RESPIRATORY AND CARDIOVASCULAR IMPAIRMENT RATING

OBJECTIVES FOR THE RESPIRATORY AND CARDIOVASCULAR IMPAIRMENT RATING SECTION

1. Define the four pulmonary functions that must be measured in order to determine a pulmonary impairment rating.

2. Know that the spirometric measurements and the D_{CO} measurement must conform to 1993 ATS standards.

3. Describe the use of arterial blood gas results in determining pulmonary impairment ratings.

4. Explain which situations require exercise capacity testing to determine pulmonary impairment.

5. Describe respiratory impairment rating for those diseases in which impairment is not directly related to lung function (asthma, hypersensitivity pneumonitis, pneumoconiosis, sleep disorders, and lung cancer).

6. Provide a correct pulmonary impairment rating given a case scenario.

7. List all 8 types of cardiovascular disease that can be rated using specific tables in Chapter 6.

8. Define the four functional classifications for cardiac disease found in Table 1, page 128.

9. List at least six elements of the history, physical, lab tests, or pathology that are needed to rate permanent impairment due to cardiovascular disease (in Tables 7 through 12, Chapter 6).

10. Explain how to estimate permanent impairment when a cardiovascular disease affects both cardiac output and causes arrhythmias.

RESPIRATORY AND CARDIOVASCULAR IMPAIRMENT RATING

INTRODUCTION

As with all of the "AMA Guides," the respiratory system and cardiovascular system chapters provide a reasonable starting point for impairment assessment and are meant only as a guide. In many instances, strict reliance on a set of tables of pulmonary function or of cardiovascular performance will provide a less than adequate assessment. Some occupational diseases, such as asthma, may wax and wane in severity, greatly complicating the determination of impairment. Others, like the pneumoconioses, cardiomyopathies, and valvular heart disease may continue to progress, leading to worsening impairment over time. Yet others, such as systemic arterial hypertension, may respond to specific medical interventions that require time to take effect before impairment estimates should be made. Sometimes radical changes in an individual's work environment are necessary to avoid further impairment, even when there is only a partial permanent impairment, as in individuals who become sensitized to a specific chemical. Confounding factors, such as the effect of cigarette smoking, must be taken into account. Under some circumstances both cardiac and respiratory disease are present. When this occurs, apply the Combined Values Chart (pp. 254-256).

RESPIRATORY SYSTEM IMPAIRMENT

Most schemes for assessing impairment due to respiratory disease incorporate some combination of: (1) pulmonary function test values, (2) pulmonary function test results as a percent of predicted normal values, and (3) respiratory symptom severity. The AMA Guides rely mainly on #2, and to some extent on #3. The principal components include: (1) medical history, (2) physical examination, (3) chest radiograph, and (4) measurements of pulmonary physiology, including spirometry, diffusing capacity (D_{CO}), and in some instances arterial blood gases and exercise testing.

Medical History and Physical Examination

The first obligation of the clinician is to establish or confirm the disease diagnosis. History and exam are important components, although the actual impairment rating is based mainly on the physiologic assessment discussed below.

Inquire about:

- Dyspnea (see "dyspnea scale," Table 1, Chapter 5 (p.116) estimation of severity)
- Cough/sputum
- Wheezing
- Environmental/occupational exposures
- Tobacco use
- Job chronology - including specific exposures to inhaled dust, fumes, gases, vapors
- Hobbies with such exposures

Physical examination should especially focus on both the cardiac and respiratory systems, as well as certain key peripheral signs:

- Breathing rate and pattern
- Lung sounds (e.g., wheezes, rales, rhonchi)
- Signs of cor pulmonale (e.g., increased P_2 component of S_2, tricuspid regurgitation, parasternal lift, jugular venous distention)
- Edema
- Cyanosis
- Clubbing

Chest Radiography

The chest radiograph is important in diagnosis and in assessing onset and progression of disease, but it correlates poorly with lung physiology in many circumstances. It also correlates poorly with an individual's ability to work.

The International Labor Organization (ILO) Classification of Radiographs of the Pneumonoconioses is a standardized system for the assessment of the severity of chest radiographs. By this system, qualified readers rate the extent of disease based on the profusion of interstitial lung opacities, size of masses, and extent of pleural reaction. It is not directly used in the estimation of impairment.

Physiologic Testing

Spirometry (FEV_1, FVC, FEV_1/FVC ratio) and diffusing capacity are the mainstays. Both studies must be performed in accordance with American Thoracic Society (ATS) standards (1993). Under some circumstances, arterial blood gases and exercise capacity testing are also warranted, as discussed below.

SIMPLE SPIROMETRY

It should be performed both pre- and post-bronchodilator. For purposes of estimating impairment, use the best effort obtained either pre- or post-bronchodilator.

Three pieces of data obtained from spirometry are used in estimating impairment:

1. Forced vital capacity (FVC)
2. Forced expiratory volume at 1 second (FEV_1)
3. FEV_1/FVC ratio

DIFFUSING CAPACITY OF CARBON MONOXIDE (D_{CO})

This is an indirect measure of pulmonary gas exchange and can be especially helpful in estimating impairment related to interstitial lung diseases. Although it is sometimes insensitive compared to more direct measurements of gas exchange during exercise, it is less invasive.

SIMPLE SPIROMETRY AND D_{CO} INTERPRETATION

In interpreting spirometry and D_{CO}, several generalizations can be made, although they are not inviolate:

- Obstructive diseases produce low FEV_1 and low FEV_1/FVC ratio. In asthma, D_{CO} is preserved; in emphysema it is decreased.

- "Restrictive diseases" (such as the pneumoconioses) produce a low FVC and low D_{CO}. FEV_1 and FEV_1/FVC ratio are normal.

- In the presence of significant emphysema, the FVC may appear low, because of lung hyperinflation (high residual volume is not measured by simple spirometry).

- Disorders that produce a "mixed" obstructive and restrictive pattern (such as hypersensitivity pneumonitis and some cases of pneumoconiosis) are difficult to interpret using spirometry alone, because the FEV_1 and FVC may both be low and ± D_{CO} low.

Applying Spirometry and D_{CO} in Estimation of Permanent Impairment

First, calculate the patient's percent predicted FEV_1, FVC, FEV_1/FVC ratio, and D_{CO} using the best observed value and applying normal values from Tables 2-5, Chapter 5. Note that there are different tables for men and women. You must know the patient's age and height (cm). For non-caucasian populations, predicted spirometry norms should be estimated at 0.9 of those shown in Tables 2-5.

Example

52 year old white male with asbestosis, 180 cm tall,
FEV_1 = 2.8 L, FVC = 3.2 L, D_{CO} = 24.4 ml/min/mm Hg

$$FVC : Apply\ Table\ 2 : \frac{3.2\ L\ (patient's\ best\ value)}{5.04\ L\ (predicted)}\ x\ 100 = 61\%$$

$$FEV_1 : Apply\ Table\ 4 : \frac{2.8\ L\ (patient's\ best\ value)}{3.99\ L\ (predicted)}\ x\ 100 = 70\%$$

$$FEVsub\ 1\ /FVC\ = \frac{2.8\ L}{3.2\ L} = 88\%$$

$$D_{CO} : Apply\ Table\ 6 : \frac{24.4\ ml/\min/mm\ Hg\ (patient's\ best\ value\ )}{36.6\ ml/\min/mm\ Hg\ (predicted)}\ x\ 100 = 67\%$$

In general, at least one of these four values must be abnormal to consider a person to have impairment. Exceptions do occur (e.g., some patients with interstitial lung disease have normal spirometry, normal D_{CO}, but abnormal gas exchange).

After calculating these values, estimate the percent impairment using Table 8, Chapter 5:

Example

Using the data above, this man with asbestosis has FVC and DCO between 60-79% of predicted. By Table 8, he would be considered in Class 2, Mild Impairment of the Whole Person, approximately 20%.

Exercise Capacity

Maximal exercise testing provides useful information about a patient's capacity to do work, and can help identify limitation due to respiratory or cardiovascular disease, or both. The AMA Guides do not specify a single protocol for such testing (e.g., cycle ergometer versus treadmill). The exercise testing result used to rate respiratory impairment is the work load achievable. It is expressed as the maximum oxygen consumption (VO_2 max) or as METS (see Table 2 in Chapter 6 -- Cardiovascular System). As a general rule, one MET = 3.5 ml/kg●min VO_2, approximately.

If the exercise test is performed with pre- and end-exercise arterial blood gases (preferably with an indwelling arterial catheter), important information about gas exchange can also be obtained. However, ABG determination is <u>not</u> part of the exercise capacity protocol outlined in the AMA Guides.

Not every patient with respiratory disease will require assessment of exercise capacity. <u>Indications</u> for exercise testing include:

1. dyspnea symptoms that are greater than spirometry or D_{CO} would indicate;

2. patient reports inability to perform specific job due to breathlessness;

3. submaximal or incorrect performance of spirometry or D_{CO}

<u>Contraindications</u> to the use of exercise testing for assessment of respiratory system impairment include:

1. severe impairment already found by spirometry and D_{CO}.

2. medical contraindications to exercise, such as heart disease, arrhythmias.

3. other physical limitations that preclude accurate testing.

Interpretation of Exercise Capacity Testing

The data derived should be interpreted by a physician with experience in exercise physiology, because results can be greatly affected by a patient's effort, metabolic state, level of conditioning, and by heart, lung, neurologic, neuromuscular, and orthopedic disorders.

See Table 8, Chapter 5. VO_2 max is utilized in that table's impairment scheme. A VO_2 max < 15 ml/kg●min is not a hard and fast criterion for severe impairment. It must be taken in context with other information about the patient's disease and other contributing diseases.

As a general rule, if working at his or her own pace, a person can work 8 hours a day if they do not exceed 40% of their VO_2 max as determined by exercise capacity testing.

Example

Our patient with asbestosis reports severe, "incapacitating" dyspnea on exertion which seems out of proportion to his spirometry and D_{CO}.

Exercise capacity testing shows good effort, normal cardiovascular response, and decreased exercise capacity. He was limited by ventilatory and gas exchange abnormalities, consistent with his underlying lung disease diagnosis.

The patient's maximum VO_2 was 15.9 ml/kg●min. (see Table 8). According to Table 8, Chapter 5, this exercise testing result would place him in Class 3 instead of Class 2, approximately 40% moderate impairment of the whole person. He presently works in "shipping and receiving" and is required to lift 20 to 50 pound boxes frequently during his work shift. He reports extreme dyspnea after 1-2 minutes of this activity.

Given a VO_2 max of 15.9 ml/kg●min, he achieves approximately 4.6 METS. Based on Table 2, Chapter 6, we estimate this to be in the range of METS seen in symptomatic patients and not in physically active individuals.

His current job requires him to work in excess of 40% of his predicted VO_2 max, making it unlikely that he is suitable for such strenuous work.

Arterial Blood Gas (ABG) Determination

ABGs can be measured both at rest and during maximal exercise. ABG determination, at rest, is not a routine part of the estimation of impairment. ABGs are not a standard part of the exercise capacity testing protocol in the AMA Guides. Its use is based on clinical judgment, and as such, is reserved for "selected cases," or if hypoxemia is "suspected." Because not all laboratories perform them accurately or reproducibly, the Guides require that you "document hypoxemia twice, 4 weeks apart," prior to using the data in estimating impairment. It makes no statement about the value of serial ABGs obtained during exercise testing, except to say that they can be performed if hypoxemia is suspected.

Interpretation of ABG

There is no normal "scale" provided for ABGs in the AMA Guides. The AMA Guides only state that ABGs indicate "severe impairment" when:

1. Resting pO_2 < 60 mm Hg on room air and the patient is stable on optimal therapy and has one or more of the secondary conditions related to hypoxemia. These secondary conditions include:
   - pulmonary hypertension
   - cor pulmonale
   - erythrocytosis
   - worsening hypoxemia during exercise

2. Resting pO_2 < 50 mm Hg on room air is by itself a criterion for severe impairment.

This is a problematic portion of the Guides, in that the Guides do not take into account the alveolar-arterial oxygen gradient $(A\text{-}a)DO_2$ and make no adjustment for altitude (even though the normal range for pO_2 is lower at Colorado's elevations). The normal range for pO_2 in Denver (5,280 feet) is 65-75 mm Hg.

Respiratory Impairment not Directly Related to Lung Function

"Certain respiratory conditions may cause impairment that is not readily quantifiable by spirometry, diffusing capacity, or measured exercise testing. Table 9 highlights these conditions, with some general comments. The evaluation of impairment of persons with these conditions should be done by physicians with expertise in lung disease, and the final impairment rating should be left to the physician's judgment.

"Note the specific comments in Table 9, Chapter 5 of the AMA Guides regarding:

1. Asthma
   - Assess when optimally treated
   - Use post-bronchodilator spirometry values
   - Three successive tests, at least one week apart
   - Note special Comments on employability

2. Hypersensitivity pneumonitis
   - Need to remove from exposure to causative agents to avoid recurrence and chronic disease

3. Pneumoconioses
   - May not cause impairment but usually requires removal from exposure to the dust that caused the condition

4. Sleep disorders
   - Sleep apnea can result in impairment through hypersomnolence, hypoxia, hemodynamic changes, or personality disorders
   - Use Combined Values Chart and criteria from Chapters 4, 6, and 14 of AMA Guides

5. Lung cancers
   - Consider severely impaired at time of diagnosis and as long as patient has the disease
   - If, at one year after diagnosis, patient is disease-free, then rate impairment according to physiologic parameters in Table 8
   - If recurrence, immediately consider patient severely impaired

6. Neurologic disorders
   - Although not mentioned in Chapter 5, respiratory impairment due to neurologic disorders is rated in accordance with Table 1, consciousness disturbances, p.109., Chapter 4, The Nervous System.

CARDIOVASCULAR SYSTEM IMPAIRMENT

Most methods of assessing impairment due to cardiovascular system disease incorporate a combination of: (1) assessing symptomatic limitation; (2) requirement for treatment; (3) objective measures, such as auscultation, electrocardiogram, exercising testing, echocardiography and, in some cases, cardiac catheterization and radioisotope studies. Chapter 6 of the AMA Guides emphasizes which of the various tests are required to determine impairment, by specific cardiovascular disease category. Impairment rating of the cardiovascular system requires familiarity with functional classifications.

Symptomatic Limitation

Familiarity with the system outlined in Table 1, Chapter 6, page 128 is essential for the appropriate estimation of cardiovascular disease impairment. Understand how the cardiovascular disease affects ordinary daily activities and heavy physical exertion. Careful history taking must focus not only on the symptoms themselves but how they affect an individual's level of activity. All of the cardiac diagnostic rating subsections are divided into four similar impairment classes. Below are descriptions of the general activity limitation for most subsections:

Class I:	0-10%	asymptomatic during normal activities or with moderately heavy physical activities.
Class II:	15-25%	asymptomatic during normal activities, but some limitation in heavy physical exertion.
Class III:	30-50%	symptomatic during normal activities.
Class IV:	55-100%	normal activities are significantly limited and at rest symptoms may occur.

Exercise Testing

Exercise testing is the preferred method of quantifying most limitations due to cardiovascular disease. In certain cardiovascular diseases, other forms of quantitative assessment will be used in lieu of, or in addition to, exercise testing (example: angiography in the assessment of coronary artery disease).

Most exercise protocols call for the use of a treadmill and estimate work load in multiples of resting metabolic energy utilized for a given activity (MET). One MET is considered to be equal to 3.5 ml/(kg●min.).

See Table 2 (page 129) for the relationship of METS and functional class using the treadmill protocols.

See Table 3 (page 130) for the relationship of METS and functional class using a more simplified two-step protocol (for use when treadmill is not available).

Table 4 (page 130) demonstrates the METS using a bicycle ergometry version of the exercise test.

Most assessments will be made using a treadmill. However, cycle ergometry or the step test are also acceptable for quantitation. Under ideal circumstances, a laboratory that is equipped to measure oxygen consumption gives the most accurate information about the patient's exercise capability.

Exercise studies are useful, but it is important that the physician estimate the patient's cooperativeness and ability to exercise. Note that when patients are taking beta adrenergic blocking agents, METS should be used in place of the target heart rates found in Table 6, page 135.

Other Forms of Cardiovascular Assessment

Depending upon the type of cardiac disease being assessed, a variety of other investigative tools may prove helpful in objectively defining the extent of disease and hence rating impairment in conjunction with symptoms (functional classification). See the individual sections of Chapter 6 for details concerning the appropriateness of such tests for estimating impairment.

The Guides clearly state that tests such as echocardiography, angiography and radioisotope studies usually should not be ordered only for the purposes of rating impairment, but can contribute to the impairment rating when they are being performed for clinical diagnosis and management. The impairment rating should not

drive physicians to perform expensive and sometimes invasive cardiovascular testing simply for the purpose of estimating impairment.

Level of Treatment

The need for chronic treatment, drug therapy, diet control and other treatment regimes are determining factors for classification and should be well described. If surgery is appropriate for the diagnosis, this will usually be included in the classification description. An impairment rating cannot be determined for many of these diagnoses until all treatment regimes (drug or surgery) have received adequate trials.

Categories of Cardiovascular Disease

The following table lists the categories of cardiovascular disease for which evaluation of permanent impairment may be required:

VALUATION OF PERMANENT IMPAIRMENT OF CARDIOVASCULAR SYSTEM

	Table In AMA Guides	Chapter	Page in Guides
AMA Cardiac Disease			
Valvular Heart Disease	5	6	133
Coronary Heart Disease	7	6	137
Congenital Heart Disease	8	6	141
Hypertensive Cardiovascular Disease	9	6	145
Cardiomyopathies	10	6	148
Pericardial Heart Disease	11	6	149
Arrhythmias	12	6	152
Vascular Disease of the Extremities*	16	3(upper)	47
	52	3(lower)	79

* These tables and page numbers are correct. There is an error in text of Chapter 6.

Review section 6.1 through 6.8, which contain good, self-explanatory case examples and complete tables.

In many cases, diagnostic categories may overlap. For instance, a patient may have coronary artery disease, hypertension and arrhythmias. When this occurs, each area

should be rated separately and then combined using the Combined Values Chart. Patients who have renal damage or cerebral damage secondary to hypertension should receive ratings in the appropriate sections and have these ratings combined with the hypertensive rating.

Hypertensive Cardiovascular Disease

Transient elevations of arterial pressure are not sufficient to determine impairment. Sustained elevated pressure (on several occasions with diastolic pressure greater than 90 mm Hg) is required.

Evaluation should focus on the target organ effects produced by sustained elevations of blood pressure (such as aortic dissection, central nervous system, and renal injury).

Identify treatable causes of hypertension, such as coarctation, renal artery obstruction, Cushing's disease, endocrine disorders, etc...

Cardiomyopathies

Some cardiomyopathies are reversible. Allow adequate period of time before estimating permanent impairment.

Pericardial Heart Disease

Some cases of inflammatory pericardial disease completely or partially reverse. Allow sufficient time for patient recovery before assessing impairment.

Vascular Disease Affecting the Extremities

These disorders are dealt with only very briefly in the AMA Guides. Permanent impairment of the peripheral vascular system can result from:

1) Diseases of arteries reducing blood flow and producing claudication, trophic changes, ulceration, gangrene, Raynaud's phenomenon, or even loss of an extremity;
2) Diseases of veins producing pain, edema, stasis dermatitis, ulceration; and

3) Disorders of lymphatics, leading to lymphedema, sometimes complicated by infection.

A specific diagnosis of vascular disease should be established prior to evaluating impairment.

Estimation of impairment depends upon severity and extent of lesions rather than on diagnosis.

Upper extremity ratings are determined from Table 16, page 47, and lower extremity ratings from Table 52, page 79.

This page holds the place for an article from the American Thoracic Society, *"Guidelines for the Evaluation of Impairment/Disability in Patients with Asthma"*

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