= Nomenclature of monoclonal antibodies =

The nomenclature of monoclonal antibodies is a naming scheme for assigning generic , or nonproprietary , names to monoclonal antibodies . An antibody is a protein that is produced in B cells and used by the immune system of humans and other vertebrate animals to identify a specific foreign object like a bacterium or a virus . Monoclonal antibodies are those that were produced in identical cells , often artificially , and so share the same target object . They have a wide range of applications including medical uses .

This naming scheme is used for both the World Health Organization ? s International Nonproprietary Names (INN) and the United States Adopted Names (USAN) for pharmaceuticals . In general , word stems are used to identify classes of drugs , in most cases placed word @-@ finally . All monoclonal antibody names end with the stem -mab . Unlike most other pharmaceuticals , monoclonal antibody nomenclature uses different preceding word parts (morphemes) depending on structure and function . These are officially called substems and sometimes erroneously infixes , even by the USAN Council itself .

= = Components = =

= = = Stem = = =

The stem -mab is used for monoclonal antibodies as well as for their fragments , as long as at least one variable domain (the domain that contains the target binding structure) is included . This is the case for antigen binding fragments and single @-@ chain variable fragments , among other artificial proteins . Other antibody parts (such as Fc regions) and antibody mimetics use different naming schemes .

= = = Substem for origin / source = = =

The substem preceding the stem denotes the animal from which the antibody is obtained . The first monoclonal antibodies were produced in mice (substem -o- , yielding the ending -omab ; usually Mus musculus , the house mouse) or other non @-@ human organisms . Neither INN nor USAN has ever been requested for antibodies from rats (theoretically -a-) , hamsters (-e-) and primates (-i-) .

These non @-@ human antibodies are recognized as foreign by the human immune system and may be rapidly cleared from the body , provoke an allergic reaction , or both . To avoid this , parts of the antibody can be replaced with human amino acid sequences , or pure human antibodies can be engineered . If the constant region is replaced with the human form , the antibody is termed chimeric and the substem used is -xi- . Part of the variable regions may also be substituted , in which case it is called humanized and -zu- is used ; typically , everything is replaced except the complementarity determining regions (CDRs) , the three loops of amino acid sequences at the outside of each variable region that bind to the target structure . Partly chimeric and partly humanized antibodies use -xizu- . These three substems do not indicate the foreign species used for production . Thus , the human / mouse chimeric antibody basiliximab ends in -ximab just as the human / macaque antibody gomiliximab . Pure human antibodies use -u- .

Rat / mouse hybrid antibodies can be engineered with binding sites for two different antigens . These drugs , termed trifunctional antibodies , have the substem -axo- .

= = = Substem for target = = =

The substem preceding the source of the antibody refers to the medicine 's target . Examples of targets are tumors , organ systems like the circulatory system , or infectious agents like bacteria or viruses . The term target does not imply what sort of action the antibody exerts . Therapeutic ,

prophylactic and diagnostic agents are not distinguished by this nomenclature .

In the naming scheme as originally developed , these substems mostly consist of a consonant , a vowel , then another consonant . The final letter may be dropped if the resulting name would be difficult to pronounce otherwise . Examples include -ci (r) - for the circulatory system , -li (m) - for the immune system (lim stands for lymphocyte) and -ne (r) - for the nervous system . The final letter is usually omitted if the following source substem begins with a consonant (such as -zu- or -xi-) , but not all target substems are used in their shortened form . -mul- , for example , is never reduced to -mu- because no chimeric or humanized antibodies targeting the musculoskeletal system ever received an INN . Combination of target and source substems results in endings like -limumab (immune system , human) or -ciximab (circulatory system , chimeric , consonant r dropped) .

New and shorter target substems were adopted in 2009 . They mostly consist of a consonant , plus a vowel which is omitted if the source substem begins with a vowel . For example , human antibodies targeting the immune system receive names ending in -lumab instead of the old -limumab . Some endings like -ciximab remain unchanged . The old system employed seven different substems for tumor targets , depending on the type of tumor . Because many antibodies are investigated for several tumor types , the new convention only has -t (u) - .

= = = Prefix = = =

The prefix carries no special meaning . It should be unique for each medicine and contribute to a well sounding name . This means that antibodies with the same source and target substems are only distinguished by their prefix . Even antibodies targeting exactly the same structure are differently prefixed , such as the adalimumab and golimumab , both of which are TNF inhibitors but differ in their chemical structure .

= = = Additional words = = =

A second word following the name of the antibody indicates that another substance is attached , which is done for several reasons .

An antibody can be PEGylated (attached to molecules of polyethylene glycol) to slow down its degradation by enzymes and to decrease its immunogenicity ; this is shown by the word pegol as in alacizumab pegol .

A cytotoxic agent can be linked to an anti @-@ tumor antibody for drug targeting purposes . The word vedotin , for example , stands for monomethyl auristatin E which is toxic by itself but predominantly affects cancer cells if used in conjugates like glembatumumab vedotin .

A chelator for binding a radioisotope can be attached . Pendetide , a derivative of pentetic acid , is used for example in capromab pendetide to chelate indium @-@ 111 . If the drug contains a radioisotope , the name of the isotope precedes the name of the antibody . Consequently , indium (111In) capromab pendetide is the name for the above example including indium @-@ 111 .

= = History = =

Emil von Behring and Kitasato Shibasabur? discovered in 1890 that diphtheria and tetanus toxins were neutralized in the bloodstream of animals by substances they called antitoxins , which were specific for the respective toxin . Behring received the first Nobel Prize in Physiology or Medicine for their find in 1901 . A year after the discovery , Paul Ehrlich used the term antibodies (German Antikörper) for these antitoxins .

The principle of monoclonal antibody production , called hybridoma technology , was published in 1975 by Georges Köhler and César Milstein , who were awarded the 1984 Medicine Nobel Prize for their discovery together with Niels Kaj Jerne . Muromonab @-@ CD3 was the first monoclonal antibody to be approved for clinical use in humans , in 1986 .

The World Health Organization (WHO) introduced the system of International Nonproprietary Names in 1950 , with the first INN list being published three years later . The stem -mab for

monoclonal antibodies was proposed around 1990 , and the current system with target and source substems was developed between 1991 and 1993 . Due to the collaboration between the WHO and the United States Adopted Names Council , antibody USANs have the same structure and are largely identical to INNs . Until 2009 , more than 170 monoclonal antibodies received names following this nomenclature .

In October 2008 , the WHO convoked a working group to revise the nomenclature of monoclonal antibodies , to meet challenges discussed in April the same year . This led to the adoption of the new target substems in November 2009 . In spring 2010 , the first new antibody names were adopted .

= = Examples = =

= = = New convention = = =

Olaratumab is an antineoplastic . Its name is composed of the components olara @-@ t @-@ u @-@ mab . This shows that the drug is a human monoclonal antibody acting against tumors .

The name of benralizumab , a drug designed for the treatment of asthma , has the components benra @-@ li @-@ zu @-@ mab , marking it as a humanized antibody acting on the immune system .

= = = Old convention = = =

Adalimumab is a drug targeting TNF alpha . Its name can be broken down into ada @-@ lim @-@ u @-@ mab . Therefore , the drug is a human monoclonal antibody targeting the immune system . If adalimumab had been named after 2009 , it would have been adalumab .

Abciximab is a commonly used medication to prevent platelets from clumping together . Broken down into ab @-@ ci @-@ xi @-@ mab , its name shows the drug to be a chimeric monoclonal antibody used on the cardiovascular system . This and the following two names would look the same if the new convention were applied .

The name of the breast cancer medication trastuzumab can be analyzed as tras @-@ tu @-@ zu @-@ mab . Therefore , the drug is a humanized monoclonal antibody used against a tumor .

Alacizumab pegol is a PEGylated humanized antibody targeting the circulatory system .

Technetium (99mTc) pintumomab and technetium (99mTc) nofetumomab merpentan are radiolabeled antibodies , merpentan being a chelator that links the antibody nofetumomab to the radioisotope technetium @-@ 99m .

Rozrolimupab is a polyclonal antibody . Broken down into rozro @-@ lim @-@ u @-@ pab , its name shows the drug to be a human polyclonal antibody acting on the immune system . The suffix -pab shows it is a polyclonal antibody .

= = = Deviations = = =

The monoclonal antibody muromonab @-@ CD3 , approved for clinical use in 1986 , was named before these conventions took effect , and consequently its name does not follow them . Instead , it is a contraction from " murine monoclonal antibody targeting CD3 " .