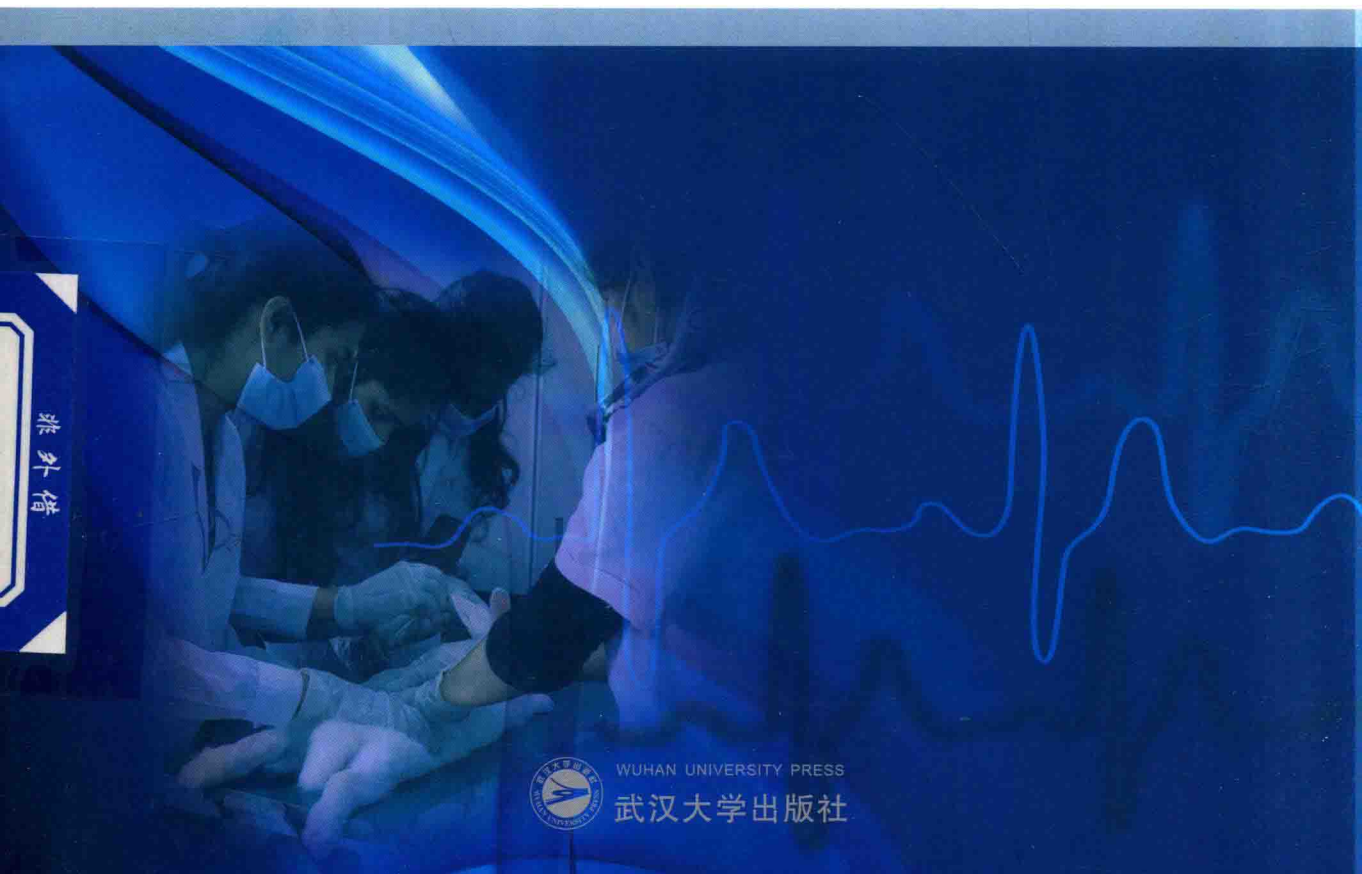


English-Chinese
Laboratory Manual
for
Medical Physiology

英汉对照 · 医学生理学实验指导

主编 彭碧文 张先荣



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Preface

1. An Overview of Physiology Experiments

Physiological experiments observe the changes of the function and metabolism of the organisms, mainly on animals and the human body, under the conditions of normal or with chemical compound treatments, thus to explore mechanism and regularity.

The main target of physiological experiments is to explain the physical and chemical factors that are responsible for the origin, development, and progression of life based on *in vitro* or *in vivo* experiments. It is beneficial for students to understand the process of life activities, diseases, and treatment. Physiological experiments have become a basic compulsory course in medical science which involves the theories and the experimental techniques of pharmacology, pathophysiology, statistics, zoology and computer science. This overview systematically introduces the basic knowledge of the physiological experiments including the basic theory, experimental methods, modern experimental techniques and experimental research. Hopefully it can cultivate the students' ability of utilizing knowledge and scientific practice through the foundation, comprehensive experiments.

2. The Rules of Laboratory

①Observe the discipline and arrive at the lab on time. Exemption from attending the course should be applied for.

②Wear lab coats in the laboratory at all time, otherwise you are not allowed to enter.

③Work seriously and earnestly while doing experiments, do not engage in any other activities that are not related to the experiments.

④Speak with a lower voice and keep quiet while you are in the laboratory. Eating and drinking are not allowed in the laboratory.

⑤The experimental animals and equipments will be issued by groups. Any want of supplements should be allowed by teachers.

⑥The experimental instruments and equipments in each group should be used by

yourselves and any replacements are not allowed in case of disorders.

⑦If an instrument is out of order, please report to the teacher in charge of the class so as to repair or replace it as soon as possible. Do not try to conceal the truth, let alone disassemble or repair it by yourself. You should compensate for the breakdown of any instrument due to violation of operating procedures.

⑧After the experiments, please wash and wipe the surgical instruments, clean up the laboratory equipment, supplies, and your experiment table. The number of equipment and supplies must be counted clearly, do not make a mess of them. Animal bodies, wastes, and scraps of paper should be put to the designated location, littering is not allowed here. After the class, the students on duty should clean the laboratory floor and check the safety of it.

⑨Writing reports on experiments would be required to submit on time. Normally your experimental reports will be submitted to the teacher in charge of the class within one week of the completion of the experiments and your sheets handed in will be concerned in final examination marks.

(Peng Biwen)

3. Methods of Writing an Experimental Report

(1) Purpose of Writing an Experimental Report

The experimental report is a summary of an experiment and also a basic training of the experimental class. By writing the experiment reports, you learn the basic format of scientific paper writing and basic methods of chart drawing, data analysis, and literature reviewing, as well as using the experimental data and literature to analyze and summarize the results of the experiment and improve the your ability to analyze, hypothesis and summarize the problems, thus laying a good foundation for future scientific paper writing.

(2) Requirements of Writing an Experimental Report

You are supposed to hold a scientific attitude when writing the experimental reports and finish them seriously and earnestly all by yourself. You shouldn't blindly copy books and experimental reports of others. Meanwhile, you ought to pay attention to making your words and sentences concise and smooth, as well as making your handwriting clear and clean, you should always keep in minds to use the punctuations correctly.

(3) General format and notice of Writing an Experimental Report

The experimental report of physiology

Name Student number Class Group Date

The title of experiment

A title can highly summarize the central idea and main content of an experimental report, which should be concise and comprehensive. You can use the title in this textbook. Remember to add the sequence number on every experimental item.

The purpose of experiment

At the beginning of an experimental report, you can raise more than one problem that the experiment should resolve. Remember that refinement and simplicity are both required.

Materials and methods of experiment

The materials and methods reported in the experiment are generally formatted as follows:

①Objects: Type, strain, gender and physical station of experimental animals. gender, body weight, and age of human body.

②Instruments: Name and manufacturer of instruments components and parameters of experimental instrument system.

③Drugs and reagents: Name, specification, dosage forms, and manufacturer of drugs and reagents.

④Experimental procedure: experimental environment and conditions, preparation methods of samples, rearing condition for experimental animals, preparation methods of drugs and reagents. Grouping and handling of experimental subjects, the experimental procedures and processes, operating methods and so on.

⑤Analysis of data: Observation methods data recording and collection of information and results.

⑥Statistical analysis

Results

Results include table, chart, and text narrative and so forth. You shall provide the following content in experimental results:

①Text description of the results

②The original experimental data in a manner of table.

③A chart or a table after statistical processing.

④Original recording curves through editing and marking

⑤The text description of your diagram and table.

Discussion and conclusion

The experimental results are discussed according to the known theoretical knowledge to explain and analyze the results. The analysis should point out the theoretical or practical

significance of the experimental results. If any unexpected result occurs, you should consider and analyze the possible reasons of it and write them in your discussion.

The conclusion is a general judgment summarized from your experimental results and discussion, i. e a concise summary of concepts or theories that can be verified by this experiment. The conclusion should correspond with the purpose of this experiment. You should write your conclusion concisely. Neither should you list the specific results nor infer or extend your conclusion too far. Theoretical analysis that fails to obtain sufficient evidence in the experimental results should not be written in your conclusion.

References

You are supposed to choose the latest published books or papers closely related to methods, results and discussions in the experimental reports.

(Peng Biwen)

Chapter 1 Biological Signal Recording System

RM6240 Physiological Signal Recording System

1.1 The Characteristics of RM6240

RM6240 Physiological signal recording systems (including RM6240B and RM6240C) are a new generation of medical and laboratory instruments produced by the Chengdu Instrument Factory. The RM6240 has two ports including an Enhanced Parallel Port (EPP) and a USB with a 12-bit A/D converter. The sampling frequency can achieve as high as 100kHz (EPP) or 200kHz (PCI high speed type).

This system is equipped with a multichannel and multifunctional amplifier. The amplifier in each channel has the function of a bioelectric amplifier, blood pressure amplifier, or bridge amplifier. It can also be used as a lung monitor (supplied with flow transducer), a thermometer (supplied with temperature transducer), and a pH meter (supplied with pH probe amplifier). In addition, this system also provides other functions, such as a drop recorder, sounder recorder, and a program-controlled and isolated stimulator.

1.2 Instrument Panel

(1) Channel input port. The channel is a physical path for analog signal input, signal amplification, digital signal conversion, and signal recording. RM6240B can process and record sync signals from 4 channels.

(2) Stimulator output port. Output voltage or current stimulation with a square waveform.

(3) Drop recorder input. Signals of drops can be input through this channel when connected with a drop collector and detector. This input port can also be used for recording external trigger signals.

(4) Sound recorder input. Sound signals from allocated channel can be recorded when it is connected with the sound box.

1.3 The Windows User Interface

The user interface of the RM6240 recording system can be divided into 6 functional areas:

(1) Menu. Top-level menu is located at the top of the window. Selecting either one of them will activate the drop down menu.

(2) Tool Bar. The toolbar is displayed across the top of the application window, below the menu bar. The toolbar provides quick mouse access to many tools used in the Menu.

(3) Parameter control area. Parameters for each channel are found in this area, including channel mode, scanning rate, sensitivity, and cut-off frequency. These parameters can be adjusted by selecting the corresponding button.

(4) Data display area. Data will be shown in waveform in this area.

(5) Ruler and Data Processing. This area is located on the left side of the window, it shows the number of each channel and corresponding ruler. Click the "Processing" button in this area, it will activate the drop down menu which shows channel calibration, marker, measurement and analysis, data processing, et al.

(6) Stimulator. The parameters of the program-controlled stimulator can be adjusted in the floating pop-up window.

1.4 The Basic Function

1.4.1 Instrument Parameters

1. Shortcut for setting parameters

Parameters for most of the experiment program have been properly set. Start RM6240 software, select the program needed in the "experiment" menu bar, and the parameters will be set automatically according to the experiment.

2. Parameters for amplifier

(1) Selection of channel mode: click "channel mode" and select the form of recorded signal in drop down menu.

(2) Bandpass setting

Time constant: specify a system's low-frequency response.

High-frequency filter: adjust the high-frequency cutoff.

(3) Sampling rate. Sampling rate ranges from 1Hz to 100kHz. Appropriate sampling rate should be selected according to the frequency of signals in the experiment. Choose high

sampling rate when the frequency of signals are high, and low sampling rate when the frequency of signals are low.

(4) Sensitivity. Display the signals in appropriate amplitude by adjusting the sensitivity in order to record and analyze data properly.

1.4.2 Signal Recording

1. Shortcut for Signal Recording

There are four functional shortcut buttons for signal recording:

(1) Oscillography button. Start oscillography. Signals will be displayed in “signal recording area” on the current screen. System parameter adjustments can be done under the state of oscillography, but data cannot be saved in this state.

(2) Recording button. Start recording, signals will be displayed and saved.

(3) Pause button. After clicking on this button, signal recordings and saving will be paused and will continue after clicking on the “recording button” again.

(4) Stop button. After clicking on this button, signal recordings and saving will be stopped. The recorded signals will be displayed in the “signal displaying area”. If clicking on the “recording button” again, signals will be recorded and saved in another page (the signals in different pages can be displayed on the screen by pressing the “Page Up” and “Page Down” key).

2. Triggering of Synchronizing Record

Open stimulator window, select “Synchronizer trigger”, click “start stimulation” button to record and display signals. Signals will be displayed on one “screen” from left to right. The number of displaying “screen” of signals is based on the “repetition” times of stimulation.

1.4.3 Stimulator

When stimulation is needed in a certain experiment, select stimulator, select stimulating mode, adjust stimulation parameters.

1. Function Palette

(1) Synchronizer trigger. Once choosing “synchronizer trigger”, signal recording and stimulating pulse will be processed synchronously. The system will display signals in one “screen” in response to each stimulation.

(2) Record current waveform. The waveform on the current screen will be saved in a subfile. The waveform will be displayed once on “screen” in response to clicking on the button, and will be saved in a separate subfile.

(3) Non-superimposing. The newly recorded original waveform will be displayed on one “screen” in response to each stimulation.

(4) Superposed average. The waveform evoked by the current stimulation will be superposed with all waveforms recorded before by the synchronizer trigger and averaged. The averaged waveform will be displayed on the screen.

(5) Superposed accumulation. The waveform evoked by the current stimulation will be superposed with all waveforms recorded before by the synchronizer trigger, the superposed waveform will be displayed on the screen.

(6) Start stimulation. After clicking on this button, the stimulator will output stimulation pulses according to the mode and parameters set on the panel.

(7) Stop stimulation. After clicking on this button, the stimulator will stop outputting stimulation pulses.

2. Stimulation Parameters

The output stimulation pulse from the stimulator is a square wave. The basic parameters are as follow:

(1) Stimulation intensity. The intensity of voltage or current of the output pulse. The range of the output voltage is from 0 to 50 volts. The increment of it is 0.02V between 0 and 10V, and 0.05V between 10 and 50V. The range of output current is from 0 to 10 mA.

(2) Pulse width. Time interval between the leading edge and trailing edge of a square pulse. It is the duration of stimulation. It can be modulated from 0.1 to 1000ms.

(3) Pulse interval. Time interval of inter-pulse in continuous pulse stimulation. It can be modulated between 0.1 and 1000ms. The reciprocal of the sum of the pulse width and pulse interval is stimulation frequency, ranging from 1 to 3000Hz.

(4) Major cycle. The stimulator outputs sequential pulses per unit time. Stimulation pulses can be one, a few, or even several hundred in a single major cycle, and pulse interval varies and can be set as needed. "Number of cycle" or "repetitive times" refers to the numbers of periodic output stimulation per "major cycle". For example, when "major cycle" = 1s, "number of pulse" = 3, "delay" = 5ms, "pulse interval" = 200ms, "pulse width" = 1ms, "stimulation intensity" = 1V, "repetitive times" = 7. Click the "stimulation button" and the stimulator will output stimulations at 1V intensity, 3 pulses with 1ms "pulse width", "pulse width" 200ms. The first pulse will begin at 5ms of stimulation, and the stimulation will be repeated for 7 times. The major cycle, delay, pulse width, pulse interval, and number of pulses should be set in line with the following formula: major cycle (s) > delay (s) + [pulse width (s) + pulse interval (s)] × number of pulse.

(5) Number of pulse. The number of pulses output from the stimulator in a set period.

(6) Delay. The period from the time when the stimulator starts to the time when the pulse output. The delay can be used to adjust the level of signals on screen when using triggering of synchronizing recording.

3. Output Mode

Stimulator can output constant voltage or constant current. It delivers a pulse that is

rectangular in shape. The constant voltage may have positive or negative voltage output pulse. The constant current also has positive or negative current output pulse.

4. Stimulation Mode

A pulse sequence can be made up with a series of parameters, such as a certain major cycle, number of pulses, pulse interval, etc. This specific pulse sequence is called stimulation mode. The basic stimulation modes are as following, meeting the needs of most experiments.

(1) Single twitch stimulation. Only one stimulation pulse is output in a major cycle. The adjustable parameters are intensity, pulse width, delay, major cycle, and repetitive times. The signals can be caught in the triggering of synchronizing recording. This stimulation mode is used mostly in recording compound action potential in a nerve trunk, a single twitch of skeletal muscle, premature contraction, evoked potential, etc.

(2) Continuous single stimulation. The major cycle is 1s, and the stimulation is recycled unlimitedly. The number of pulses output in a major cycle is frequency, and the pulse intervals are equal. The stimulation mode is always used when stimulating the depressor nerve and vagus nerve, as well as recording the effect of the stimulating frequency on skeletal muscle contraction.

(3) Double stimulation. Two stimulation pulses are output in a major cycle. The adjustable parameters are intensity, pulse width, delay, pulse interval, major cycle, and repetitive numbers. The signals can be caught in triggering of synchronizing recording. This mode can be used in recording skeletal muscle contraction, or in a refractory period recording experiment.

(4) Train stimulation. A series of stimulation will be output in a major cycle, the number of pulses ranging from 3 to 999. The adjustable parameters are intensity, pulse width, delay, pulse interval, major cycle, number of pulses, repetitive times. The triggering of synchronizing recording is applicable in this stimulation mode. This mode can be used in stimulating the depressor nerve or vagus nerve, as well as recording the effect of stimulation frequency on skeletal muscle contraction.

(5) Timed stimulation. The stimulating pulse will be output according to the set frequency in a given stimulation time. It is usually used when observing the effect of stimulation frequency in the same stimulation time. For example, stimulating the depressor nerve or vagus nerve, as well as the effect of stimulation frequency on skeletal muscle contraction. The adjustable parameters are delay, pulse width, amplitude, time, frequency, major cycle, and repetitive times.

(6) Stimulation intensity increases or decreases automatically. Under single twitch or double stimulation mode, the stimulation intensity automatically increases or decreases with a certain increment from initial intensity. This mode is used for automatic testing of stimulation intensity and response.

(7) Stimulation frequency ascending or descending automatically. Under single twitch or timed stimulation mode, the stimulation frequency automatically increases or decreases with a

certain increment from initial frequency. This mode is used for automatic testing of stimulation intensity and response.

(8) Pulse width increases or decreases automatically. Under single twitch or continuous single stimulation mode, the stimulation pulse width automatically increases or decreases with a certain increment from initial pulse width. This mode is used for automatic testing of basic intensity and timing.

(9) Double train stimulation. Two stimulation pulses form a group of pulses in this mode; a few to several hundred of pulse groups can be output in one major cycle. The adjustable parameters are intensity, pulse width, delay, pulse interval, frequency, group numbers, major cycle, and repetitive times.

(10) Continuous double stimulation. Continuous double stimulation is essentially the same as double train stimulation. The groups of pulses in a major cycle can be expressed in frequency.

(11) Advanced function. Stimulation train can be further specialized by modulating parameters, such as major cycle, intensity, pulse interval, the number of pulse, et al. It is called 'programmed stimulator'.

(Zhang Xianrong)