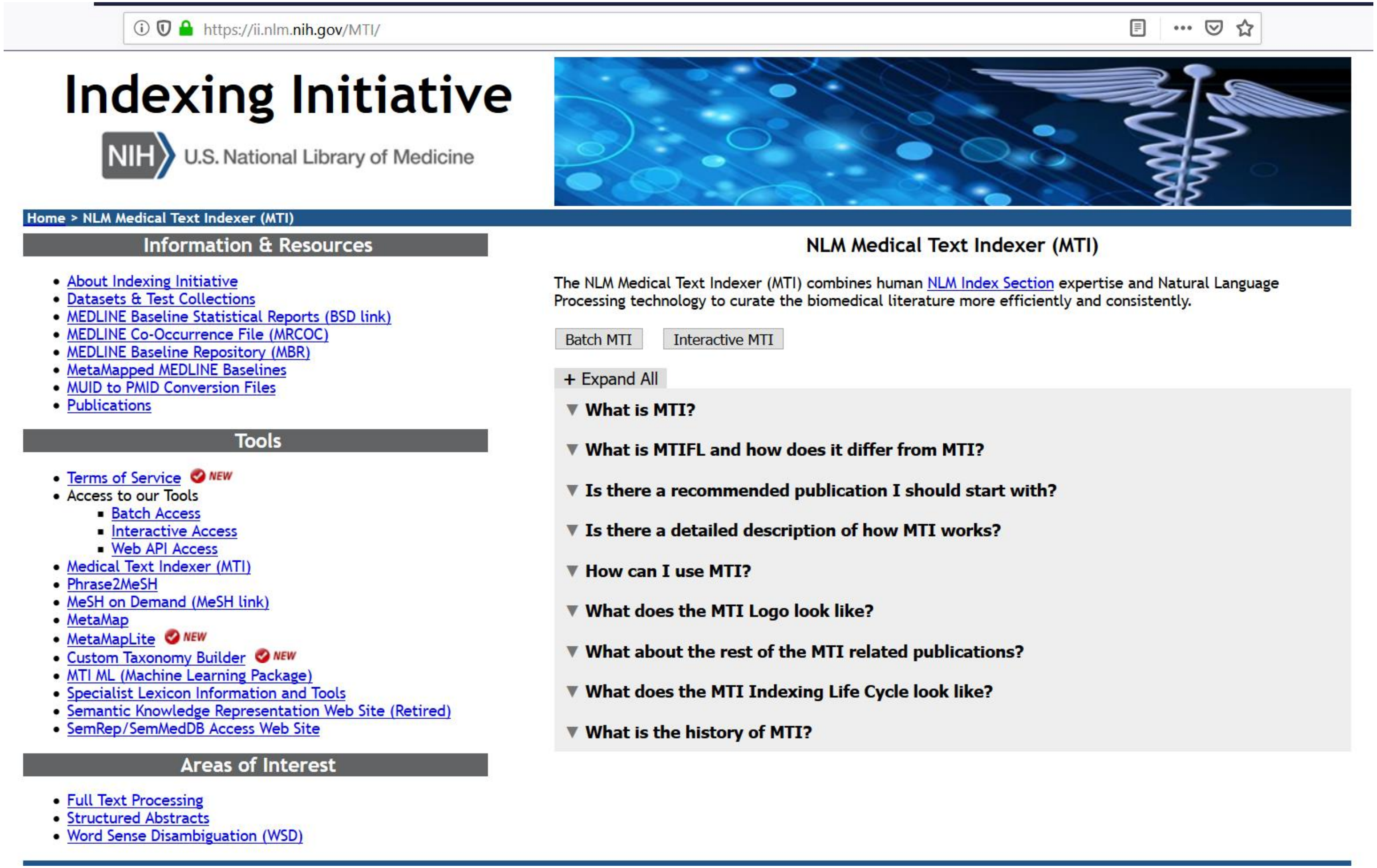
OPEN i®
Open Access Biomedical Image Search Engine
Search by text or dropping an image.

Article’s MeSH terms snippet from the Open-i API



https://ii.nlm.nih.gov/MTI/

Indexing Initiative

NIH U.S. National Library of Medicine

Home > NLM Medical Text Indexer (MTI)

Information & Resources

- About Indexing Initiative
- Datasets & Test Collections
- MEDLINE Baseline Statistical Reports (BSD link)
- MEDLINE Co-Occurrence File (MRCOC)
- MEDLINE Baseline Repository (MBR)
- MetaMapped MEDLINE Baselines
- MUID to PMID Conversion Files
- Publications

Tools

- Terms of Service NEW
- Access to our Tools
  - Batch Access
  - Interactive Access
  - Web API Access
- Medical Text Indexer (MTI)
- Phrase2MeSH
- MeSH on Demand (MeSH link)
- MetaMap
- MetaMapLite NEW
- Custom Taxonomy Builder NEW
- MTI ML (Machine Learning Package)
- Specialist Lexicon Information and Tools
- Semantic Knowledge Representation Web Site (Retired)
- SemRep/SemMedDB Access Web Site

Areas of Interest

- Full Text Processing
- Structured Abstracts
- Word Sense Disambiguation (WSD)

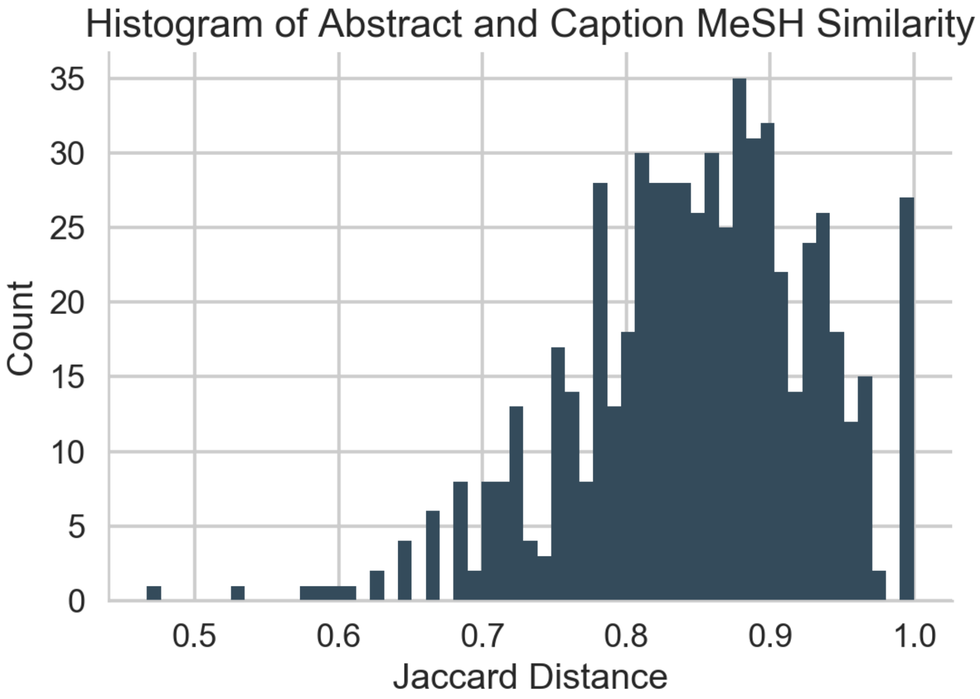
NLM Medical Text Indexer (MTI)

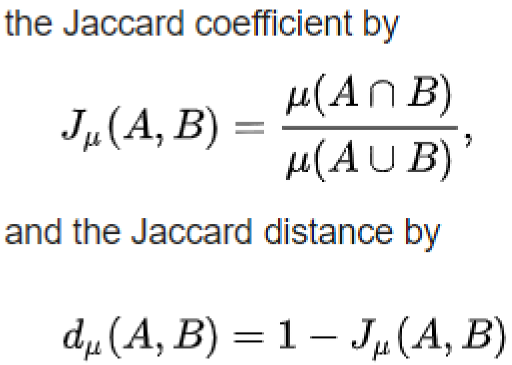
The NLM Medical Text Indexer (MTI) combines human NLM Index Section expertise and Natural Language Processing technology to curate the biomedical literature more efficiently and consistently.

- ▼ What is MTI?
- ▼ What is MTIFL and how does it differ from MTI?
- ▼ Is there a recommended publication I should start with?
- ▼ Is there a detailed description of how MTI works?
- ▼ How can I use MTI?
- ▼ What does the MTI Logo look like?
- ▼ What about the rest of the MTI related publications?
- ▼ What does the MTI Indexing Life Cycle look like?
- ▼ What is the history of MTI?

Indexing Initiative's NLM Medical Text Indexer Tools generated MeSH headings for each Caption in our dataset
Used MTI Batch Access first. Used MTI Interactive Access later.

MeSH Indexing of Figure Legends Adds Value!





the Jaccard coefficient by

$$J_\mu(A,B) = \frac{\mu(A \cap B)}{\mu(A \cup B)},$$

and the Jaccard distance by

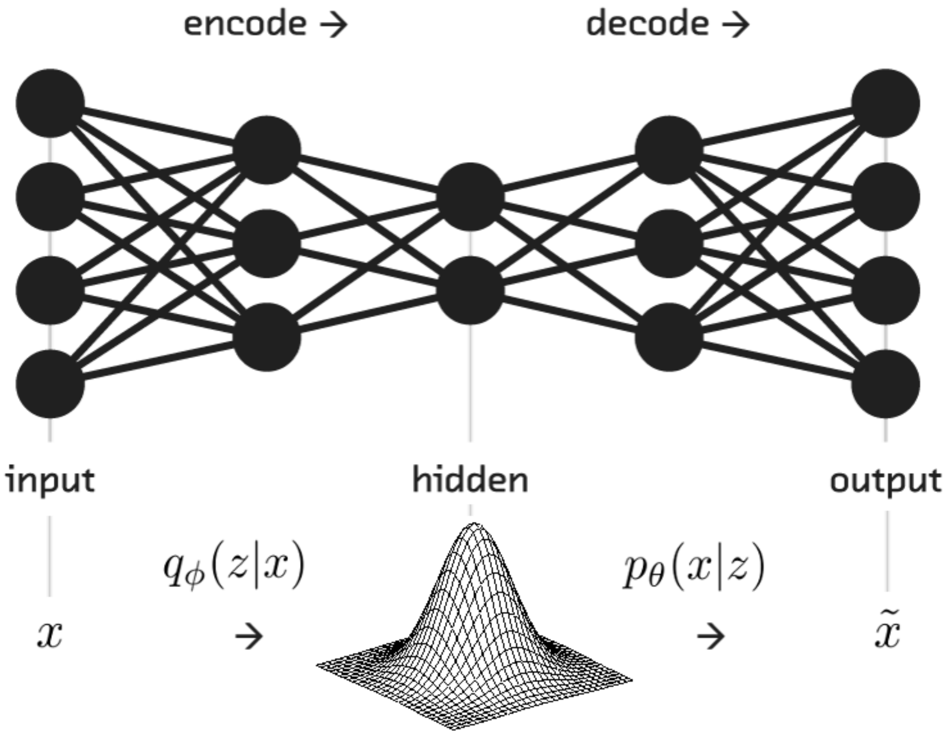
$$d_\mu(A,B) = 1 - J_\mu(A,B)$$

- 1115 Figures from 371 Papers
- 615 Figure for which both source paper and caption have MeSH terms (~55%)
- 588 Figures with at least 1 MeSH term in common between article and caption (~96%)

Machine-Learning for Image Classification

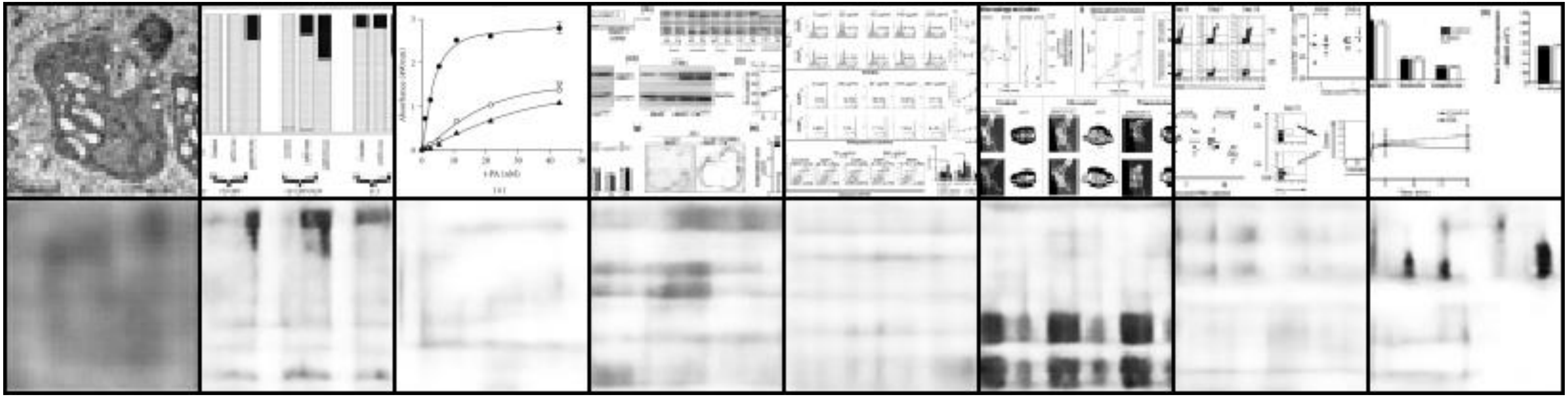
Variational Autoencoder ==

What does Magic look like?

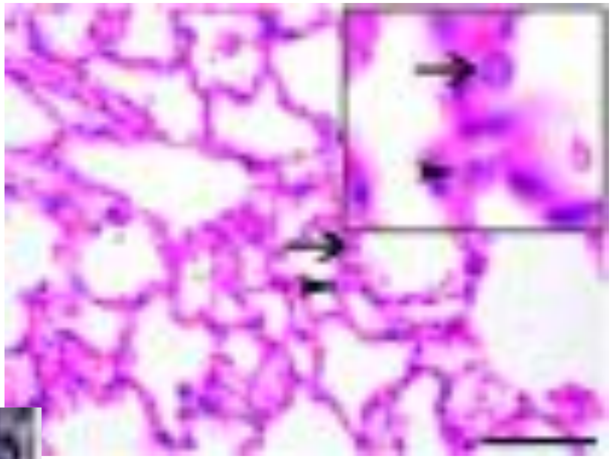


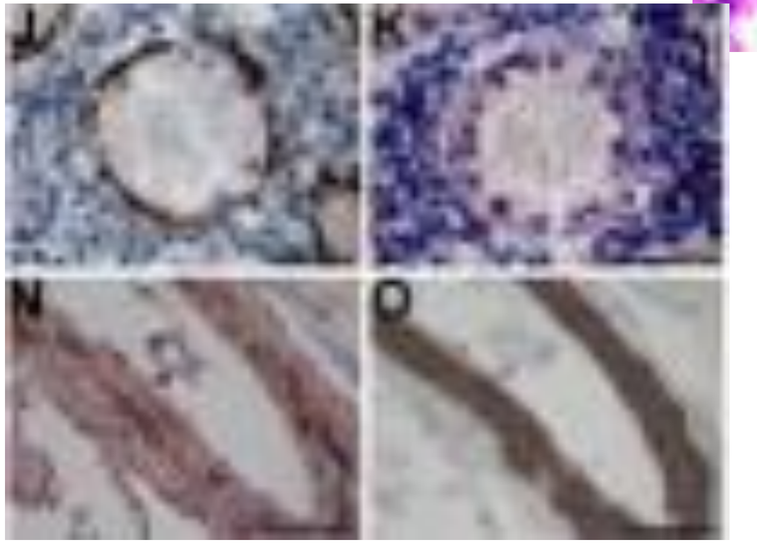
- In English?
  - Variation Autoencoder model consists of encoder, decoder and a loss function.
  - Encoder is a neural network that outputs a latent representation of an image - features of an image that represent a point in the D-dimentional feature space; The encoder serves as inference model.
  - Decoder is a neural network that learns to reconstruct the data - input image - given its representation (latent variables).
  - We will produce features vector for each image of a training set and will use these features to fit a KMeans clustering model and decide on number of clusters using "elbow" heuristic.

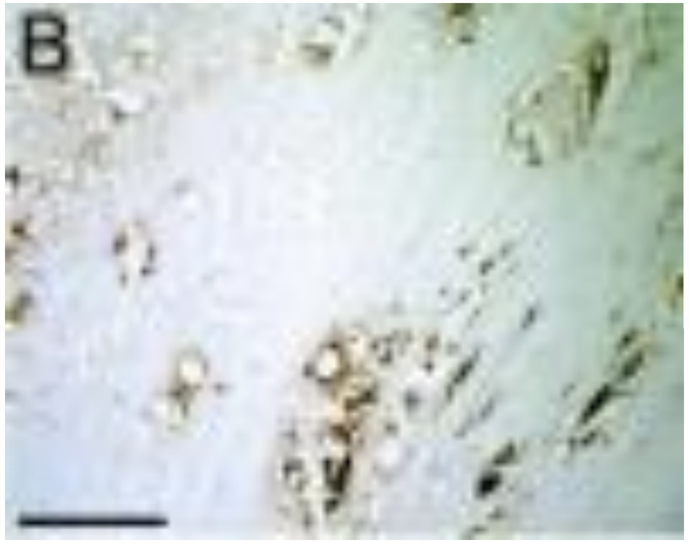
Example Decoder Output

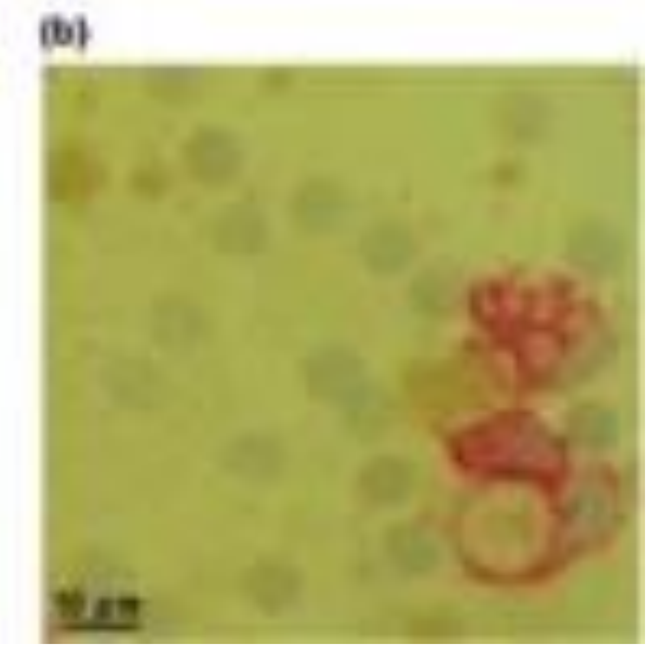


Example Clusters

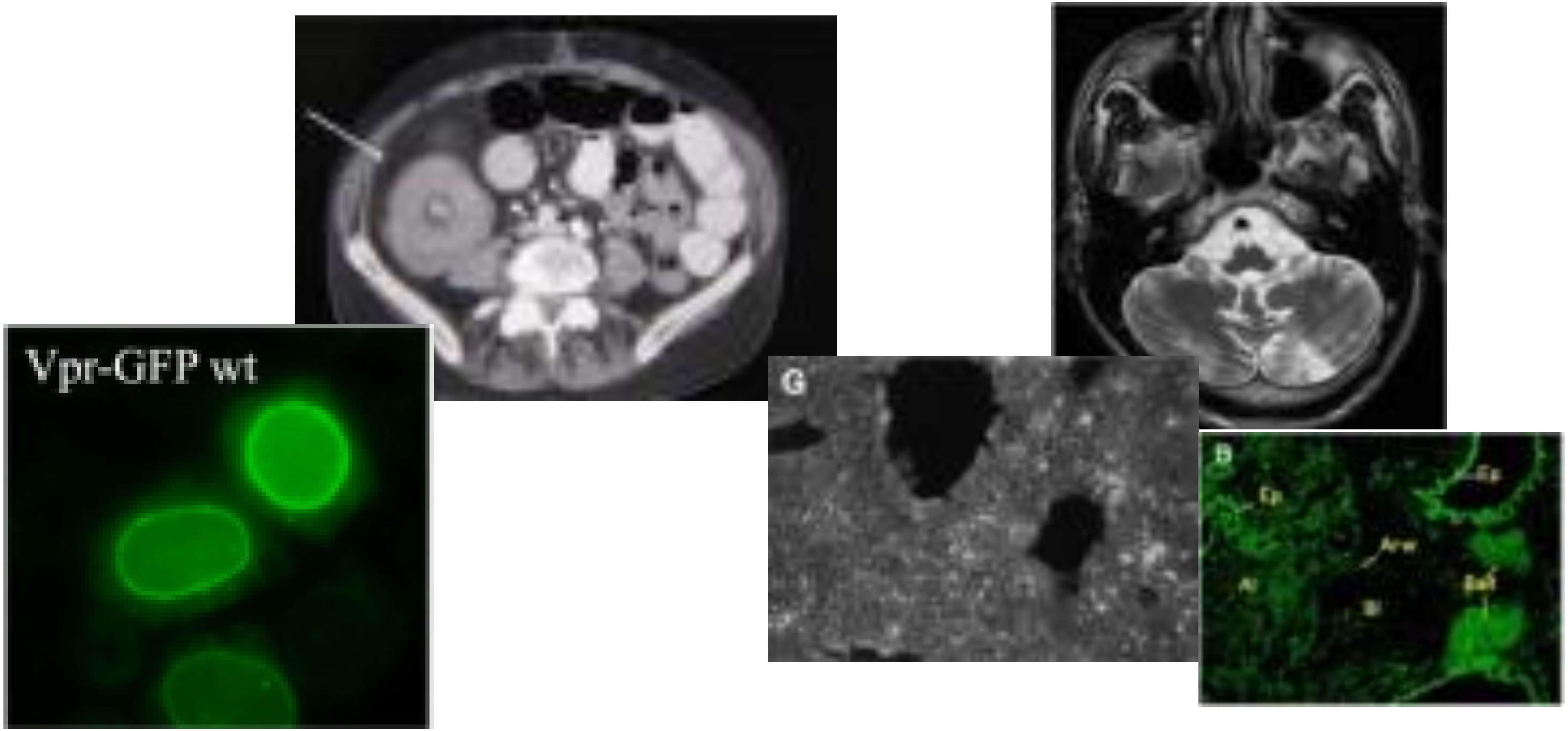




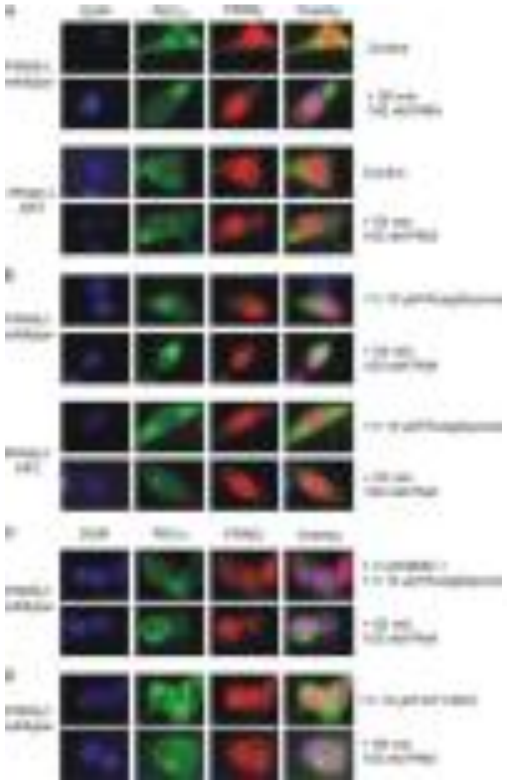


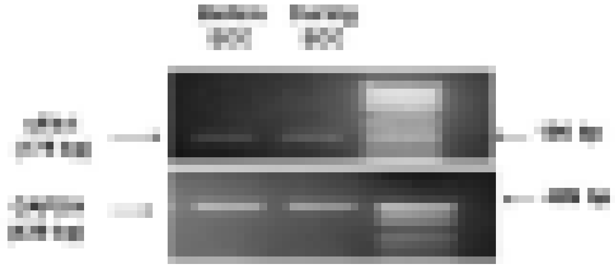


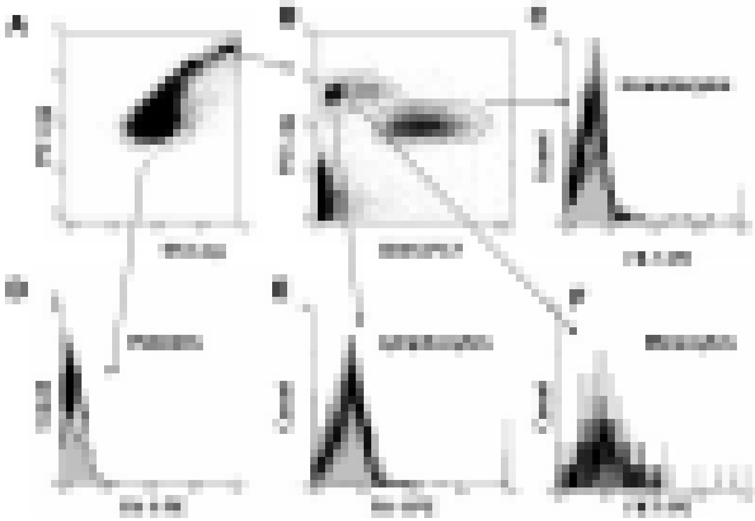
Example Clusters

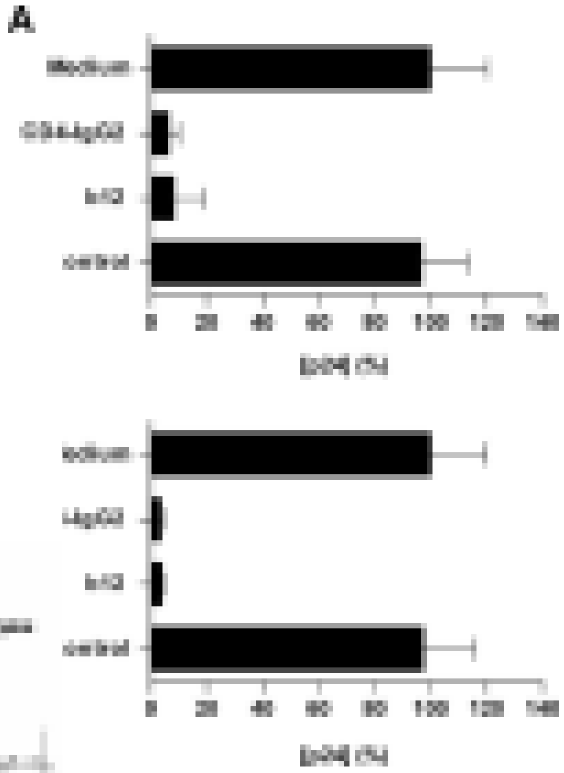


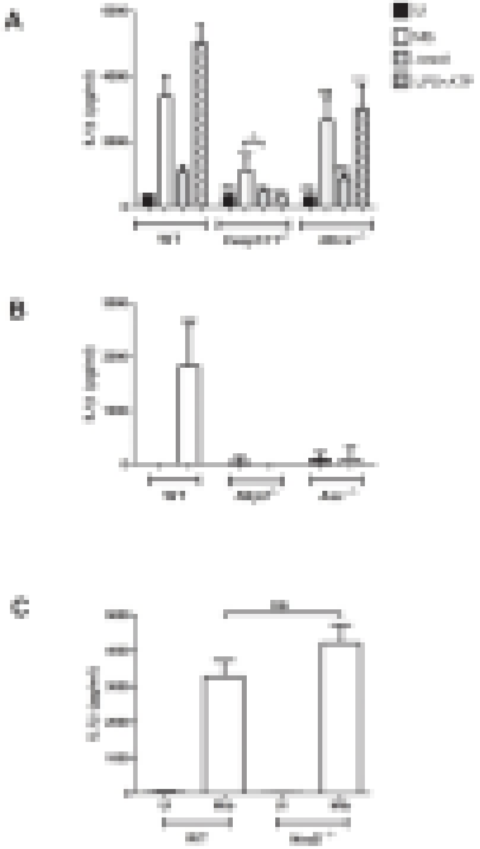
Example Clusters











Thank You

Questions? Comments? Suggestions?

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     mouse <b>PSGL-1<\/b>, or with preimmune rabbit IgG. (B) For reverse transcriptase PCR, total RNA was prepared from
     gel-filtered human platelets and from two human megakaryocytic cell lines, CMK-86 and CMK-11/5. After cDNA
     conversion, a fragment of expected length was amplified by PCR using primers from human <b>PSGL-1<\/b> sequence.
     (C) <b>PSGL-1<\/b> expression on CMK-11/5 evaluated by flow cytometry. CMK-11/5 cells were labeled with the mAb
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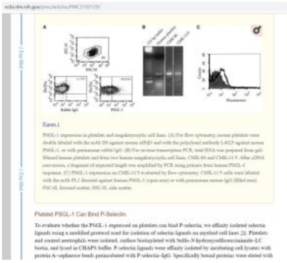

Caption snippet from the Open-i API

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cytometry, mouse platelets were double labeled with the mAb D9 against mouse αIIbβ3 and with the
polyclonal antibody L4025 against mouse PSGL-1, or with preimmune rabbit IgG. (B) For reverse
transcriptase PCR, total RNA was prepared from gel-filtered human platelets and from two human
megakaryocytic cell lines, CMK-86 and CMK-11/5. After cDNA conversion, a fragment of expected length was
amplified by PCR using primers from human PSGL-1 sequence. (C) PSGL-1 expression on CMK-11/5 evaluated
by flow cytometry. CMK-11/5 cells were labeled with the mAb PL1 directed against human PSGL-1 (open
area) or with preimmune mouse IgG (filled area). FSC-H, forward scatter; SSC-H, side scatter.
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Input to MTI (Identifier | Caption)

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PMC2193129_JEM991708.f1|Animals|C0003062|156604
PMC2193129_JEM991708.f1|DNA, Complementary|C0006556|81641
PMC2193129_JEM991708.f1|Blood Platelets|C0005821|45514
PMC2193129_JEM991708.f1|Reverse Transcriptase Polymerase Chain Reaction|C0599161|40552
PMC2193129_JEM991708.f1|Flow Cytometry|C0016263|37414
PMC2193129_JEM991708.f1|DNA Primers|C0206416|155604
PMC2193129_JEM991708.f1|Megakaryocytes|C0025166|87831
PMC2193129_JEM991708.f1|Polymerase Chain Reaction|C0032520|45810
PMC2193129_JEM991708.f1|Cell Line|C0007600|11652
PMC2193129_JEM991708.f1|Immunoglobulin G|C0020852|1000
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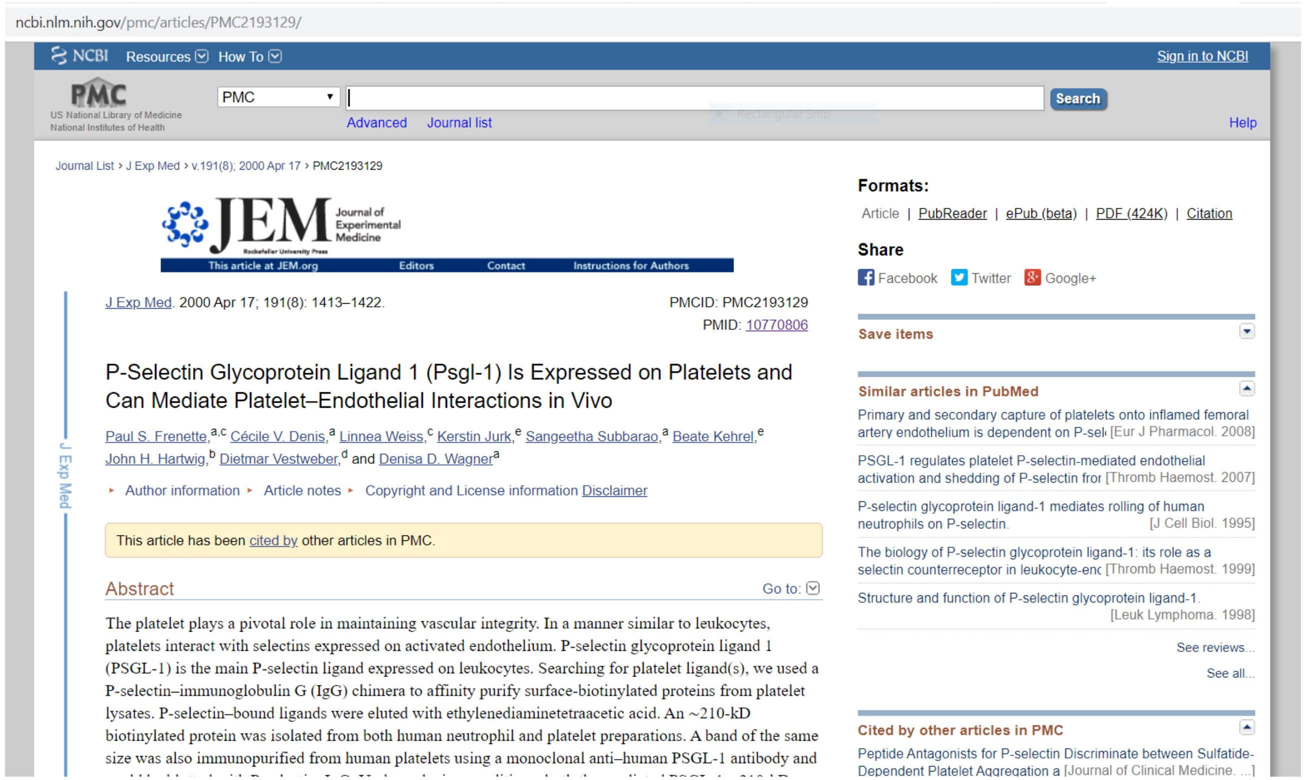
Output from MTI (includes Identifier and MeSH heading)



Journal List › J Exp Med › v.191(8); 2000 Apr 17 › PMC2193129

J Exp Med. 2000 Apr 17; 191(8): 1413–1422.

PMCID: PMC2193129
PMID: 10770806

P-Selectin Glycoprotein Ligand 1 (Psgl-1) Is Expressed on Platelets and Can Mediate Platelet–Endothelial Interactions in Vivo

Paul S. Frenette,[a,c] Cécile V. Denis,[a] Linnea Weiss,[c] Kerstin Jurk,[e] Sangeetha Subbarao,[a] Beate Kehrel,[e] John H. Hartwig,[b] Dietmar Vestweber,[d] and Denisa D. Wagner[a]

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Abstract — Go to:

The platelet plays a pivotal role in maintaining vascular integrity. In a manner similar to leukocytes, platelets interact with selectins expressed on activated endothelium. P-selectin glycoprotein ligand 1 (PSGL-1) is the main P-selectin ligand expressed on leukocytes. Searching for platelet ligand(s), we used a P-selectin–immunoglobulin G (IgG) chimera to affinity purify surface-biotinylated proteins from platelet lysates. P-selectin–bound ligands were eluted with ethylenediaminetetraacetic acid. An ~210-kD biotinylated protein was isolated from both human neutrophil and platelet preparations. A band of the same size was also immunopurified from human platelets using a monoclonal anti–human PSGL-1 antibody and

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Article | PubReader | ePub (beta) | PDF (424K) | Citation

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Primary and secondary capture of platelets onto inflamed femoral artery endothelium is dependent on P-sel [Eur J Pharmacol. 2008]

PSGL-1 regulates platelet P-selectin-mediated endothelial activation and shedding of P-selectin fror [Thromb Haemost. 2007]

P-selectin glycoprotein ligand-1 mediates rolling of human neutrophils on P-selectin. [J Cell Biol. 1995]

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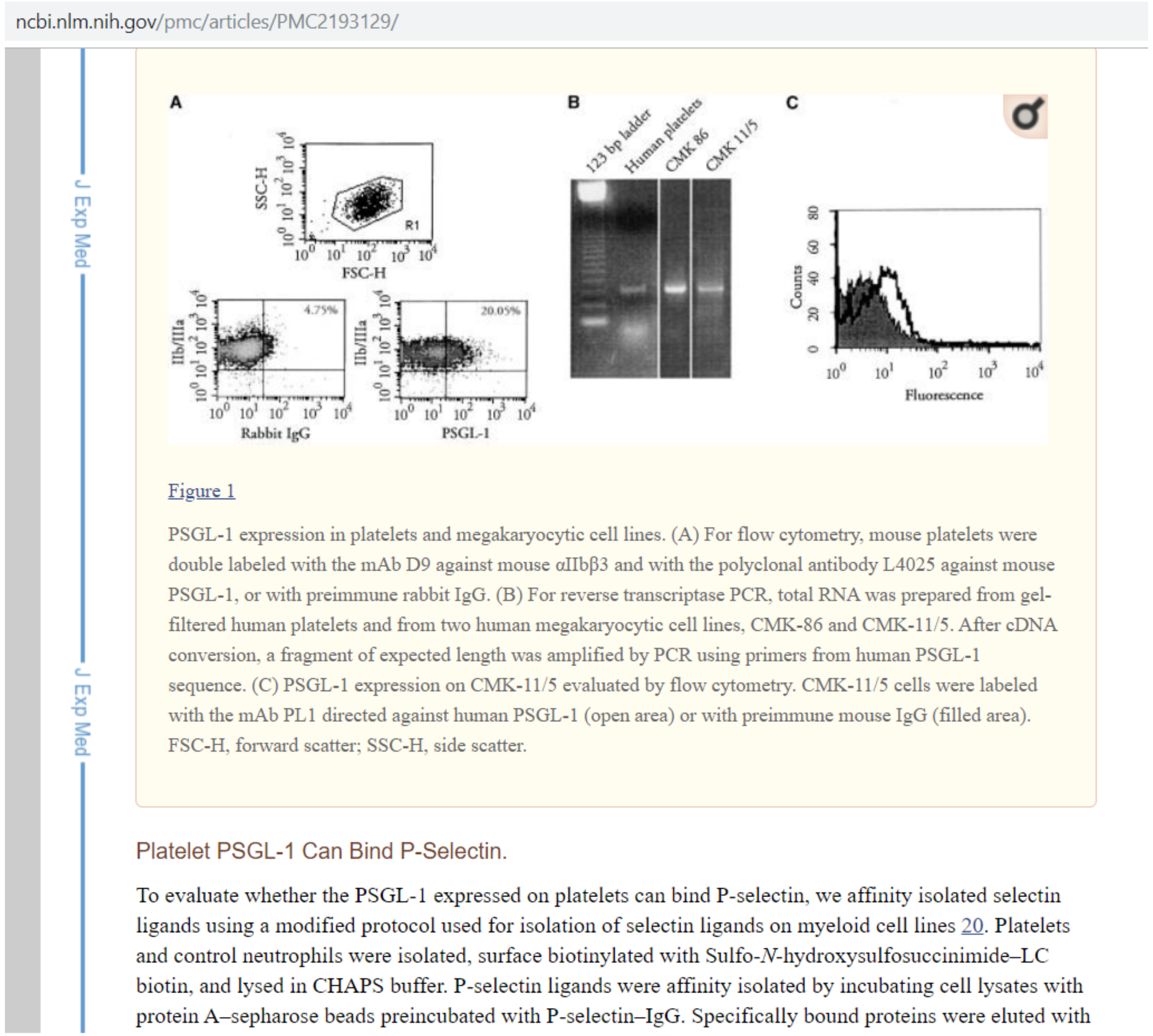

Figure 1

PSGL-1 expression in platelets and megakaryocytic cell lines. (A) For flow cytometry, mouse platelets were double labeled with the mAb D9 against mouse αIIbβ3 and with the polyclonal antibody L4025 against mouse PSGL-1, or with preimmune rabbit IgG. (B) For reverse transcriptase PCR, total RNA was prepared from gel-filtered human platelets and from two human megakaryocytic cell lines, CMK-86 and CMK-11/5. After cDNA conversion, a fragment of expected length was amplified by PCR using primers from human PSGL-1 sequence. (C) PSGL-1 expression on CMK-11/5 evaluated by flow cytometry. CMK-11/5 cells were labeled with the mAb PL1 directed against human PSGL-1 (open area) or with preimmune mouse IgG (filled area). FSC-H, forward scatter; SSC-H, side scatter.

Platelet PSGL-1 Can Bind P-Selectin.

To evaluate whether the PSGL-1 expressed on platelets can bind P-selectin, we affinity isolated selectin ligands using a modified protocol used for isolation of selectin ligands on myeloid cell lines 20. Platelets and control neutrophils were isolated, surface biotinylated with Sulfo-*N*-hydroxysulfosuccinimide–LC biotin, and lysed in CHAPS buffer. P-selectin ligands were affinity isolated by incubating cell lysates with protein A–sepharose beads preincubated with P-selectin–IgG. Specifically bound proteins were eluted with

Figure and caption in full text article