A Clinical Decision Making Framework For the Medically Compromised Patient: Ischemic Heart Disease and Chronic Obstructive Pulmonary Disease

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ABSTRACT

The intent of this article is to assist dentists and their staff in the assessment of systemic disease, and establish a framework for clinical decision making that correlates medical risk with the anticipated complexity of the planned dental procedures. Two examples of systemic disease, ischemic heart disease (IHD) and chronic obstructive pulmonary disease (COPD), are discussed in terms of pathophysiology, risk factors, clinical manifestations of disease and disease progression.

SOMMAIRE

Cet article a pour objet d’aider les dentistes et leur personnel dans l’évaluation des maladies systématiques et d’établir, pour la prise de décision clinique, un cadre de corrélation entre le risque et la complexité anticipée des procédés prévus au plan de traitement dentaire. On y examine deux maladies systémiques, la cardiopathie ischémique (CPI) et les maladies pulmonaires obstructives chroniques (MPOC) du point de vue de la pathophysiologie, des facteurs de risque, des manifestations cliniques et de la progression de la maladie.

Strategic Reserve, Systemic Illness and Loss Of Strategic Reserve

Human organ systems have the adaptive capacity to respond to internal and external stresses. Each system has a finite reserve. Once this reserve is exhausted, the failure of the system is imminent.

In the medically-compromised patient, the reserve available to the organ diminishes as a function of chronic disease, and the patient’s ability to “rise to the occasion” decreases. As a result, the patient is less capable of dealing with stress and more likely to suffer a medical crisis in the dental chair.

A scale of 1 to 4 is proposed to classify systemic disease. The first category, known as stage “1,” includes minor diseases that have a minimal impact on the patient’s reserve and a very small impact on his or her lifestyle. This category represents the lowest level of “risk” for systemic complications. At the other extreme, the stage “4” category represents severe disease resulting in a significant compromise of the patient’s reserve and lifestyle, and serious risk for acute decompensation (crisis or medical emergency).

Ischemic Heart Disease (IHD)

Pathology

Ischemic heart disease is one manifestation of atherosclerosis, a more generalized disease. As atherosclerotic heart disease progresses, the cross-sectional diameter of the coronary arteries decrease as deposits of atherosclerotic material increase. This results in an overall decrease in the vessels’ ability to deliver blood (including oxygen) to the working myocardium.

Risk factors

The likelihood that atherosclerotic heart disease and subsequent myocardial ischemic disease will occur increases when a number of risk factors that can be identified in the medical history are present. These factors include: gender (the condition is more prevalent among males), age, smoking, strong family history, high cholesterol (high LDLs/low HDLs), diabetes,
Table I
Disease Classification by Clinical Symptomatology: Ischemic Heart Disease

<table>
<thead>
<tr>
<th>Class 1</th>
<th>Class 2</th>
<th>Class 3</th>
<th>Class 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angina with strenuous</td>
<td>Angina with moderate</td>
<td>Angina at rest or unstable</td>
<td></td>
</tr>
<tr>
<td>exertion or</td>
<td>exertion*</td>
<td>angina or unstable</td>
<td>MI &lt; 6 months</td>
</tr>
<tr>
<td>MI &gt; 6 months</td>
<td></td>
<td>or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Walking two blocks or more or climbing more</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>than one flight of stairs.</td>
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</tbody>
</table>

** Walking two blocks or less or climbing one flight of stairs or less.

Table II
Disease Classification by Pharmacology: Ischemic Heart Disease

<table>
<thead>
<tr>
<th>Class 1</th>
<th>Vasodilator as needed</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 2</td>
<td>Plus one anti-anginal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class 3</td>
<td>Plus two anti-anginals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class 4</td>
<td>Plus three anti-anginals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examples</td>
<td>Nitroglycerine</td>
<td>Nitroglycerin, Isordil, Nitropaste</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Beta-Blockers: Propranolol, Labetolol,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Timolol</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Calcium channel blockers: Diltiazem,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nifedipine, Verapamil</td>
<td></td>
</tr>
</tbody>
</table>

Clinical Manifestations
There are two principal clinical manifestations of IHD, both of which are directly related to oxygen deprivation of the myocardium:

Angina: Momentary, reversible, ischemia results in angina or chest pain. The pain is usually brought on by exertion and is typically described as a crushing pressure in the centre of the chest with possible radiation to the left arm and/or jaw. The ischemic episode, and therefore the anginal pain, usually resolve if the patient stops exerting him or herself, rests and/or takes nitroglycerine. Angina is a symptom of the underlying problem: compromised blood flow in the heart due to IHD. In general terms, the amount of exertion necessary to precipitate an anginal episode decreases as the severity of IHD increases. An increase in the frequency of angina or a decrease in the amount of exertion necessary to precipitate angina is considered unstable angina. Therefore, a clear description of the nature, frequency, duration and precipitating factors of angina should be obtained from the patient’s medical history to help characterize the severity of the underlying disease (and thus, help in the assessment of risk). As the underlying disease worsens, physicians typically prescribe additional drugs to help the patient cope with the resulting angina. Worsening angina and the multiplication of anti-anginal medications are a reflection of more severe ischemia and, therefore, surgical risk.

Myocardial Infarction (MI): Severe, sustained ischemia brought on by thrombus formation in a chronically-clogged coronary artery results in irreversible ischemic or hypoxic damage to heart muscle cells. Nomenklatura myocardial infarction, this process results in the death of the muscle. If it is accompanied by significant electrical disturbances (for example ventricular fibrillation), the patient may have cardiac arrest and die. Even when MI is not accompanied by cardiac arrest, the patient will often experience crushing chest pain or pressure that is not relieved by rest or nitroglycerine. In the short term, this results in a damaged myocardium that is susceptible to reinfarction. Elective surgery should be delayed for six months if a patient has experienced an MI. This allows the damaged myocardium to heal, and minimizes the risk of reinfarction to five per cent or less per year. If surgery is performed within six months of an MI, the risk of reinfarction increases significantly (11-30 per cent per year). In the chronic situation, infarcted areas of the myocardium heal by scarring, which decreases the efficiency of the heart’s pumping ability. If this scarring is severe, it can lead to congestive heart failure.

Classification of Severity
Disease classification by clinical symptomatology
The patient’s strategic reserve diminishes as the stress required to induce angina decreases. This is a reflection of the underlying worsening of the disease state, or a pathological deviation from normalcy (Table I).

Disease classification by complexity of pharmacology
Physicians use a staged or stair-stepped approach in the pharmacological management of some diseases. As the disease state worsens, the number of drugs used tends to increase. It is usually possible to identify the patient’s medical diagnosis, and how advanced his or her condition is, by conducting a careful analysis of the list of drugs used by the physician (Table II).

Determining the patient’s cardiac history for angina or myocardial infarction, in conjunction with an analysis of his or her drug history, allows the relative severity of the underlying disease to be assessed.
Table III
Disease Classification by Clinical Symptomatology: COPD

<table>
<thead>
<tr>
<th>Class 1</th>
<th>Class 2</th>
<th>Class 3</th>
<th>Class 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>COPD:</td>
<td>SOBOE* with moderate exertion or occasional dry cough</td>
<td>SOBOE with minimal exertion or chronic dry cough</td>
<td>SOBOE with normal activity or chronic productive cough</td>
</tr>
</tbody>
</table>

* Shortness of breath on exertion

Table IV:
Disease Classification by Complexity Of Pharmacology: COPD

Class 1: Bronchodilator (Ventolin puff) as needed
Class 2: Two or more puffers (Ventolin, Atrovent, Beclovent)
Class 3: Two or more puffers and systemic steroids (prednisone)
Class 4: Two or more puffers, steroids and home oxygen

Table V:
Classification of Procedural Stress

Level 1: Denture adjustments, examinations or radiographs, etc.
Level 2: Scaling/root planing, simple restorations, extractions or impressions
Level 3: Lengthy crown and bridge procedures, complex extractions, etc.
Level 4: Difficult impactions, trauma surgery, etc.

As noted, an increase in the severity of symptoms or an increase in the complexity of their pharmacological management indicate an increased risk of cardiac problems.

Chronic Obstructive Pulmonary Disease

Pathology
Chronic Obstructive Pulmonary Disease (COPD) is usually a combination of two clinical entities: chronic bronchitis and emphysema. Chronic bronchitis is a persistent irritation of the bronchial tree, or conducting airways, which results in an accumulation of thickened secretions, a decreased ability to clear these secretions, and a more or less persistent infection of the smaller conducting airways. The subsequent irritation stimulates coughing, as the body attempts to clear the accumulated secretions and relieve the relative obstruction to airflow to and from the exchange airways (the alveoli). Clinically, chronic bronchitis is defined as a chronic cough with daily sputum production for three months in two consecutive years.

Emphysema is largely a problem of the exchange airways, leading to the progressive destruction of the septa or walls between alveoli. This results in fewer alveoli, with much larger volumes and decreased surface areas. The decrease in surface area greatly decreases the efficiency of gas exchange at the capillary level. Further, the loss of support between the alveoli makes them more susceptible to collapse, resulting in a further physical obstruction to airflow. The combined result of chronic bronchitis and emphysema is a progressive obstruction to airflow, accumulation of secretions, chronic cough, and decreased efficiency of gas exchange.

Risk factors
The risk factors for COPD include: cigarette smoking, environmental exposure to pollutants, and heredity (alpha-1 antitrypsin deficiency).

Clinical manifestations
The typical COPD patient has shortness of breath on exertion (SOBOE) ... diminished reserve, chronic cough and wheezing. The shortness of breath is due to the inefficiency of gas exchange at both the conducting airway level and the alveolar level; the chronic cough is due to secretions, combined with chronic inflammation and the loss of mucociliary function; and the wheeze is due to an increased airflow resistance, which is caused by the chronically inflamed and constricted bronchioles. As the disease worsens, each symptom worsens and the patient's exercise tolerance diminishes. The patient's strategic reserve also decreases, making it more likely that the superimposition of an acute respiratory tract infection (such as a cold, flu or pneumonia) will precipitate decompensation and failure (Tables III and IV).

Reviewing the patient’s clinical respiratory symptomatology and drug history allows the clinician to assess the patient's respiratory reserve and, hence, his or her ability to cope with the stresses of dental procedures.

Although there are more sophisticated classifications of cardiac disease, pulmonary disease and
operative risk, these classifications rely on technology such as EKG, stress testing, angiography, pulmonary function tests and radionuclide studies that are not readily available to a general community dentist. The classification presented in this paper is intended to be a rough guide for assessment and initial decision making. Once a concern is identified, significant questions regarding the patient's medical status should be referred to his or her physician or specialist.

Procedural Stress

From a systemic point of view, each procedure we do places a certain level of stress on the patient. Simple procedures such as denture adjustments, examinations or radiographs involve minimal stress. More complex procedures such as scaling or root planing, simple restorations or impressions involve increased stress, and put greater levels of demand on the system. Still more complex procedures such as lengthened crown and bridge appointments or extractions are increasingly stressful. Finally, complicated surgery such as difficult impactions, trauma surgery or orthognathic surgery carry even greater levels of stress, and pose a greater threat to the patient. Because the threat that any given procedure poses to a patient may be magnified as a function of patient anxiety, this factor must also be taken into the equation. In general, a simple categorization of stress levels can be applied to given procedures (Table V).

Determination Of Relative Risk and Treatment Planning

Once the severity of the patient's disease and the anticipated stress of the proposed procedure have been assessed, the relative risk of a given procedure for a given patient can be determined. The patient's residual strategic reserve is related to the threat to his or her system that the procedure represents. When procedural "threat," "stress," or "complexity" exceeds the patient's ability to handle the situation, we are faced with the potential for medical crisis. A careful assessment of risk allows the clinician to avoid precipitating medical emergencies.
Fig. 1: Correlation of medical compromise with procedural stress: a grid system is used to plot the severity of the patient's medical problems (horizontal axis) against the anticipated stress of the proposed procedure (vertical axis). The point at which these two intersect will fall within the comfort, caution or danger zones of the practitioner.

It is possible to relate disease severity to procedural stress using a graphic method (Fig. 1). The horizontal axis of Fig. 1 represents disease severity from 0 to 4 and the vertical axis represents procedural stress from 0 to 4. Each clinician has their own comfort, caution and danger zones, which can be superimposed on this grid. A given practitioner's comfort zone will be based on his or her:
1. Training and experience with the proposed procedure;
2. Familiarity with the systemic disease and its implications;
3. Procedural complexity;
4. Disease severity;
5. Facilities and equipment available;
6. Urgency or emergency of the proposed treatment.

The more experienced the clinician, the more efficiently he or she is likely to complete a procedure on the ill patient. Also, urgent procedures require the acceptance of greater risk than elective procedures.

Through this assessment, practitioners can determine who can safely be treated in an office setting, who should be seen on specialty consultation, and who should be referred for hospital management.

Summary
This paper has sought:
1. To define disease as a loss of reserve;
2. To place disease stage on a continuum from mild to severe;
3. To correlate disease progression and medical risk using the examples of ischemic heart disease and chronic obstructive pulmonary disease;
4. To correlate medical risk to procedural complexity;
5. To produce a graphic representation of these correlations;
6. To express the relative risk in terms of the practitioner's "comfort zone";
7. To allow the practitioner to use risk assessment as a treatment planning tool, so that he or she stays within the reserve boundaries of the patient and his or her own ability to respond to a medical crisis.

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References