Cleveland Clinic

MNS Blood Group System

History

- 1927: Anti-M and N discovered after ABO by Landsteiner and Levine
- 1947: Anti-S discovered by Walsh and Montgomery
- 1951: Anti-s discovered
- 1953: Anti-U discovered

MNS System

- M and N are antithetical
- S and s are antithetical
- MNSs genetically linked
- 46 antigens in MNS system
- Primarily found on RBC membrane

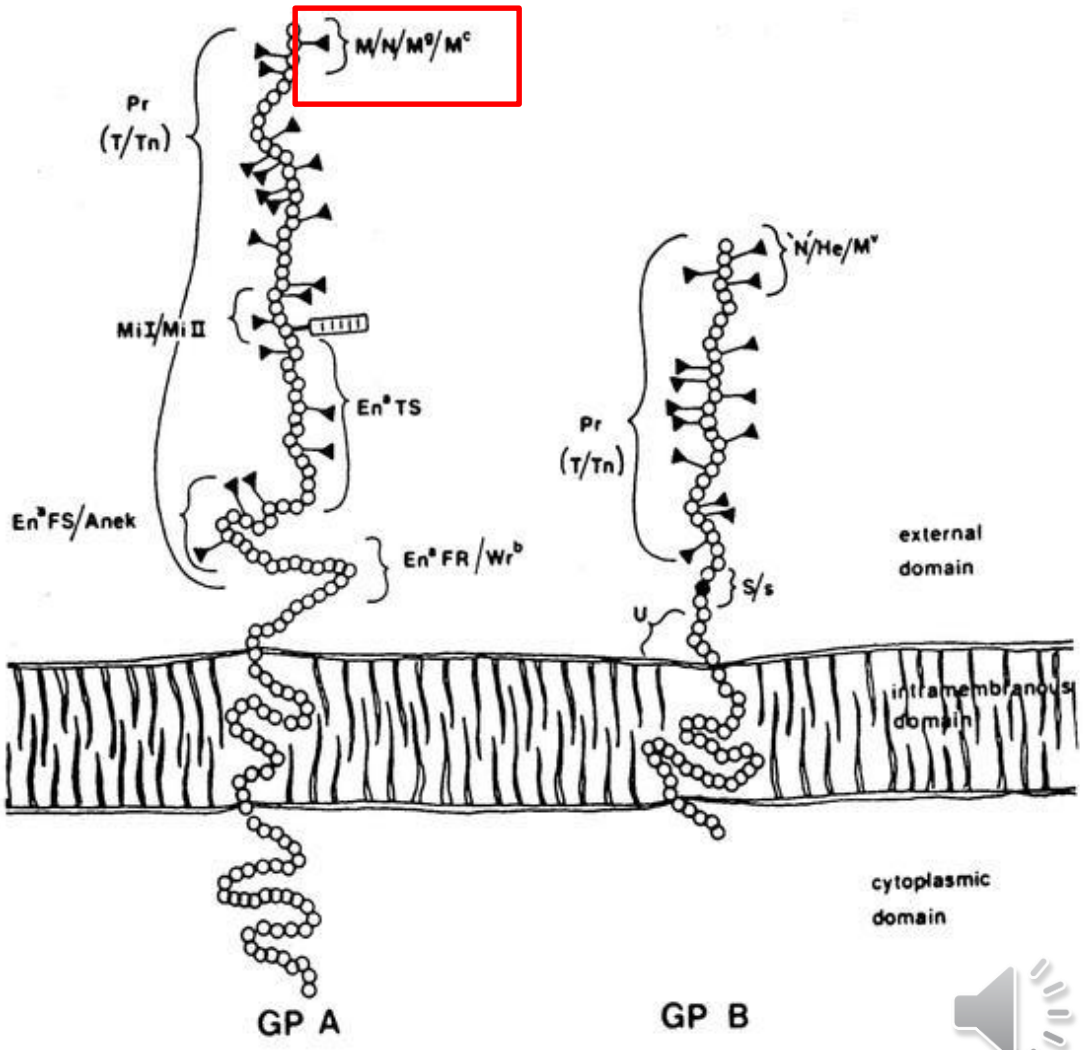
M- = ~26%
N- = ~27%
S- = ~65%
s- = ~10%

Most common phenotype: MNs

Phenotype	Whites (%)	Blacks (%)
M+N-	30	25
M+N+	49	49
M-N+	21	26
S+s-	10	6
S+s+	42	24
S-s+	48	68
S-s-U-	0	2

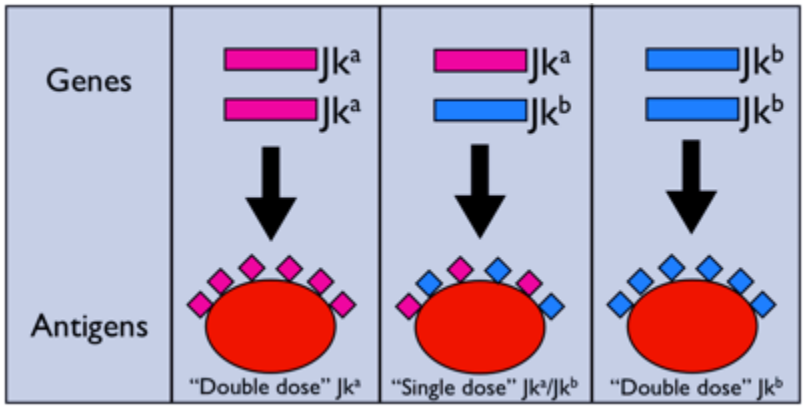
M and N Antigens

- Location: Glycophorin A (GPA)
  - Sialic rich glycoprotein
  - Single pass transmembrane protein
- M and N differ by amino acids at position 1 and 5
- Well developed at birth
- Destroyed by enzymes
- Show dosage



Dosage

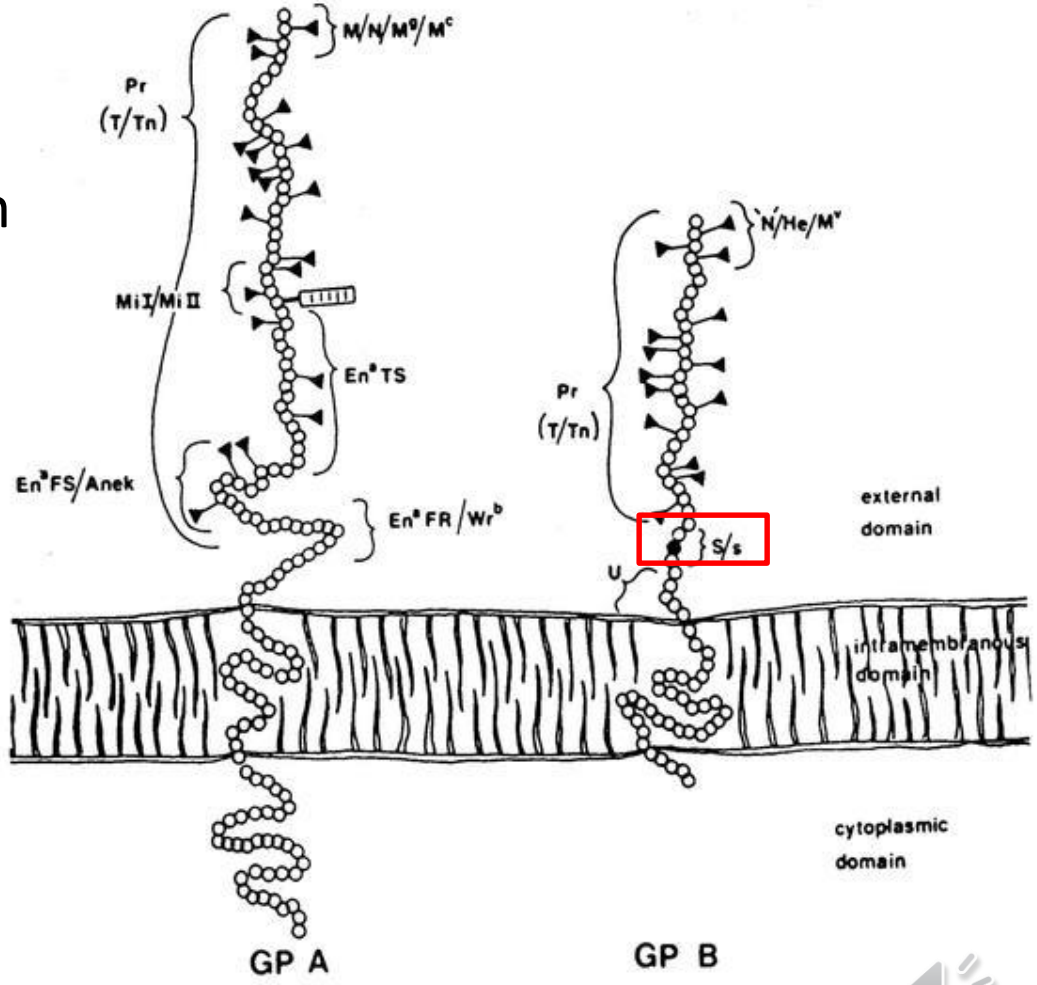
- Give stronger reaction with double dose of antigen (homozygous)
- Give weaker reaction with single dose of antigen (heterozygous)



Antibody	RBCs	Reaction
Anti-Jk^a	Jk(a+b–) 	3+
Anti-Jk^a	Jk(a+b+) 	1+

S and s Antigens

- Location: Glycophorin B
  - Single pass transmembrane protein
- S and s differ by one amino acid at position 29
  - S= methionine
  - s= threonine
- Well developed at birth
- Variable degradation with enzymes



Genetics

- *GYPA* – gene codes for GPA (alleles M/N)
- *GYPB* – gene codes for GPB (alleles S/s)
- Both on chromosome 4
- Similar genes that are close to each other
- Expression is codominant

Anti-M

- 50-80% IgG, rest IgM
- Most saline reacting below 37°C
  - If react at 37, give crossmatch compatible units
- Do not bind complement
- Shows dosage (react more weakly with M+N+)

Enzymes	Decreased
IgM vs. IgG	both
Cold or Warm	Most 4°C
Natural vs. Immune	Natural
HTR	Rare
HDN	Rare

Anti-M

- pH dependent
  - React pH 6.5
  - Detect in plasma from acidic anticoagulants
  - Not detected in unacidified serum
- Glucose dependent
  - Only react with RBCs exposed to glucose solution
  - Reagent RBCs and donor RBCs with preservative

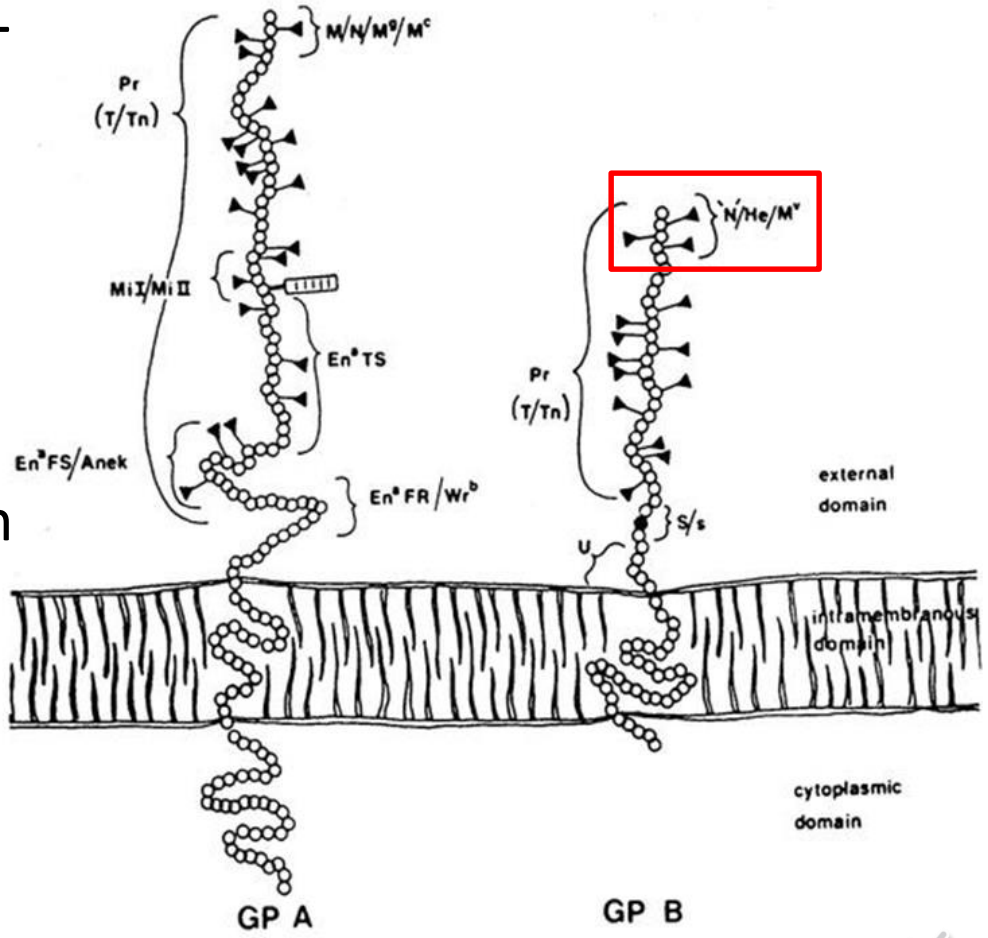
Anti-N

- Similar to anti-M
- Does not bind complement
- Shows dosage
- Not clinically significant unless reactive at 37°C

Enzymes	Decreased
IgM vs. IgG	both
Cold or Warm	Most 4°C
Natural vs. Immune	Natural
HTR	Rare
HDN	Rare

Anti-N

- Can make if M+N- and S+ or s+
  - Less common than anti-M
- Glycophorin B has N-like antigen
  - N no longer looks foreign
- Labeled as ‘N’
- M+N- S-s- has more potent anti-N
  - No glycophorin B



Anti-N^f

- Found in renal patients dialyzed on equipment sterilized by formaldehyde
- Seen in N+ and N- patients
- Formaldehyde alters M and N: recognized as foreign
- Clinically insignificant for transfusion
- Problems with rejection of chilled kidney transplants
- Rarely used today

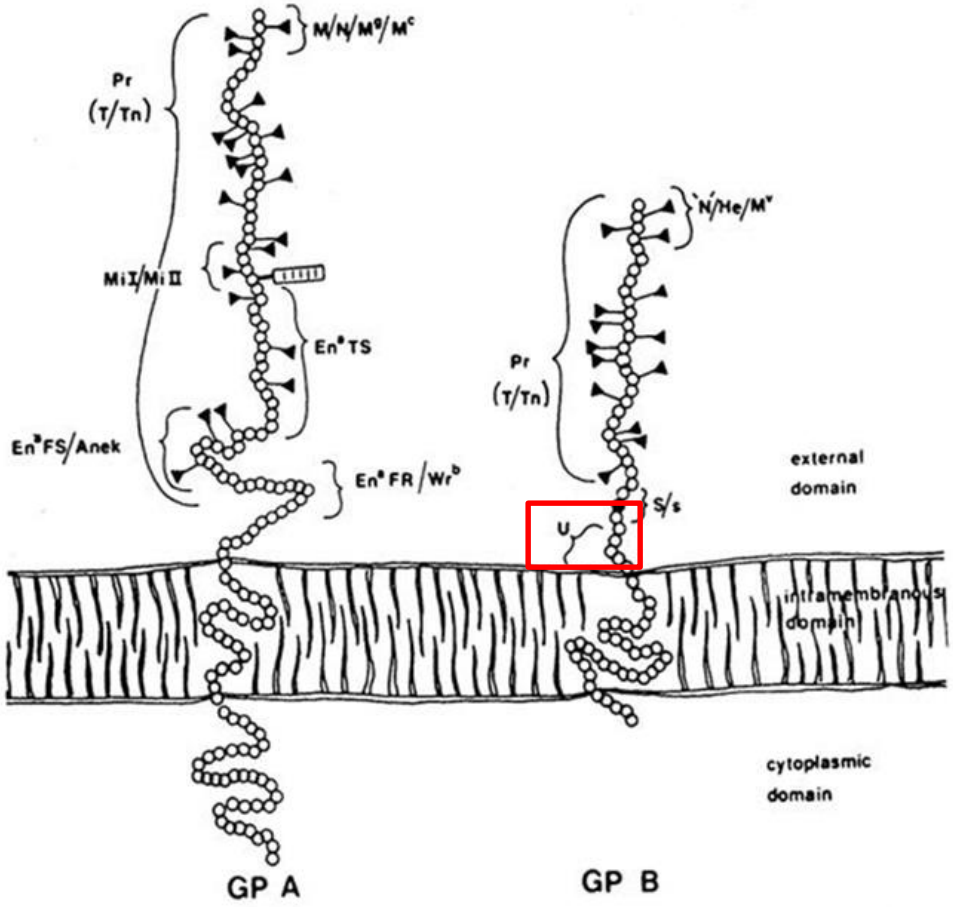
Anti-S and s

- Clinically significant (IgG at 37)
- May bind complement
- If have anti-S or s, must find antigen negative units for crossmatch
- Shows dosage

Enzymes	Variable
IgM vs. IgG	IgG
Cold or Warm	37°C
Natural vs. Immune	Immune
HTR	Yes
HDN	Yes

U Antigen

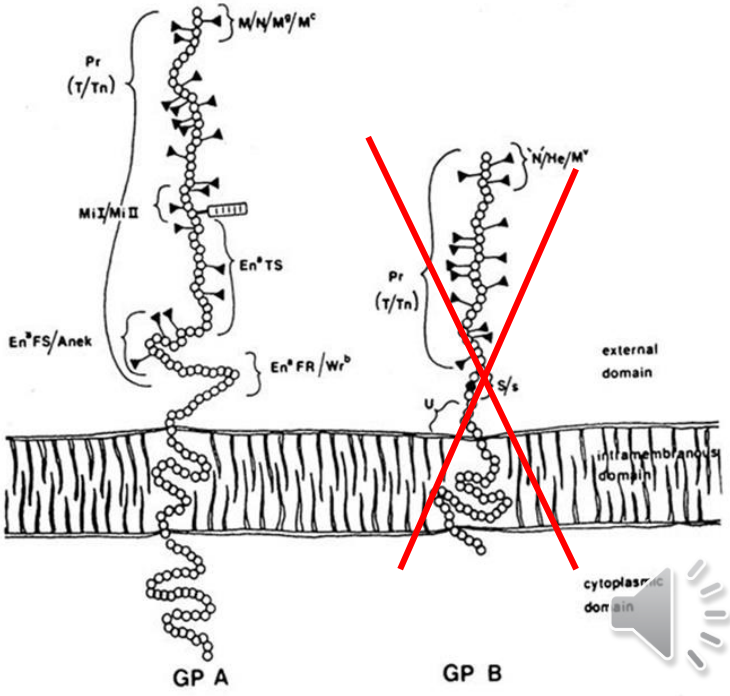
- U antigen- on GPB very close to RBC membrane
- Found on almost all RBCs (Universal antigen) except:
  - 1% African Americans
  - 1-35% Africans



Anti-U

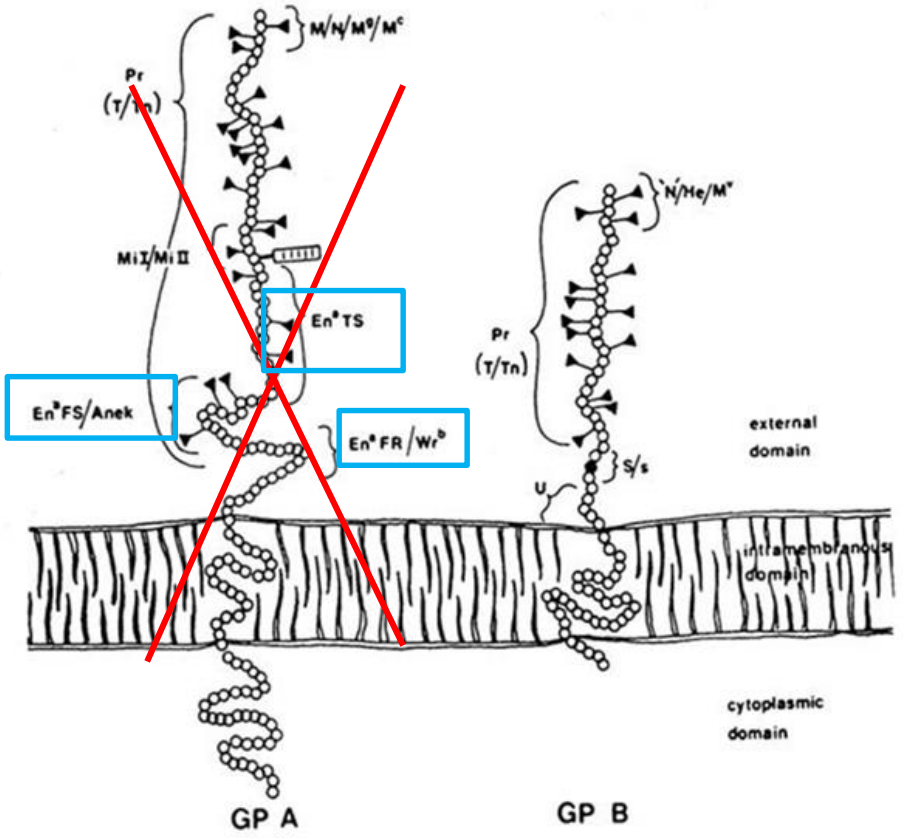
- Partial or complete deletion of *GYPB*
  - lack GPB
  - Phenotype S-s-U-
- Severe to fatal HDN/HTR
- Need U negative units to crossmatch
- If M+N-S-s-U- : Make more potent anti-N

Enzymes	Resistant
IgM vs. IgG	IgG
Cold or Warm	37°C
Natural vs. Immune	Immune
HTR	Yes
HDN	Yes



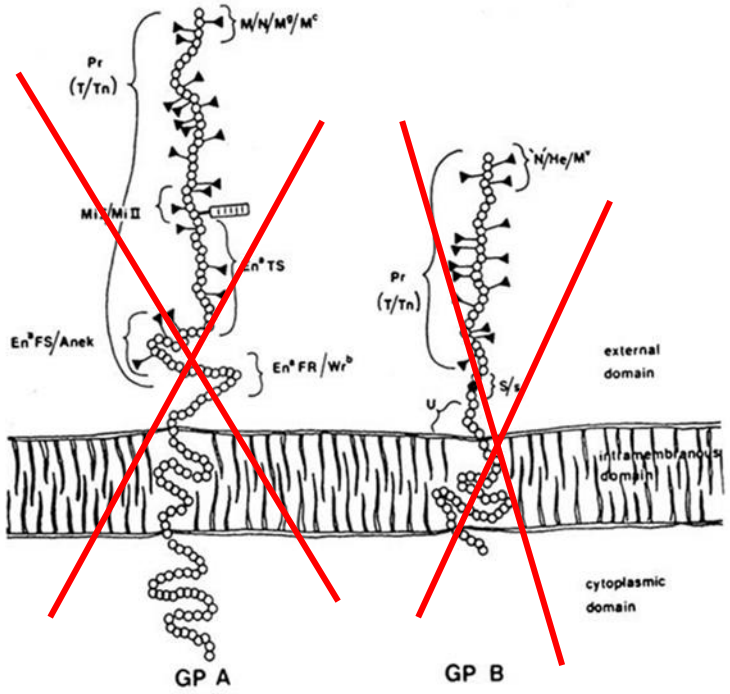
En(a-) Phenotype

- Also M-N- if En(a-)
- Homozygosity for rare deletion at *GYPA* locus
  - No GPA produced
- Most En(a-) individuals produce anti-En^a
  - Antibody to various portions of GPA
  - Different epitopes
- Severe HDN/HTR
- Extremely difficult to find units



M^k Phenotype

- Single near complete deletion of both *GYPA* and *GYPB*
- M^kM^k : null phenotype- M-N-S-s-U-En(a-)



Autoantibodies

- To M and N
  - Not all anti-M in M+ individuals and anti-N in N+ individuals are auto
  - Altered GPA- antibody to portions they lack
- To U and En^{a}
  - More common
  - Associated with warm autoimmune hemolytic anemia

Cleveland Clinic

Every life deserves world class care.