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UNIFORM QUARTERLY MEDICAL EXAMINATIONS FOR THE AIRCREW

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SUMMARY: *In this article, the authors discuss the approach to quarterly medical examinations uniform in all units of the Armed Forces of the Republic of Poland and based on the Air Force outpatient polyclinics. The authors took the Rules of Flight Operations 2010 into account as well as personal experience of long-term work with the aircrew at the air unit level. Constructing a range of medical tests, the authors considered basic qualifications of the medical staff in the Air Force outpatient polyclinics and standard equipment found in these polyclinics. The authors are convinced that the designed standards are clear and secure, and worth implementing in the units of The Armed Forces of the Republic of Poland*

KEY WORDS: *Rules of Flight Operations of Aviation of the Armed Forces of the Republic of Poland, quarterly medical examinations for the aircrew, air force doctor, military outpatient polyclinic*

Aircrew quarterly medical examinations are obligatory in the Armed Forces of the Republic of Poland since 01.01.2007. On the 13th October 2006, Minister of Defense decided to implement them (Decision No. 412/MON: Decision on the implementation in the Air Force of the Armed Forces of the Republic of Poland: Regulations of Flights in the Armed Forces of the Republic of Poland).

These Regulations, being in force since 01.01.2011, require quarterly medical examinations (paragraph 46: conditions and course of the aircrew aero-medical qualification), in point 1, beside preliminary, periodical, occasional, and pre-flight medical examinations [6].

Aircrew quarterly examinations are carried out in the air units within an obligatory periodical certification of health status and prophylactic measure [6].

Flight Regulations of 2006 and 2010 do not precisely define the range of the obligatory quarterly medical examinations in the air units.

Considering only basic medical; staff qualification and usually simple diagnostic equipment in the outpatient clinics in the air units, limitation of the quarterly medical

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examinations to the assessment of physical fitness seems logic. In this case, physical fitness means an ability to perform heavily loaded or prolonged physical exercise with participation of the large muscle groups without quickly increasing fatigue and development of the unfavorable changes in the body. This includes also fatigue tolerance and capability of rapid regeneration after work completion [4]. In both human physiology and aviation medicine, adequately high level of the physical fitness is considered an important element of pilots' ability to perform their tasks [3].

Physiology of an exercise

Energy, which is necessary to maintain all vital processes, especially physical exercise, originates from different sources and is produced by various reactions, which may be divided into two basic types: aerobic and anaerobic. Anaerobic reactions enable, first of all, rapid energy supply necessary from the substrates present directly in the muscular cells (phosphocreatine, glucagon) and do not need oxygen. However, an available quantity of these substrates is limited and an only way to continue exercise is a switch to the sources of aerobic energy. Fatty acids constitute a basic substrate as their deposits in the body are practically unlimited. Moreover, aerobic processes are several times more efficient [4].

Anaerobic power and anaerobic capacity are most often measured with WINGATE anaerobic test on cyclo ergometer during a 30-second exercise. Then, a mean absolute power and mean power per 1 kilo body weight, peak power, total work, peak power onset and maintenance, and anaerobic fatigue index are calculated [3]. Peak oxygen uptake (VO_2 max) is an index of aerobic capacity. It is most frequently measured indirectly with Astrand-Ryhming test, basing on the heart rate during submaximal exercise [11].

Concepts of an importance of pilots' endurance and physical fitness in this profession evolved in the military aviation in the past decade or so with an introduction of the high maneuverability aircraft. Anaerobic capacity became more and more important, as its parameters are consider as the elements directly correlated with acceleration tolerance. However, commonly used VO_2max. as a measure of aerobic capacity remained an illustration of the general physical fitness.

Quarterly medical examinations performed in the Armed Forces units are no uniform. They are frequently limited to an analysis of the commission examination or medical examination, control of the inspection of validity of the tests in hyperbaric chamber, stay of aircrew in the Military Training and Fitness Center (WOSz-K) or execution of the commission recommendations.

An analysis of the available literature also did not provided an uniform model of the aircrew quarterly medical examinations in the Armed Forces of the Republic of Poland. Enters into the Pilot Health Book (WLOP-zdr/8) may be used as some guide. However, limitation of the quarterly medical examinations to the general medical examination and simple tests of the circulatory system efficiency without defined principles of the "circulatory system quarterly examination".

Uniform quarterly medical examinations

Basing on a 15-year experience of the aviation physicians working in other military units and WOSz-K, acquired by the authors during scholarships and medical practice as well as an analysis of the literature, Health Care Section of the 44 Naval Air Base in Siemirowice designed an own, author's program of the aircrew quarterly medical examinations. This program takes staff qualifications, equipment, and housing possibilities in the military aviation units into consideration.

Medical examination is carried out in a separate room in an out-patient clinic, combined with ER.

The staff of health care section executes medical examination: physician, paramedic, and a nurse or an orderly.

Quarterly medical examination is a 4-phase and lasts for about 30 minutes.

1. Preliminary phase: includes detailed anamnesis, analysis of the medical documentation provided by the Military Medical Commissions and Military Training and Fitness Center as well as physical examination (including resting HR and BP), ECG or assessment of resting cardiomonitor record. Detailed analysis of both contraindications and recommendations of the Military Medical Commissions is also obligatory, as it frequently accompanies medical certification. ECG records indicating unstable CAD or suspected pathologies are contraindications to the exercise tests.
2. Basic phase: includes patient's exercise tests on the treadmill or cyclo ergometer, according an algorithm of a 2-degree loading.
   I°: load 1 W/kg b.w. for 3 minutes;
   II°: load depending on HR in 60 sec. For 6 minutes.
   HR ‹110/min → 2 W/kg b.w.
   HR =111-120/min → 1.5 W/kg b.w.
   HR ›120/min → 1 W/kg b.w.
   The test may be interrupted, if there are absolute or relative contraindications.
   Absolute contraindications include:
   - ST elevation equal or higher than 0.1 mV,
   - decrease in systolic blood pressure by more than 10 mmHg in compariso with baseline value, despite increasing loading, with accompanying other signs of ischemia,
   - anginal pain,
   - neurological disorders (e.g. vertigo, pre-fainting state),
   - signs of inadequate perfusion (pallor or cyanosis),
   - sustained ventricular tachycardia,
   - technical problems in ECG monitoring or BP measuring,
   - patient's refusal to continue the test.

   Relative contraindications:
   - rapidly increasing ST elevation (>2 mm) or sudden change of the electrical axis of the heart,
   - systolic blood pressure fall by over 10 mmHg in comparison with baseline value, despite increasing load and without other signs of ischemia,
   - increasing anginal pain,
   - marked muscular fatigue of legs,

- arrhythmia other than sustained ventricular tachycardia,
- excessive hypertension (systolic >250 mmHg and/or diastolic >115 mmHg),
- development of bundle branch block,
- general health status (e.g. weakness, cold sweat, skin paleness) [8].

3. Phase of the peak oxygen uptake determination (VO_2max) during submaximal exercise with indirect Astrand-Ryhming test. VO_2max. is read from the special nomograms (Astrand-Ryhming normogram of 1953) based on the mean HR value in the last 10 sec. after 6 minutes of IIş load.
4. The last phase includes evaluation of HR (with modified Harvard step test) during 30 sec. (expressed per 1 minute) in a proper time after test completion. There are two methods of HR measurements: slow and rapid:
   a) Slow 1, 2, and 4 minutes after exercise.
   b) Rapid 1 minute after exercise.

The obtained results are used to calculate fitness index (FI) from the following formulas:

a) Slow method:

$$FI = \frac{\text{duration of exercise (in sec.) x 100}}{\text{sum of 3 HR measurements x 2}}$$

b) Rapid method:

$$FI = \frac{\text{duration of exercise (in sec.) x 100}}{\text{HR x 5.5}}$$

Results are graded as follows:

- Slow method:
  below 55 scores – low physical fitness
  55 – 64 – sufficient
  65 – 79 – average
  80 – 89 – good
  over 90 – excellent
- Rapid method:
  below 50 scores – low physical fitness
  50 – 80 – sufficient
  over 80 – good
  over 90 – excellent [1]

Recapitulation

Quarterly medical examinations performed in the Armed Forces units are no uniform. They are frequently limited to an analysis of the commission examination or medical examination, control of the inspection of validity of the tests in hyperbaric chamber, stay of aircrew in the Military Training and Fitness Center (WOSz-K) or execution of the commission recommendations.

An analysis of the available literature [2,3,4,5,6,11] also did not provided an uniform model of the aircrew quarterly medical examinations in the Armed Forces of the Republic of Poland. Enters into the Pilot Health Book (WLOP-zdr/8) may be

used as some guide. However, limitation of the quarterly medical examinations to the general medical examination and simple tests of the circulatory system.

Due to the fact that physical fitness plays an important role in the health status, one should know some of its parameters, which include physiological markers of cardiac functioning, oxygen transportation, respiration or body energy [7]. An increase in the physical fitness is determined by inborn and environmental factors. Level of physical fitness depends on both circulatory and respiratory systems efficiency. Constant development of the oxygen capacity as measured with VO_2max results in a simultaneous improvement in these systems functioning [10].

The best way to properly evaluate exercise level is HR measurement at the given load. To determine peak HR, the following formula is used: peak HR= 220 – age (in years). This formula is used only for healthy men, e.g. military pilots [2]. It seems that the tests evaluating elements of anaerobic capacity, using peak body exercise, so useful for evaluation of pilots' of high maneuverability aircrafts health, should not be used in the quarterly medical examinations carried out in the air bases [2,9].

Range of the proposed aircrew quarterly medical examinations considers basic knowledge and skills, which should have every member of the health care institution in the air unit.

Simple, easy, and safe range of the quarterly medical examinations is recommended by the authors as possible to carry out in each air unit and used to unify these examinations in the Armed Forces of the Republic of Poland.

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