



Guide of Internet Sites for the Study of Cardiology

Luciana Aikawa, Denise Cássia Moreira Zornoff, Beatriz Bojikian Matsubara
Botucatu, SP - Brazil

Objective

To increase the offer of didactic resources for medical students, physicians, and health care professionals, stimulating the use of the Internet for academic purposes or cardiological updating.

Method

Electronic addresses with academic content in the areas of anatomy, biophysics, physiology, semiology, electrocardiography, and image diagnosis were researched and selected. The selection criteria included the following: relevance of the content, neatness of presentation, and richness of animation resources. The sites obtained were classified in regard to their contents and academic level.

Results

The sites obtained were as follows: 5 sites of anatomy and anatomical pathology, one of biophysics, 3 of physiology, 8 of semiology, 7 of image diagnosis, and 2 of electrocardiography. The sites were also organized according to academic level to provide an alternative access. The set of addresses resulted in a simplified and hierarchic guide of contents for the study of cardiac morphology and image diagnosis in cardiology.

Conclusion

The resulting list of sites is an example of the potential of the Internet as a learning instrument to be used in association with other conventional pedagogical methods.

Key words

medical education, health education, cardiology, medical informatics, Internet

The technological revolution has allowed for changes in the process of teaching and learning ¹. This binomial is no longer centered on the teacher's figure as the source of knowledge, but is beginning to focus on the learner as an active agent of his own academic formation.

Of the new pedagogical instruments available, the Internet deserves to be highlighted, because of the popularization of its use and richness of content. In the university environment, its possibilities of application are unlimited, encompassing the rapid access to information, increase in the number of didactic references, possibility of simulation of real professional situations, and active interactive search for new knowledge. Research from the Institute of Educational Studies in Canada showed that learners adopt a more active attitude as they have access to electronic books, on-line articles of journals, interactive exercises, discussion panels, and videos ².

Thus, our institution has been encouraging the use of technology as a complementary pedagogical resource in the formation of its students. For this, we count on a long-distance learning nucleus to support the faculty and students, concentrating and multiplying the initiatives and resources in this area.

For this initiative to be successful, the development of academic projects is necessary to benefit a large number of students, teachers, and health care professionals. Following this line of thought, we assumed that a study in cardiology would have a significant impact on that population providing an incentive for using the Internet in their daily academic or professional lives.

The high incidence and prevalence of cardiovascular diseases and the great technological development in cardiology made that specialty attractive to medical students. In addition, cardiology may be understood as a multidisciplinary area of health care, whose process of learning requires interaction with sound, movement, graphics, and images, which may be particularly explored with Internet resources.

Finally, it is worth stressing that the recommendation of that technology is not done with the intention of replacing traditional didactic techniques. On the contrary, this is a resource to enrich the teaching-learning process, because it allows the combination of technological tools and traditional methods ³.

This study aimed at elaborating a study guide in cardiology for medical students, professors, physicians, and health care professionals, providing ease of access to information, and the use of the Internet as an academic tool.

Methods

The research of electronic addresses was performed by using the Google search engine, chosen due to its broad database, which has already exceeded 3 billion addresses ⁴, and to its valo-



rization of the official and governmental sites ⁴. In addition, this search engine composes its list of results using its own database and the so-called URLs (uniform resource locators) ^{4,5}. In a search performed using the search engine Showdown, Google was the "searcher" that found the greatest number of electronic addresses related to 25 proposed keywords ⁶.

Google has the pagerank system that interprets a link of one page with another as a vote. The more votes one page has, the greater its importance and the better its ranking in a search, ie, it will be placed among the first sites on the list ⁷.

The keywords used in this study were as follows: "cardiac anatomy," "heart anatomy," "cardiac physiology," "heart physiology," "cardiac semiology," "heart semiology," "electrocardiogram," and their corresponding Portuguese terms.

The initial selection of the Internet pages was performed by the medical student, and the final decision about the most appropriate electronic addresses involved the combined assessment of the student, the cardiology faculty, and the physician with experience in teaching via an electronic medium.

The great themes established were as follows: anatomy and anatomical pathology, biophysics, physiology, semiology, image diagnosis, and electrocardiography.

Within the pre-established themes, those with the greatest visual impact and objectivity of information in the support of the fundamental concepts in cardiology were included in the guide. The addresses with redundant contents and those requiring conditional registration were excluded. Although aware of the academic value of sites with scientific journals, discussions of clinical cases, and collections of consensus and guidelines in cardiology, those were not objects of our study.

Results

This study was carried out from May to September 2003. Of the 16,420 electronic addresses provided by Google, 640 were

visited because their description was compatible with the objective of our study. After one first evaluation, 65 met our selection criteria and were submitted to a faculty member. At the end, 26 electronic addresses containing files of text, images, animation, videos, and sound were selected and organized to provide a study guide.

The sites obtained were as follows: 5 sites of anatomy and anatomical pathology, one of biophysics, 3 of physiology, 8 of semiology, 7 of image diagnosis, and 2 of electrocardiography.

The guide of the sites followed a sequence of complexity, considering aspects of anatomy, biophysics, physiology, semiology, image diagnosis, and electrocardiography. For such, the electronic addresses were presented in the form of one or more links that conduct the reader directly to the suggested content, considering that many electronic addresses comprise several aspects in cardiology. The sites were also classified according to the academic level of the user, so that an alternative sequence of access to the site was provided.

The results are shown in tables I to III. Tables I and II list the electronic addresses according to their contents, and table III classifies the sites according to their academic level.

Discussion

This guide was limited to a few pages to provide pertinent, comprehensive, and objective didactic material.

When accessing the electronic addresses, the user will find materials of varied complexity, from the simplest to the most elaborate, which are useful for learning purposes or for updating in cardiology, in addition to being available for a larger target population.

The reader will note that this guide emphasizes the anatomic aspects of the heart, both from the clinical and image diagnosis views. This approach was based on the assumption that the topic would be more attractive to users due to its applicability to clinical practice.

Table I - Classification of the electronic addresses according to content. Part I

Table I - Classification of the electronic addresses according to content. Part I	
Anatomy and anatomical pathology	<ul style="list-style-type: none"> • Interactive cardiac anatomy - <i>Heart Anatomy: Interior View</i>: interactive system of cardiac structures; self-evaluation at the link "Test Yourself". Idiom: English. Available at: <http://www.gwc.maricopa.edu/class/bio202/cyberheart/hartint0.htm> • Cardiac anatomy - <i>Yale University School of Medicine</i>: collection of 3D cardiothoracic anatomical images, with radiological, tomographic, scintigraphic and echocardiographic correlations, in addition to some animations and videos. Idiom: English. Available at: <http://info.med.yale.edu/intmed/cardio/imaging/anatomy/anatomy_lightbox/index.html> • Anatomical pathology of the circulatory system - <i>Anatomic Pathology of UNICAMP</i>: images of anatomical specimens of the heart and circulatory system, some of which accompanied by pictures of histological sections. Idiom: Portuguese. Available at: <http://www.fcm.unicamp.br/departamentos/anatomia/pecascard.html> • Animations of cardiac anatomy - <i>Nemours Cardiac Center</i>: animations of normal and pathological cardiac anatomy. Idiom: English. Available at: http://www.nemours.org/no/ncc/cardiac/crd1519.html> • Cardiovascular pathology - <i>The Internet Pathology Laboratory of Medical Education</i>: pictures of anatomical specimens, draws, radiographs, and histological sections of normal and pathological hearts. Idiom: English. Available at: <http://medstat.med.utah.edu/WebPath/CVHTML/CVIDX.html#2>
Biophysics	<ul style="list-style-type: none"> • Cardiothoracic imaging techniques - <i>Yale University School of Medicine</i>: description of the techniques of radiography, computed tomography, scintigraphy, nuclear magnetic resonance imaging, echocardiography, and others; provides images, animations, comments, and notes. Idiom: English. Available at: <http://info.med.yale.edu/intmed/cardio/imaging/techniques/techniques_lightbox/index.html>
Physiology	<ul style="list-style-type: none"> • Cardiac physiology - <i>UNIFESP Virtual</i>: illustrated text about cardiac physiology, comprising excitability, conductivity, contractility and cardiac performance. Idiom: Portuguese. Available at: <http://www.virtual.epm.br/material/tis/curr-bio/trab2000/cardiovasc/cardio1.htm> • HyperHeart - <i>Knowledge Weavers</i>: contains animations of the heart beat with a graph of the simultaneous behavior of the ventricular pressure and volume throughout time, ECG, and cardiac sounds. Idiom: English. (requires installation of the Shockwave™). Available at: <http://www-medlib.med.utah.edu/kw/pharm/hyper_heart1.html> • Cardiovascular system - <i>Human anatomy and physiology</i>: illustrated text with basic information about the cardiocirculatory system, electrocardiography, and cardiac disorders. Idiom: Portuguese. Available at: <http://www.afh.bio.br/basicos/Cardio1.htm>

Table II - Classification of the electronic addresses according to content. Part II

Semiology
<ul style="list-style-type: none"> • Cardiac examination - <i>Cyber Anatomy Tutorials</i>: chapter on cardiac examination in the form of a tutorial on the physical examination of the thorax. Idiom: English. Available at: <http://anatomy.ncl.ac.uk/tutorials/chest/text/page10.html> • Examination of the heart - <i>University of California, San Diego</i>: physical examination with pictures of patients and anatomical specimens (in the links), with indication of some structures and cardiac auscultation foci. Idiom: English. Available at: <http://medicine.ucsd.edu/clinicalmed/heart.htm> • Cardiovascular physical examination - <i>Hospital Universitário Prof Polydoro Ernani de São Thiago; Universidade Federal de Santa Catarina</i>: study guide and lessons about several topics in cardiology, including blood pressure, cardiac cycle, arterial pulse, venous pulse, and cardiac auscultation. Idiom: Portuguese. Available at: <http://hu.ufsc.br/~cardiologia/> • Normal cardiac cycle and its semiology - <i>Manuais de Cardiologia</i>: chapter on cardiac semiology with cardiac sounds, venous and arterial pulses, murmurs, clicks and sounds of the mitral valve. Idiom: Portuguese. Available at: <http://www.manuaisdecardiologia.com/> • The stethoscope and information on auscultation - <i>3M United States</i>: cardiac sounds in mp3, wav and aif files (link "Heart Sounds"), description of the sites and drawings of the auscultation foci (link "Techniques"); detailed description of the stethoscope (link "Stethoscope Anatomy") and additional information on the stethoscope (links "Short vs long tubing" and "Differences in acoustics"). Idiom: English. Available at: <http://www.3m.com/us/healthcare/professionals/littmann/jhtml/education.jhtml> • Simulation of cardiac excitation - <i>Universitätsklinikum Hamburg-Eppendorf</i>: collection of images and computed animations of the heart illustrating cardiac depolarization developed based on the "Projeto Humano Visível" (http://www.nlm.nih.gov/research/visible/vhp_conf/vhpconf.htm). Idiom: English. Available at: <http://www.uke.uni-hamburg.de/institute/imdm/idv/forschung/excitation/> • Cardiac sounds - <i>CADI (Cardiac Auscultation Diagnosis Instruction). The University of Chicago</i>: illustrated text and files with sounds in normal situations in the mitral, tricuspid, aortic, and pulmonary valves and in mitral stenosis. Idiom: English. Available at: <http://people.cs.uchicago.edu/~fensterm/CADI/heart-sounds.html> • Tutorial on cardiac sounds - <i>Blaufuss</i>: the button "Start tutorial" initiates with concepts of normal cardiac anatomy and physiology, passing to changes in pulse inspection, and to auscultation in pathological situations. The button "Heart Sounds Quiz" is an interactive program about cardiac auscultation. Idiom: English. (requires installation of the Flash Player™). Available at: <http://www.blaufuss.org/tutorial/#>
Image diagnosis
<ul style="list-style-type: none"> • Cardiac radiological anatomy - <i>Virtual Hospital</i>: anatomical and radiographic correlations of the heart in anteroposterior (AP) and lateral views, with indications of the structures. Idiom: English. Available at: <http://www.vh.org/adult/provider/radiology/icmrad/chest/parts/PACardiac.html> and <http://www.vh.org/adult/provider/radiology/icmrad/chest/parts/LateralCardiac.html> • Cardiothoracic atlas - <i>University of Arkansas for Medical Science</i>: pictures of anatomical structures, and magnetic resonance imaging and radiographies with colored contours of some structures. Idiom: English. Available at: <http://anatomy.uams.edu/htmlpages/anatomyhtml/gross_atlas.html> • Echocardiographic atlas - <i>Yale University School of Medicine</i>: correlation between anatomy and the normal and pathological echocardiogram of the heart with animations and indications of structures. Idiom: English. Available at: <http://info.med.yale.edu/intmed/cardio/echo_atlas/contents/> • Discussion of Radiological Cases - <i>Yale University School of Medicine</i>: radiological case series, some cases with tomographic and magnetic resonance correlation. Idiom: English. Available at: <http://info.med.yale.edu/intmed/cardio/imaging/cases/normal_female_1/index.html> • Angiographic images of the heart - <i>Yale University School of Medicine</i>: illustrated texts and videos of angiographies of pathological coronary arteries. Idiom: English. Available at: <http://info.med.yale.edu/intmed/cardio/imaging/findings/coronary_stenosis/index.html> and <http://info.med.yale.edu/intmed/cardio/imaging/findings/coronary_clot/index.html> • Radiological images of the heart - <i>Yale University School of Medicine</i>: radiographies, nuclear magnetic resonance imaging, and echocardiographic images; indications of the major structures, comments and notes. Idiom: English. Available at: <http://info.med.yale.edu/intmed/cardio/imaging/contents.html> • Cardiothoracic radiographies - <i>Nicks Image Base xray2000 Version 5</i>: series of chest radiographies, with normal and pathological examples. Idiom: English. Available at: <http://www.xray2000.f9.co.uk/ibase3/chest2/ALBUM1.HTML>
Electrocardiography
<ul style="list-style-type: none"> • Electrocardiographic leads and learning center for ECG - <i>Site Knowledge Weavers</i>: electrocardiographic leads and course of electrocardiography in 12 illustrated lessons. Notions range from basic to advanced with self-evaluation tests. Idiom: English. Available at: <http://medstat.med.utah.edu/kw/ecg/animations/ecg.html> and <http://medstat.med.utah.edu/kw/ecg/> • Electrocardiography - <i>Site Hospital Universitário Prof Polydoro Ernani de São Thiago</i>: notions and basis of the method (in slides) and examples of normal and altered tracings. Idiom: Portuguese. Available at: <http://www.hu.ufsc.br/%7Ecardiologia/ecgcases.htm> and <http://www.hu.ufsc.br/%7Ecardiologia/fundaecg.ppt>

A classification of the electronic addresses according to academic levels, with stratification of priorities, is also provided, constituting another attraction for the user. However, the division is not strict, considering that the medical schools adopt different curricula. In addition, the more advanced students, residents, and clinical professionals should be encouraged to access the electronic addresses classified in all levels to update their knowledge.

One single electronic address may provide several alternatives of content, making navigation easier for less experienced users. However, the formulation presented allows variations according to the user's interest.

One possible limitation of this guide is the small number of pages with texts in Portuguese. Although high-quality Brazilian sites exist, this type of didactic material is not very developed or diffused among us. Thus, until this deficiency is solved, foreign material should be used. Another limitation of this instrument is the characteristic of great mutability of the Internet pages over

time, hindering an accurate reproducibility of the guide. In addition, the lack of maintenance of the sites may lead to inactivation of the links, preventing access to the page indicated. Therefore, the user should be aware of modifications in the content of the electronic addresses listed in this guide.

It should be emphasized that the address list here presented is extremely short compared with the number of sites available on the Internet. The reader should be encouraged to search other sites after using the present guide. Finally, it is worth noting that this guide does not replace the reading of the classical medical books or specific scientific journals. On the contrary, the reading of those books should be encouraged, because they provide the required details for the basic learning of cardiology. The greatest advantage of the Internet is its dynamic, visual and objective, character, which may facilitate the understanding of the knowledge acquired through traditional study.



Table III - Classification of the electronic addresses according to academic level

Table III - Classification of the electronic addresses according to academic level
First year
<ul style="list-style-type: none"> Interactive cardiac anatomy http://www.gwc.maricopa.edu/class/bio202/cyberheart/hartint0.htm Techniques of Cardiothoracic Imaging http://info.med.yale.edu/intmed/cardio/imaging/techniques/techniques_lightbox/index.html
Second year
<ul style="list-style-type: none"> Cardiac anatomy http://info.med.yale.edu/intmed/cardio/imaging/anatomy/anatomy_lightbox/index.html Heart examination http://medicine.ucsd.edu/clinicalmed/heart.htm Cardiac physiology http://www.virtual.epm.br/material/tis/curr-bio/trab2000/cardiiovasc HyperHeart http://www-medlib.med.utah.edu/kw/pharm/hyper_heart1.html The stethoscope and information about auscultation http://www.3m.com/us/healthcare/professionals/littmann/jhtml/education.jhtml Cardiovascular system http://www.afh.bio.br/basicos/Cardio1.htm Cardiac sounds http://people.cs.uchicago.edu/~fensterm/CAD/
Third year
<ul style="list-style-type: none"> Cardiac anatomy http://info.med.yale.edu/intmed/cardio/imaging/anatomy/anatomy_lightbox/index.html Animations of cardiac anatomy http://www.nemours.org/no/ncc/cardiac/crd1519.html Cardiac examination http://anatome.ncl.ac.uk/tutorials/chest/text/page10.html Cardiovascular physical examination http://hu.ufsc.br/~cardiologia/ The normal cardiac cycle and its semiology http://www.manuaisdecardiologia.med.br/Semiologia/ciclono1.shtml Cardiovascular pathology http://medstat.med.utah.edu/WebPath/CVHTML/CVIDX.html#2
Fourth year
<ul style="list-style-type: none"> Anatomical pathology of the circulatory system http://www.fcm.unicamp.br/departamentos/anatomia/pecascard.html Radiological anatomy of the heart http://www.vh.org/adult/provider/radiology/NormalRadAnatomy/Text/ThorImagtitle.html Cardiothoracic atlas http://anatomy.uams.edu/htmlpages/anatomyhtml/gross_atlas.html ECG leads http://medstat.med.utah.edu/kw/ecg/animations/ecg.html Electrocardiography http://hu.ufsc.br/~cardiologia/ Radiographic images of the heart http://info.med.yale.edu/intmed/cardio/imaging/contents.html Tutorial on cardiac sounds http://www.blaufuss.org/tutorial/
Internship (fifth and sixth years), residence, and continuing education in cardiology
<ul style="list-style-type: none"> Angiography - Coronary stenosis http://info.med.yale.edu/intmed/cardio/imaging/findings/coronary_stenosis/index.html Cardiothoracic atlas http://anatomy.uams.edu/htmlpages/anatomyhtml/gross_atlas.html Echocardiographic atlas http://info.med.yale.edu/intmed/cardio/echo_atlas/contents/ Center for ECG learning http://medstat.med.utah.edu/kw/ecg/ ECG leads http://medstat.med.utah.edu/kw/ecg/animations/ecg.html Cardiothoracic images http://info.med.yale.edu/intmed/cardio/imaging/contents.html Cardiothoracic radiographies http://www.xray2000.f9.co.uk/ibase3/chest2/ALBUM1.HTML 4D Reconstruction of the cardiac beat http://www.uke.uni-hamburg.de/institute/imdm/idv/gallery/early_works3.en.html Simulation of cardiac excitation in 3D models http://www.uke.uni-hamburg.de/zentren/experimentelle_medizin/informatik/forschung/excitation/ Tutorial on cardiac sounds http://www.blaufuss.org/tutorial/

We hope that based on this model, others may be created, and that the medical schools, hospitals, and scientific societies encourage this type of initiative.

Acknowledgment

We thank Edmilson Rocha Marques for the analysis of methods.

References

- Borges JM, Lima LA. Ensino de segurança no trabalho via Internet. In: XXVIII Congresso Brasileiro de Ensino de Engenharia, 10, 2000, Ouro Preto. Anais... Paraíba: UFPB. Disponível em: <<http://www.google.com.br/search?q=cache:EQjd-P9oa3IJ:www.asee.org/international/INTERTECH2002/512.pdf+&hl=pt-BR&ie=UTF-8>>. Acesso em: 15 jun. 2003.
- Oliveira JPM, Lima JV, Proença ML et al. Projeto Electra sistemas de ensino na Internet. Disponível em: <<http://www.google.com.br/search?q=cache:aA1G9ExGRXoJ:www.inf.ufrgs.br/~tapejara/electra/docs/electra.pdf+&hl=pt-BR&ie=UTF-8>>. Acesso em: 15 jun. 2003.
- Hahnemann G. Internet complementa ensino tradicional. Clipping, Pernambuco, 05/03/2001. Seção Matéria. Disponível em: <<http://www.csocialufpe.com.br/clipping/materias/002.htm>>. Acesso em: 07 jun. 2003.
- Notess, Gr. Review of Google. Search Engine Showdown, Montana, 01/10/2003. Disponível em: <<http://www.searchengineshowdown.com/features/google/review.html>>. Acesso em 07/10/2003.
- Notess, GR. Google Special Report: Databases Components. Search Engine Showdown, Montana, 05/03/2002. Disponível em: <http://www.searchengineshowdown.com/features/google/dbanalysis.shtml>>. Acesso em 07/10/2003.
- Notess, GR. Search Engine Statistics: Relative Size Showdown. Search Engine Showdown, Montana, 31/10/2002. Disponível em: <<http://www.searchengineshowdown.com/stats/size.shtml>>. Acesso em: 23/07/2003.
- Por que usar o Google. Google 2002. Disponível em: http://www.google.com/intl/pt-BR/why_use.html>. Acesso em: 06/10/2003.