International Journal of Paleopathology xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

International Journal of Paleopathology

journal homepage: www.elsevier.com/locate/ijpp

Differential diagnosis in archaeology

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ARTICLE INFO

Article history:
Received 11 August 2015
Received in revised form 28 April 2016
Accepted 1 May 2016
Available online xxx

Keywords:
Archaeology
Bioarchaeology
Differential diagnosis
Medical diagnosis
Paleopathology

ABSTRACT

Diagnosing archaeological bone specimens can be likened to practices used in medical and veterinary medical health care. Increasing the rigor of archaeological diagnosis can be supported by a systematic approach derived from health care settings. The process of information synthesis and diagnosis can be viewed as being very similar among these disciplines.

A first diagnostic step is developing an Initial Information Set (sometimes called an Initial Database in health care environments) from descriptive data about the archaeological specimen or the patient, accompanied by recording environmental and ecological observations. The second diagnostic step is to develop an Expanded Information Set that includes structured physical examination, constructing a problem list, and considering potential differential diagnoses for each recorded problem. Subsequently, a Diagnostics Information Set consists of outcomes of carefully selected diagnostic testing, and a Diagnostic Assessment is developed from an orderly mental synthesis of information across Information Sets.

Critical aspects of a structured and orderly process are preparing inclusive differential diagnoses, thorough mental synthesis across Information Sets, and recognizing that a short list of the most plausible diagnostic alternatives may represent the furthest possible extent of the evaluation for many archaeological bone specimens.

1. Introduction

There is a recognized need for increased rigor in archaeological diagnosis, just as there is a continuous charge to improve diagnostic processes in health care and in most areas of bioscience research (Freyschmidt, 2003; de Gray, 2007; Klaus, 2015). A large disease-specific literature exists on this subject, across health care and research disciplines. Yet, it is distressing that diagnostic reports in paleopathology, and particularly in animal paleopathology, continue to follow patterns that were established based on incomplete diagnostic methodology in prior publications.

This writing describes an approach to animal and human archaeological bone specimens, for classifying observations into a format that will facilitate orderly and more complete differential diagnosis.

Diagnosis in health sciences refers to identifying a condition or an illness, or establishing its underlying cause(s) (Webster's Encyclopedic Dictionary, 1989). The process through which archaeological scientists, clinicians, and biomedical researchers might conduct a specimen or patient evaluation involves first developing several Information Sets. Following, differential diagnosis is the process of mental synthesis across those Information Sets. Potential causes of recognized problems are considered subjectively and objectively in an orderly fashion, as are diagnostic tests, leading to either a definitive diagnosis or a brief list of the most plausible alternative diagnoses.

The similarities between the medical and veterinary medical diagnostic systems and the process of diagnosing archaeological specimens suggest that an Information Set approach and thought process for differential diagnosis in health care can be organized to support increased rigor in the study of archaeological specimens.

2. How does differential diagnosis work in the clinical setting?

2.1. *Initial Information Set – Signalment, Initial Evaluation, Environment*

2.1.1. *Signalment*

The Initial Information Set originates with *Signalment* information (Table 1), such as species, sex, age, and size. Additional descriptors often are species-specific, such as race and ethnicity among humans, or subspecies, strain or breed, coat color, and

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http://dx.doi.org/10.1016/j.ijpp.2016.05.001
1879-9817/

reproductive status, among domestic animals. *Signalment* features, while seemingly obvious, provide important direction for the subsequent differential diagnosis thought process by defining a field of vision without being limiting.

2.1.2. Initial Evaluation

The *Initial Evaluation* is the second portion of the Initial Information Set, first including the *health history* (Table 1). Recording of objective metrics such as weight, height, overall size, blood pressure, temperature, pulse rate, and respiratory rate, constitutes the first part of the *presenting status* (Table 1). Several additional important *presenting status* traits are more subjective, including character of pulse and respiration, state of hydration, evidence of pain, and state of alertness (Table 1). The patient's current *symptoms* are the last component of the *Initial Evaluation.* After all of the information is acquired, the provider mentally relates the *Initial Evaluation* to the *Signalment*. The resulting collection of observations thus begins to form the basis for subsequent components of the diagnostic thought process, and actions on the patient's behalf.

2.1.3. Environment

Since many diseases have cyclic characteristics, the Initial Information Set also includes a third component, the *Environment* (Table 1). Factors such as *season* and *weather* exert physiological stress, even when patients are confined indoors. *Intra- and inter-species contacts* are important not only in terms of aggression and other social interactions, but also because of potential disease transmission (e.g. zoonoses). Aspects of *culture* (*social norms*) may influence health and disease and must be considered, as should effects of *housing* and *daily activity*, such as type of work performed (Table 1).

Close *housing* quarters in humans and animals can create emotional and physiological stress and facilitate transmission of infectious diseases, requiring that *cleanliness* in such environments must be managed aggressively and daily. Finally, *nutrition* plays a critical role in health, especially among young children and the elderly; the same is true for similar age groups of many mammals (Table 1).

2.2. Expanded Information Set – Physical Examination, Problem List, Differential Diagnosis

2.2.1. Physical Examination

The first component of the Expanded Information Set, *Physical Examination*, should be done directly by the health provider, using what is termed a "body systems approach" (Table 2). This approach is a thorough and orderly assessment of each of the patient's body systems: integumentary, muscular, skeletal, circulatory, respiratory, digestive, urinary, endocrine, reproductive, central and autonomic nervous, hematologic, immune, and special senses (vision, hearing, taste, smell) (Ham, 1959). All information is recorded and listed according to the body system into which observations are categorized (Tables 1 & 2).

A very important aspect of *Physical Examination* is that the provider must recognize and understand aspects and ranges of **normality**. Often, ranges of normal for any given body metric or function differ by species, breed or strain, age, sex, general state of health, and environmental influences. But, in all instances, abnormal cannot be recognized and described if the full range of normal is not understood. The provider must become accustomed to conducting the *Physical Examination* in the same way at every occasion, to insure that no major or minor observation is overlooked. It is critically important that all observations will be recorded at the time that they are made.

2.2.2. Problem List

The second component of the Expanded Information Set, the *Problem List,* is created by reviewing all previously-recorded abnormal data, regardless of evident relationship to presenting *symptoms* (Table 1). From the *Problem List*, the examiner begins to consider which body systems (or combinations thereof) could be affected, to explain each observation. The purpose of considering possible explanations for observations to this point is to establish all alternatives, following with intellectually-processed rule-outs, and then diagnostic tests as appropriate to further accept or reject causal hypotheses. The examiner must not overlook the fact that multiple disorders that cause similar *symptoms* may exist simultaneously.

2.2.3. Differential Diagnosis

Differential Diagnoses are the third component of the Expanded Information Set (Table 1). These are considered for **each** major and minor problem. Recognized problems are approached in *Differential Diagnosis* in the orderly manner that has characterized the components of *Signalment*, *Initial Evaluation*, *Environment*, *Physical Examination*, and *Problem List*. From these information sets, the Expanded Information Set is completed by compiling, reviewing, and mentally synthesizing the sum of the observations for each feature of the *Problem List,* to create the *Differential Diagnosis* list.

Creating an inclusive *Differential Diagnosis* is a significant challenge, often requiring considerable literature review. The mental process is an exercise in looking at each observation set in light of the others, while remaining conscious that plausible diagnoses are those that best align the components of the Initial and Expanded Information Sets.

2.2.4. The "DAMNIT" scheme

The "DAMNIT" pathophysiology format (Table 3) may be used to facilitate this mental synthesis within and across body systems. This format can and should be modified as required by varying clinical circumstances that require disease- or system-specificity (Saunders Comprehensive Medical Dictionary, 2007, modified for this manuscript). However, the DAMNIT format rarely is comprehensive and should be considered only as an information-processing guideline. It does not substitute for provider expertise, experience, and research effort (Saunders Comprehensive Medical Dictionary, 2007, modified for this manuscript). Many clinicians also use various subject-specific algorithms to support this process. In all events, information synthesis using a body systems format is preferred for final refinement of *Differential Diagnosis* (Table 2).

At this point of a clinical investigation, the examiner who has followed an orderly and sequential evaluation format usually will have a good grasp of the presenting patient and circumstances, and will be prepared to list most likely diagnoses and proceed to confirmatory (or rule-out) diagnostic studies.

2.3. Diagnostics Information Set

2.3.1. Medical tests

Medical testing is constructed to confirm or reject from the list of hypothesized differential diagnoses (Mark, 2005) (Table 1). If medical testing is done haphazardly, the result can be overlooking correct diagnoses because the proper confirmatory tests were not selected or because the hypothesized cause was incorrect and overemphasized. Within each category of medical test procedures are various choices, depending on target criteria for retaining or eliminating causal alternatives from the *Differential Diagnosis* (Tables 1 & 2). Clearly, the thought process for test selections must be orderly and deliberate.

Please cite this article in press as: Lawler, D.F., Differential diagnosis in archaeology. Int. J. Paleopathol. (2016), http://dx.doi.org/10.1016/j.ijpp.2016.05.001