Yt Blood Group System

Number of antigens 2

High prevalence	Yt^a
Polymorphic	Yt^b

Terminology

ISBT symbol (number)	YT (011)
Obsolete name	Cartwright
History	Named after the high prevalence antigen, Yt^a; became a system in 1964 after discovery of the antithetical antigen.

Expression

Other blood cells	Not on lymphocytes, granulocytes or monocytes
Tissues	Brain, muscle, nerves

Gene

Chromosome	7q22.1
Name	*YT* (*ACHE*)
Organization	6 exons distributed over 2.2 kbp of gDNA (exons 5 and 6 are alternatively spliced)
Product	Acetylcholinesterase (AChE)

Database accession numbers

GenBank	M55040 (mRNA); L42812 (DNA)
Entrez Gene ID	43

The Blood Group Antigen (3/e). DOI: http://dx.doi.org/10.1016/B978-0-12-415849-8.00013-2

Molecular bases of Yt phenotypes

The reference allele, *YT*01* or *YT*A* (Accession number M55040) encodes Yt[a] (YT1). Nucleotide differences from this reference allele, and the amino acids affected, are given.

Allele encodes	Allele name	Exon	Nucleotide	Amino acid	Ethnicity (prevalence)
Yt(a–b+) or YT:–1,2	*YT*02.01* or *YT*B*	2	1057C>A	His353Asn	Israeli Jews, Israeli Arabs, Druse > Blacks > Europeans (Common)
Yt(a–b+) or YT:–1,2	*YT*02.02* or *YT*B*	2 5	1057C>A 1775C>G	His353Asn Pro592Arg	Israeli Arabs, Druse, and Jews

Amino acid sequence[1]

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MRPPQCLLHT  PSLASPLLLL  LLWLLGGGVG  AEGREDAELL  VTVRGGRLRG   50
IRLKTPGGPV  SAFLGIPFAE  PPMGPRRFLP  PEPKQPWSGV  VDATTFQSVC  100
YQYVDTLYPG  FEGTEMWNPN  RELSEDCLYL  NVWTPYPRPT  SPTPVLVWIY  150
GGGFYSGASS  LDVYDGRFLV  QAERTVLVSM  NYRVGAFGFL  ALPGSREAPG  200
NVGLLDQRLA  LQWVQENVAA  FGGDPTSVTL  FGESAGAASV  GMHLLSPPSR  250
GLFHRAVLQS  GAPNGPWATV  GMGEARRRAT  QLAHLVGCPP  GGTGGNDTEL  300
VACLKTRPAQ  VLVNHEWHVL  PQESVFRFSF  VPVVDGDFLS  DTPEALINAG  350
DFHGLQVLVG  VVKDEGSYFL  VYGAPGFSKD  NESLISRAEF  LAGVRVGVPQ  400
VSDLAAEAVV  LHYTDWLHPE  DPARLREALS  DVVGDHNVVC  PVAQLAGRLA  450
AQGARVYAYV  FEHRASTLSW  PLWMGVPHGY  EIEFIFGIPL  DPSRNYTAEE  500
LIFAQRLMRY  WANFARTGDP  NEPRDPKAPQ  WPPYTAGAQQ  YVSLDLRPLE  550
VRRGLRAQAC  AFWNRFLPKL  LSATASEAPS  TCPGFTHGEA  APRPGLPLPL  600
LLLHQLLLLF  LSHLRRL                                       617
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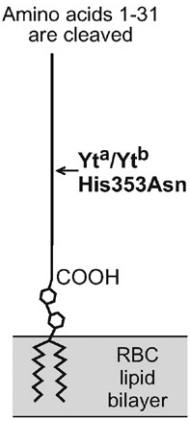
YT encodes a signal peptide of 31 amino acids, which is cleaved from the membrane bound protein. The carboxyl-terminal 29 amino acids are cleaved from the RBC GPI-linked form.

Carrier molecule

GPI-linked glycoprotein that probably exists as a dimer in the RBC membrane.



M_r (SDS-PAGE)	160,000 (72,000 as monomer under reducing conditions)
CHO: N-glycan	3 sites
CHO: O-glycan	Present
Cysteine residues	8
Copies per RBC	7,000–10,000 (or 3,500–5,000 dimers)

Function

AChE terminates nerve impulse transmission. AChE is in many tissues in various forms as a result of alternative splicing and post-translational modification. Function in RBC unknown.

Disease association

PNH III RBCs are deficient in AChE. Levels are reduced in myelodysplasias associated with chromosome 7 abnormalities and in some cases of SLE.

Phenotypes (% occurrence)

Phenotype	Most populations	Israelis
Yt(a+b–)	91.9	74.4
Yt(a+b+)	7.8	23.7
Yt(a–b+)	0.3	1.9
Null: Inherited Yt(a–b–) phenotype not found		
Unusual: One example of transient Yt(a–b–) RBCs reported[2]		

References

[1] Bartels, C.F., et al., 1993. Mutation at codon 322 in the human acetylcholinesterase (ACHE) gene accounts for YT blood group polymorphism. Am J Hum Genet 52, 928–936.

[2] Rao, N., et al., 1993. Human erythrocyte acetylcholinesterase bears the Yt^a blood group antigen and is reduced or absent in the Yt(a−b−) phenotype. Blood 81, 815–819.

Yt^a Antigen

Terminology

ISBT symbol (number)	YT1 (011001 or 11.1)
Obsolete name	Cartwright
History	In 1956 when the antibody to this high-prevalence antigen was found, most letters in the patient's name (Cartwright) had been taken by other antigens. The authors thought "why not T?" but to avoid confusion with T polyagglutination, they then said "why T" or "Yt". The Yt^a antigen achieved system status in 1964 after discovery of the antithetical antigen.

Occurrence

Most populations	>99.8%
Israeli Jews	98.6%
Israeli Arabs	97.6%
Israeli Druse	97.4%

Antithetical antigen

Yt^b (**YT2**)

Expression

Cord RBCs	Weak
Altered	Weak or absent from PNH III RBCs

Molecular basis associated with Yt^a antigen[1]

Amino acid	His353
Nucleotide	C at bp 1057 in exon 2

Effect of enzymes and chemicals on Yt^a antigen on intact RBCs

Ficin/Papain	Sensitive (variable)
Trypsin	Resistant
α-Chymotrypsin	Sensitive
DTT 200 mM/50 mM	Sensitive/weakened (thus sensitive to WARM™ and ZZAP)
Acid	Resistant

In vitro characteristics of alloanti-Yt^a

Immunoglobulin class	IgG (some are IgG4)
Optimal technique	IAT
Complement binding	Some

Clinical significance of alloanti-Yt^a

Transfusion reaction	No to moderate (rare)/delayed
HDFN	No

Comments

A report of an apparent alloanti-Yt^a in a Yt(a+) person suggests the possibility of heterogeneity of the Yt^a antigen[2].
Experts agree that anti-Yt^a are often benign and antigen-negative blood may not need to be transfused.

References

[1] Bartels, C.F., et al., 1993. Mutation at codon 322 in the human acetylcholinesterase (ACHE) gene accounts for YT blood group polymorphism. Am J Hum Genet 52, 928–936.
[2] Mazzi, G., et al., 1994. Presence of anti-Yt^a antibody in a Yt(a+) patient. Vox Sang 66, 130–132.

Yt^b Antigen

Terminology

ISBT symbol (number)	YT2 (011002 or 11.2)
History	Identified in 1964 and named when its antithetical relationship to Yt^a was recognized.

Occurrence

Europeans	8%
Israeli Jews	21.3%
Israeli Arabs	23.5%
Israeli Druse	26%

Not found in Japanese.

Antithetical antigen

Yt^a (**YT1**)

Expression

Cord RBCs	Weak
Altered	Weak or absent from PNH III RBCs

Molecular basis associated with Yt^b antigen[1]

Amino acid	Asn353
Nucleotide	A at bp 1057 in exon 2

Effect of enzymes and chemicals on Yt^b antigen on intact RBCs

Ficin/Papain	Sensitive (variable)
Trypsin	Resistant
α-Chymotrypsin	Sensitive
DTT 200 mM/50 mM	Sensitive/weakened (thus sensitive to WARM™ and ZZAP)

In vitro characteristics of alloanti-Yt^b

Immunoglobulin class	IgG
Optimal technique	IAT

Clinical significance of alloanti-Yt^b

Transfusion reaction	No
HDFN	No

Comments

Anti-Yt^b is rare and usually occurs in sera with other antibodies. The second example of anti-Yt^b was made by a patient with PNH.

Reference

[1] Bartels, C.F., et al., 1993. Mutation at codon 322 in the human acetylcholinesterase (ACHE) gene accounts for YT blood group polymorphism. Am J Hum Genet 52, 928–936.