Teaching outline of medical immunology

<table>
<tr><td>Course name</td><td colspan="3">Medical Immunology</td></tr>
<tr><td>Course nature</td><td colspan="3">Medical basic courses</td></tr>
<tr><td>Credits</td><td>3.5</td><td>Hours: 64</td><td>Total hours: 64, Including: Lecture 48, and Experiment 16</td></tr>
<tr><td>Semesters</td><td colspan="3">Spring</td></tr>
<tr><td>Suitable object</td><td colspan="3">Undergraduate medical immunology education</td></tr>
<tr><td>Pre-study courses</td><td colspan="3">Molecular Biology, Molecular Genetics, systematic anatomy, Histology and Embryology, Biochemistry, Physiology, General introduction in Medical Microbiology.</td></tr>
<tr><td>aft-study courses</td><td colspan="3">Human parasitology, Anatomopathology, Pathophysiology, Pharmacology, etc.</td></tr>
<tr><td>Lecture unit</td><td colspan="3">Department of Pathogenic Biology and Immunology, School of Medicine, Southeast University</td></tr>
<tr><td>Course person in charge</td><td colspan="3">Jun Dou</td></tr>
<tr><td>Course objective and graduates supported by the knowledge, ability, and diathesis</td><td colspan="3">Students should know that medical immunology is a science that involves the immunological defense, immunological homeostasis, and immunological surveillance, covering the areas of the composition and function of immune system after they have finished the study of immunological principles and techniques. With the immunological theoretical and technical interactions with other disciplines, such as molecular biology, cellular biology, genetics and biochemistry etc., medical immunology has developed rapidly over last 50 years, and become one of the fastest growing disciplines.
Medical immunology is located at the brink of the life science and is closely intertwined with all the disciplines of clinical medicine in the 21 Century. The objective medical immunology course is let students to know that the medical immunological theory and techniques have been extensively applied to many other areas of life science and medicine, and is also an important basic and applied discipline to many other disciplines such as biology, basic medicine, clinical medicine, preventive medicine and veterinary science, etc. By learning the medical immunology, students should master its basic theory knowledge and techniques to prevent and treat the diseases, save life, as well as safeguard the people’s healthy in future. Students should have a sense of honor, a sense of mission, and a sense of responsibility to serve our country.
<table>
<tr><th>Course objective serial number</th><th>Course objective</th><th>Graduates supported by the knowledge, ability, and diathesis</th></tr>
<tr><td>1</td><td>Students should master the basic functions of immune system including the immunological defense, immunological homeostasis, and immunological surveillance as well as the medical immunological theory and techniques in order to better learn the</td><td>To train the students the abilities of trimming, generalization, and absorbing learned knowledge of the medical immunology and to clarity the immunopathogenesis mechanisms of hypersensitivity, autoimmune disease, and graft rejection etc.</td></tr>
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		clinic courses.	
	2	To comprehend the immune system how to identify the pathogenic organisms of 2019 Novel Coronavirus (2019-nCoV), hepatitis virus, tubercle bacillus, etc, and the mechanisms of immune tolerance and immune-regulation. Students should know well the characteristic of innate and adaptive immune responses and interrelationship.	Students should learn the knowledge of humoral immunity and cellular immunity responses to new coronary pneumonia COVID-19, hepatitis virus, tubercle bacillus etc. infectious diseases by the immunological defense and immunological damage, as well as have the ability to analyze the phenomenon of immune deficiency, tumor immunity escape.
	3	To be familiar with the medical immunological theory and techniques of immunoprophylaxis and immune-therapy, and know the brink of the medical immunology. Students should know the active immunity, and passive immunity related knowledge.	Students should have the ability to analyze the tested results of the humoral and cellular immunity responses by using immune detection techniques and to design related immunological assays for testing clinic diseases associated with autoimmune disease, etc.
	4	To expand the medical immune theory and techniques, students should master the literature retrieval of Chinese-English languages to simplify immune knowledge and experiments in order to better to infer the rest from what is already known and to have the capability of independent thinking and capability of expressing immunological related questions by Chinese-English languages.	To culture exact value and scientific weltanschauung, students should have a scientism of seeking truth from fact, scrupulous work style and a superior medical ethics. And, students should have an ability to find problems and solve problems based on the knowledge framework of modern immunological theory and techniques and criticism thinking.

Correspondence relationships between the course objective and the teaching contents teaching and elements	Course objective serial number	Course contents	Teaching elements			
			Lecture	Study and discuss	Experiment	Computer
	1	Immune and basic functions of immune system and immune response features of innate and adaptive immunity, antigen, antibody and complement, CD, MHC, etc.	21		6	
	2	Hypersensitivity, autoimmune disease, graft rejection, immune deficiency, tumor immunity, anti-infections immunity, relationship between the innate and the adaptive immunity, active immunity, and passive immunity etc.	18		6	
	3	Vaccine active immunity, and passive immunity, immunoprophylaxis and immunotherapy for COVID-19, hepatitis virus, tubercle bacillus, other microbe parasites infectious diseases etc.	14		6	
	4	The new progression of hypersensitivity, autoimmune disease, immunodeficiency, tumor immunity escape and graft rejection, vaccine development, and	5		6	

		immune detection techniques, etc.				
Course contents and arrange	**1. Class Lecture /Hours** (1) Immunological introduction, Immunity, innate immunity, adaptive immunity and immune system. Brief History and Prospect of Immunology, Burnet's Clonal Selection Theory, Humoral and Cellular immunity. Immunology's application. Immune Cells, Secondary (peripheral) Lymphoid Tissues and Organs, Lymphocyte recirculation. **(6 hours/ in classroom)** **Course Contents** Immunity, innate immunity, adaptive immunity. Immune Cells such as Phagocytes, Primary Lymphoid Organs (Thymus and bone marrow), Secondary (peripheral) Lymphoid Tissues and Organs (Gut Associated Lymphoid Tissue, Mucosal lymphoid system), Lymphocyte recirculation. Lymphocytes, Antigen Presenting Cells (APC), NK Cells, Pathological Immunity and Immune Diseases. Burnet's Clonal Selection Theory, Empirical Immunology, Scientific Immunology, Antigen Receptor, Signaling Pathway, Programmed Cell Death, Development of Immune Cells, Immunological Tolerance, Edward Jenner, Louis Pasteur, Robert Koch, Humoral and Cellular immunity. Immunology application such as antigen-antibody interaction, ELISPOT, immunofluorescence, Western blotting, Flow cytometry, etc. Application of Vaccines. Challenges of the immune system. Concept and properties of antigen (Ag), epitope, immunogens, happen (incomplete Ag). Physicochemical properties, T and B cells epitopes, Conformational and liner epitopes. Thymus dependent Ag (TD-Ag), Thymus independent Ag (TI-Ag), Heterophilic Ag (common Ag), Common antigen and Cross Reaction. Factors influencing immunogenicity, Effect of host on immunogen, T-dependent TCR, BCR, MHC, Mode of Contact (Route of administration, Dose). Xenogenic Ag, Allogenic Ag, Autoantigen, Super Ag, Adjuvants, Mitogen. **(2) Immunoglobulins, Complement system, Cytokines, CD, MHC, etc.** **(9 hours/ in classroom)** **Course Contents** Concept of Immunoglobulins (Ig), Molecular structure and functions of Ig,(Neutralize toxins, Bind to bacterial surfaces and aid in opsonization, Bind to bacterial surfaces and aid in complement killing, Inactivate viral particles, Provide immunity to the unborn, Provide immunity to the newborn, Complement Activation).Ig Classes, Subtypes (IgM, IgD, IgG, IgA and IgE) and types. Ig Isotypes, Allotypes, Idiotype; Ig Hinge region, Membrane and secreted Ig; Biological properties and functions of Ig Classes. Antigen Antibody Interactions, Immunoglobulin Supergene Family, Mechanisms for generation of different antibodies, molecular diversity. Use of antibodies in medicine, Properties and functions of monoclonal antibody. Concept of complement system, the component of complement system, nomenclature of complement system, classical pathways, lection pathway, alternative pathway, terminal sequence and the membrane attack complex, regulation of complement system activation, biological consequence of complement activation. Concept of cytokines, common properties of cytokines, classification of cytokines, understandconcept of cytokine receptor, Common properties of cytokines, classification of cytokines, cytokine receptor.					

	Concept of HMC and HLA, structure of MHC class I molecules, structure of MHC class II molecules, concept of polymorphism, peptide-MHC interaction, function of MHC molecules, HLA and clinical medicine, main functions of MHC molecules, concept of polymorphism interaction of MHC and antigenic peptide, genetic properties of MHC, MHC and rejection, peptide-MHC interaction, function of MHC molecules, HLA and clinical medicine. Concept of CD molecule, clinical applications of CDs and their antibodies, Concept of leukocyte differentiation, antigens, concept of cluster of differentiation, intergrin family, selectin family, immunoglobulin family, clinical application of CD molecules, CAM and monoclonal antibodies against CD molecules and CAM. **Hematopoietic stem cells, T lymphocytes, B lymphocytes, Cells of Innate Immunity (6 hours/ in classroom)** **Course Contents** Concept of functions of major immune cells; Epithelials, Phagocytes, Neutrophils, Monocytes & Macrophages, antigen presenting cells (APCs), Dendritic Cells(DC), NK cells, NKT cells, T lymphocytes, B lymphocytes PRR and PAMP, Surface molecules, KAR: function, KIR: function; Functions of Natural killing, ADCC, Regulation of the immune response, Characteristics of cytotoxicity mediated by NK cells, γδT, B1 cells. Concept of the subpopulations and functions of T lymphocytes, the development and maturation of T lymphocytes in thymus. The major surface molecules associated with activation and subpopulations of T lymphocytes, the cytokines secreted by T lymphocytes. Development and maturation of T cells, TCR rearrangement, Positive selection, Negative selection, MHC-restriction, Central tolerance. TCR: structure and characteristics of antigen recognition. CD3: structure and function, CD2: structure, ligand and function, Co-receptor (CD4/CD8): structure, ligand and function, Co-stimulator receptor (CD28/CTLA-4): ligand and function, Adhesion molecules: classes and functions, Mitogen receptors: PHA and ConA receptor, etc. Concept of the development, derivation and maturation of B lymphocytes. B cell differentiation and Ig gene rearrangement. Control of self-reactivity in B lymphocytes. the major surface molecules associated with activation and subpopulations of B lymphocytes. The subpopulations and functions of B lymphocytes, the cytokines secreted by B lymphocytes. B lymphocyte differentiation, Ig gene rearrangement, Control of self-reactivity in B lymphocytes, Antibody affinity maturation. Surface molecules of B lymphocytes, BCR: structure and characteristics of antigen recognition, Ig/Ig complex: structure and function, Co-receptor (CD19/CD21/CD81): structure and function, Co-stimulator molecules (B7): ligand and function; Adhesion molecules: classes and functions, Mitogen receptors: LPS and PWM receptors, Other CD molecules (CD20 and CD40): ligands and functions. Subpopulations of B lymphocytes, B1 cells: phenotype and functions, B2 cells: phenotype and functions. Functions of B lymphocytes, Production of antibodies, Antigen presentation, Regulation of immune responses. **Antigen presentation , Innate immune response, T/B cell immune responses** **(11 hours/ in classroom)**

	Concept of the components involved in innate immune response, the relationship between innate immune response and adaptive immune response. Concept of antigen processing and presentation. The nature of antigens to be presented. Endogenous and exogenous antigens The Antigen Presenting Cells (APCs) Professional APCs: Classes of professional APCs and Properties of professional APCs, Non-professional APCs: Classes of non-professional APCs. The Class I antigen presentation pathway. The Class II antigen presentation pathway, and across presentation pathway. Understand the recognition mechanism of innate immune response. Know the biological significance of innate immune response. Skin and mucosal surfaces. Immune cells involved in innate immune response. Humoral proteins of innate immunity. Recognition mechanism of innate immune response. Pathogen associated molecular patterns. Pattern recognition receptors. Biological significance of innate immune response. The characteristics of antigen recognition by TCR and BCR, the mechanism of CD8+T cell activation, and the roles of cell-mediated immunity and humoral immunity. Understand the concept of the immune response and the mechanism of CD4+T cell activation. Understand the mechanism of B cell activation and the mechanism of cytotoxicity mediated by CTL. Understand the primary and secondary responses. Know proliferation and differentiation of activated T and B cells. The concept of the immune response. An overview of an immune response. The humoral immune response. The cells involved and their effects. The effects of APC in a humoral response. The course of humoral immunity. CD4+T cell-mediated response. Cell types involved and their effects. The course of CD4+T cell mediated immunity. CD8+T cell-mediated response. Types of cells (Th1,Th2,Th3,Th17,Tfh,Treg, etc) involved and their effects. The course of CD8+T cell mediated immunity. Biological effects of cell-mediated immunity and humoral immunity in an individual. **Mucosal lymphoid system, Immunological tolerance, Immune regulation.** **(5 hours/ in classroom)** **Course Contents** Concept of the Mucosal lymphoid system (MIS), Mucosal Associated Lymphoid Tissue (MALT), Nasal-associated lymphoid tissue(NALT), Bronchial-associated lymphoid tissue (BALT), Gut Associated Lymphoid Tissue (GALT), Peyer's patches, isolated lymphoid follicles, commensal microorganisms, specialized antigen transporting cell (M cell), intraepithelial lymphocytes (IEL), ILC3 cells. Concept of the concepts of central tolerance and peripheral tolerance. Understand the mechanisms of Immune tolerance. Know the establishment and abrogation of Immune tolerance. the development and representation of Immune tolerance. Innate tolerance. Acquired tolerance. Mechanisms of immune tolerance, Central tolerance, Peripheral tolerance. Release of sequestered antigen from immunoprivileged site immune tolerance and clinical medicine. Establishment and maintenance of Immune tolerance. Abrogation of immune tolerance. Concept of the regulation role of regulatory T cells, the concepts of immunoreceptor tyrosine-based inhibitory motif (ITAM) and Activation-induced cell death(AICD). Understand the active receptors and suppressing receptors on the immune cells.

	Understand the idiotype network. Know the regulation role of antigen, antibody and complement. Know the regulation relationship between neuroendocrine system and immune system. Regulation role of antigen, antibody and complement. Regulation role of signaling components and suppressing receptors on the immune cells. Regulation role of T cells and the idiotype network. Neuroendocrine immune system regulation. **Hypersensitivity, Tumor Immunology, Autoimmunity, Immunodeficiency** **(6 hours/ in classroom)** **Course Contents** Concept of hypersensitivity, Immediate, Delayed, Allergy, Anaphylaxis, Allergen, Allergins, Wheal and flare reaction (red and swollen), Asthma, Atopy Dermatitis, Mast cells and Basophils, Hapten. Desensitization. Antibody-dependent cell-mediated cytotoxicity (ADCC). Graves disease. Goodpasture's syndrome, Immune complex disease (ICD). Arthus reaction. Serum Sickness, Contact hypersensitivity, Tuberculin type hypersensitivity, Granulomatous hypersensitivity. Hypersensitivity Classification. Mediators and mechanism of Type I- Type IV, example of hypersensitivity in each type. Therapy for Type I Hypersensitivity, Arthus reaction, Delayed-type Hypersensitivity (DTH). Immune complex disease (ICD), Arthus reaction, Nephritis, Tuberculin test, Drug reactions. Hypersensitivity: Gell and Coombs Classification. Mediators and mechanism of Type I Hypersensitivity, Type I Hypersensitivity associated diseases (Allergic Rhinitis, Asthma, Food allergies, Atopic dermatitis, etc). Mast cell activation and degranulation, the biological effects of histamine in allergic reactions, therapy for Type I Hypersensitivity. Three different effector mechanisms in Type II Hypersensitivity, Type II Hypersensitivity associated diseases (Hemolytic disease of the newborn, blood transfusion reaction, Drug-induced cytotoxic reactions, etc). Graves disease, Goodpasture's syndrome. Circulating Immune Complexes and Pathogenesis in Type III Hypersensitivity, Type III Hypersensitivity associated diseases (Systemic lupus erythematosus (SLE), Rheumatoid arthritis, Poststreptococcal glomerulonephritis, etc). Arthus reaction , Immune complex disease (ICD), Arthus reaction, Serum sickness, Nephritis, Myasthenia Gravis, Farmers lung, Multiple Sclerosis (MS). Delayed-type Hypersensitivity (DTH), Immune Pathogenesis in Type IV Hypersensitivity, Type IV Hypersensitivity associated diseases (Contact Dermatitis, Insulin-dependent diabetes mellitus (IDDM), etc). Tuberculin test, Drug reactions. Concept of tumor antigen, mechanism of anti-tumor effects and mechanism of tumor escape. Tumor Immunotherapy, immune privilege, tumor vaccines, tumor-specific antigen (TSA), tumor-associated antigen (TAA); Comprehend: cancer-testis Ag. Mechanism of Anti-tumor Effects, humoral and cellular immunity. Mechanism of tumor Escape. Antigen modulation, immune privilege, Fas/FasL counterattack, Tumor Immunotherapy. Tumor Immunodiagnosis, tumor-associated macrophages (TAMs), cancer stem cells (CSCs) or tumor stem cells (TSCs), tumor vaccines. The Universe of Antigens, Genetics versus Acquired Lymphocyte, B cell defects T cell defects, Complement defects, Phagocytic cell defects, CGD (chronic grannlomatous

	disease), LAD (leukocyte adhesion deficiency), SCID (T cell defects), Cytokine defects Receptor defects. **Immunological Experiments,** **(5 hours/ in classroom)** **Course Contents** Agglutination Reaction Skills: Master the principles of the agglutination reaction, to be familiar with the technique of how to do an agglutination experiment, Know how to observe and give the results of the slide agglutination test and tube agglutination test. Experiments :The classification and principle of the agglutination reaction; The application of an agglutination experiment; Direct Agglutination Reaction - Slide Agglutination Test. Direct Agglutination Reaction -- Tube Agglutination Test. Precipitation Reaction: Skills: Master the principles of a precipitation reaction, to be familiar with the technique of how to do a precipitation experiment, Know how to analyze the results. Experiments: The classification and principle of the precipitation reaction, The application of a precipitation experiment, Double Radial Immunodiffusion Test. Countercurrent Electrophoresis Test. Immunolabeling Techniques: Skills: Master the principles and classification of ELISA, to be familiar with the techniques and applications of ELISA, Know the classification and principles of the immunolabeling technique. Experiment: The classification and principles of the immunolabeling technique. The principles and classification of ELISA. The techniques and applications of ELISA. The indirect Enzyme-Linked Immunosorbent Assay. Antigen and antibody reaction Involved by Complement. Skills: Master the principle of Hemolytic Assay Involved by Complement. Be familiar with the technique of doing the hemolytic assay involved by complement. Know how to analyze the results. Experiment: The principle of Hemolytic Assay Involved by Complement. The application of Hemolytic Assay Involved by Complement. The technique of antigen and antibody reaction involved by complement. Separation of mononuclear cells from whole peripheral blood. Skills: Master the principles of cell separation, to be familiar with the technique of separation of mononuclear cells from human peripheral blood by ficoll-hypaque density gradient centrifugation. Know the stain and count of human PBMC. Experiment: The principle of separation of PBMCs from human peripheral blood by ficoll-hypaque density gradient centrifugation. The technique of separation of PBMCs from human peripheral blood. Count the live PBMCs by typan blue with the blood-cell-counter under the microscope. Detection of T lymphocyte by erythrocyte rosette forming test. Skills: Master the principle of the E rosette test for T lymphocytes, to be familiar with the method of detection of the T cells. Know the various methods for T cells detection.

	Experiment: The principle and technique of the Erosette test. Observe rosette forming cell under the microscope. Calculate the percentage of rosette-forming cells. Other methods for T cell detection, such as FACS and MACS. Measurement of phagocytosis by phagocytes. Skills: Be familiar with the technique of how to measure phagocytosis. Know the calculation and application of the percentage of phagocytosis. Experiment: The principle and method of phagocytosis. Observe phagocytosis under the microscope. Calculate the percentage of phagocytosis. Detection of B lymphocyte by PE-conjugated anti-IgM staining Skills. Master the principle of fluorescence-labeled antibody staining with cells. Be familiar with the technique of immune cells surface staining with fluorescence-labeled antibody. Know the application of flowcytometry assay. Experiment: The principle of immune cells surface staining with fluorescence-labeled antibody. Technique of cell surface staining with fluorescence-labeled antibody. Detection of B lymphocyte by PE-conjugated anti-IgM staining. Application of flowcytometry assay. **2. A case training the students to love mother land** New coronary pneumonia (COVID-19) caused by 2019 Novel Coronavirus(2019-nCoV)/ SARS-Cov-2 is becoming a serious public health threat to China and the world. Despite the continuous efforts from many countries, including China, it is still inconclusive to uncover where the 2019-nCoV originated. It is known that the many scientist in China are working hard to try to develop the drugs and vaccines to treat or prevent the coronavirus. And, some scientist in China try to discover the 2019-nCoV originated. They use coronavirus gene sequences from different species of bat/civet/pangolin / bird / turtle / pig in global databases to optimally analyze the viral evolution and T/B cell epitope related mutations; to identify the correlated mutations at receptor binding domain function region of viral S protein and the T/B epitope domains at the corresponding regions. Identify the viral reservoir and intermediate host of SARS-Cov-2. The research results will provide an important data for tracking the new coronavirus and predicting the emergence of coronavirus immune escape mutants. Simultaneously the immune footprints of the virus immune escape mutants will provide new strategies for viral rapid diagnosis, development of anti-SARS-Cov-2 drug /vaccines, and for accurate prevention and treatment of the next generation of COVID-19 as well as for enhancing the ability to deal with the public health event outburst and the health emergency. In the teaching process, our aim is to elicit the students to love the science research and serve our country via hardworking on the medical immunological theory and technique now. 3. Experiment element: Please see the experiment arrangement！
Teaching methods	In lectures, the teacher will adopt the methods of multimedia teaching combined with writing on the blackboard in English speech, accompanied with a little of Chinese readout.
Course examine	1. normal homework 10% 2. Experiment record 20%

and record assessment	3. Final examine 70%
Teaching Materials	Teaching Materials: Medical Immunology by Zhi Yao, 2017. First edition. Reference Book: Medical Immunology by Xuetao Cao, 2018. 9th edition. Janeway's Immunobiology, 8th edition, 2012.
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Issue time	2020.3