EC CARDIOLOGY
Editorial

ECG Interpretation: An Appraisal of this Clinical Skill

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Received: August 23, 2018; **Published:** September 07, 2018

The first documentation of an ECG recorded from a human was over 125 years ago [1]. Still today, despite the development of many new investigative techniques, an essential part of any cardiovascular assessment involves an ECG recording. Unlike pathology specimens and the images produced by modern techniques, which are always formally reported by trained and tested professionals, ECGs are most commonly reported and acted upon by front-line personnel who have had no formal training in, and no assessment of competency in, ECG interpretation [2]. The ubiquity of the ECG recording has led to a condescension of its clinical application. In addition, the transition from analogue to digitally acquired ECGs enabled automated computer analysis of the ECG to assume a larger role in diagnostic interpretation affecting the requirement for competent human deciphering of the ECG tracing [3-5]. Research has highlighted the impact over-reliance on computerised ECG interpretation can have in patient care [6]. Consensual recommendations that all computerised interpretation of ECG tracings should be subjected to "over reading" prior to any clinical decisions on care is compromised given that 33% of ECG interpretations reported by humans in clinical practice contain errors of major importance [4]. During ECG tracing analysis the "decision making" element is reported as the most common error due to the cognitive processes involved in ECG interpretation [7-9]. As a method of reducing variations of perception and cognition during the ECG reporting process Breen., *et al*. (2017) designed an ECG reporting smart form (ANALYSE) [10] that an interpreter could populate with important ECG waveform measurements prompted through a "command orientated/driven" format and that corresponded to a universal ECG measurement dataset (ACC/AHA Recommendations for the standardisation and interpretation of the electrocardiogram).

Comprehensive systematic approaches to patient safety has led to an increase in efforts to improve medical error detection and prevention [11]. Within the domain of ECG recording incorrect positioning of ECG electrodes, erroneous connection of ECG leads and varying patient postures during ECG acquisition can significantly impact an ECG recording by falsely indicating an emergent abnormality or the requirement to administer therapeutic interventions. The different problems arising from incorrect electrode placement are directly related to the fact that standard 12-lead electrocardiography requires the correct placement of 10 individual electrodes [12]. This number of electrodes may constitute a source of error. ECG diagnoses are valid, only if electrodes are placed in correct anatomic locations, lead wires are attached to the appropriate electrode and the recording is of good technical quality. In certain clinical settings, alternative ECG recording with simplified electrode placement is performed. Although any change in standard electrode positioning causes ECG wave alterations, this has minimal effect in continuous cardiac monitoring where the objective is to detect alterations in cardiac rhythm [13].

Patients who are obese and the female gender have been identified as common reasons for ECG electrode misplacement due to an inability to appropriately palpate anatomical bony landmarks for correct electrode placement. Obesity is a major health issue, reaching epidemic proportions in the western world and it has been estimated that "One-fifth of adults worldwide will be obese by 2025" [14]. The correlation between an increased prevalence of obesity and a rise in the number of obese patients requiring medical imaging has been explored in a study by Uppot., *et al*. 2006 [15] where dictated radiology reports over a 3-year period were assessed retrospectively for the phrase "limited due to body habitus". The authors concluded that there was a positive correlation with a progressive increase in the number of "obesity-compromised" reports. This editorial proposes that ECG related errors are mitigated through quality control measures and the need for focused training and continuing education of professionals involved in the recording of routine and research ECGs such as through use of the Electrode Misplacement Simulator (EMS) [7]. Most textbooks and ECG learning media devote little attention to inadequate ECG recordings, meaning the first encounter a novice experiences of challenges to ECG interpretation is during clinical scenarios with actual patients [16].

Within the UK and Ireland there are no formal national programmes for "training" in ECG interpretation or for the assessment of ECG interpretation skills. Numerous institutions and universities teach ECG interpretation using their own protocols and techniques. Inevitably, the standard of ECG interpretation across professionals is highly variable and is often extremely poor. There remain no established standard methods for "teaching" ECG interpretation or reporting ECG findings that are evidence based [5,17]. Within the literature, teaching of ECG interpretation mostly occurred through lecture formats (75 - 90%) supplemented by small group practical teaching (44% - 78%) with ECG interpretation rehearsal representing the main learning activity [5,17]. In contemporary medical and health professional training programs, the need to establish competence in interpretation of an expanding plethora of diagnostic imaging technologies such as C.T., M.R.I. and ultrasound, the time formerly devoted to teaching ECG interpretation has greatly diminished [18].

An important aspect about the ECG, compared to other "medical image sources" is that it is a graphical recording of the heartbeat; the ECG signal and waveforms represent temporal processes of the electrical activity coordinating the heartbeat recorded as deflections from the baseline [19]. Memorising abstract signals, such as the shape of the ECG complexes, and associating them with disease processes has become a preferred format for teachers and learners [20]. Expert performers "bypass their natural processing limitations by acquiring special knowledge structures that function as associations between encoded information and retrieval cues in long-term memory" [21]. This view specifically states that experts with at least 10 years of experience in a domain only differ to non-experts by how efficiently they process information directly related to their field of experience. When clinical scenarios are frequently encountered in practice, experienced practitioners will acquire patterns (schema) that allow them to recognise and draw on stored memories of each scenario, so to provide appropriate reactions. The expert ECG interpreter therefore reviews an ECG with no apparent pattern or rule based system. A gestalt analysis of the ECG waveforms activates previous processed memories (schema), with the expert efficiently and accurately reflecting on their repertoire of experience to refine their diagnosis.

Education offered via the Internet, commonly referred to as electronic or e-learning is common place in academia [10]. Learning programmes that use the Web offer students more opportunities to learn at their own pace outside conventional working times, thereby reducing travel time and costs. The ubiquity of the internet has an increasing impact on higher education and the way students access information for learning. Given that students and clinicians often use Internet resources as an adjunct in clinical practice the Author was part of a team that evaluated the veracity of Google images that could potentially be used by clinicians to guide the positioning of ECG electrodes [22]. The quality of web-based images, included for this study, illustrate ECG electrode placement poorly. Neither the accuracy of electrode positions or the utility of the schematics are suitable to guide clinicians in the accurate recording of the 12-lead ECG. A national guideline, in pursuit of promoting excellence in the recording of 12 lead ECGs was published by the Society for Cardiological Science and Technology (SCST). This guideline explicitly informs of best practice for 12 lead ECG acquisition and is an adopted format across educational institutions within the UK and Ireland [12].

Future Recommendations

There are a number of areas for future development within ECG acquisition and interpretation. Firstly, approaches to reduce ECG acquisition errors through reduced ECG recording lead sets could minimise the incidence of lead connection misplacement and subsequent interpretation error. Examples of reduced ECG leads sets include the simple 3 electrode bipolar monitoring format and the common 5 electrode monitoring lead format and are commonly adopted ECG recording placements for individuals being monitored during medical or surgical procedures, for the admission of anaesthesia pre-operatively, during recovery postoperatively and through telemetry whilst an inpatient on a hospital ward. An additional advantage to this approach is the simplification of the palpable bony landmarks compared to those of the standard 12 lead ECG, which are much more anatomically complicated and challenging for individuals performing this skill. A particular ECG recording format, EASI lead system, enables the acquisition of a full 12 lead ECG, with a patient wearing only 5 recording electrodes. Secondly standardising the body posture position for ECG recording could further reduce artifacts of 12 lead recording and enhance patient care. Thirdly, the integration of widespread formal training, testing and re-training of healthcare professionals, at all levels, in relation to their ECG interpretation skills. Across laboratory and other medical imaging practices, reporting of clinical findings is conducted through trained and tested personnel. Techniques to enhance the teaching and learning of ECG interpretation should incorporate the following recommendations: Learning packages of ECG representations which have been informed from data corroborating the findings of ECG reports to cardiac autopsy proceedings; Teaching formats that integrate "reflection" and "deliberate" practice; Active learning pedagogies that provide simulated scenario experiences, provide time efficient feedback and engage rigorous summative assessment formats.

Bibliography

1. Kligfield P. "The Centennial of the Einthoven Electrocardiogram". *Journal of Electrocardiology* 35 (2002): 123-129.
2. Rowland D and Moore P. "ECG interpretation in the NHS" (2014).
3. Kligfield P., *et al*. "Recommendations for the standardization and interpretation of the electrocardiogram. Part I: the electrocardiogram and its technology. A scientific statement from the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology the American College of Cardiology Foundation and the Heart Rhythm Society". *Journal of the American College of Cardiology* 49.10 (2007): 1109-1127.
4. Mele P. "Improving electrocardiogram interpretation in the clinical setting". *Journal of Electrocardiology* 41.5 (2007): 438-439.
5. Fent G., *et al*. "Teaching the interpretation of electrocardiograms: Which method is best?" *Journal of Electrocardiology* 48.2 (2015): 190-193.
6. Bogun F., *et al*. "Misdiagnosis of atrial fibrillation and its clinical consequences". *American Journal of Medicine* 117.9 (2004): 636-642.
7. Bond RR., *et al*. "The effects of electrode misplacement on clinicians' interpretation of the standard 12-lead electrocardiogram". *European Journal of Internal Medicine* 23.7 (2012): 610-615.
8. Breen CJ., *et al*. "An evaluation of eye tracking technology in the assessment of 12 lead electrocardiography interpretation". *Journal of Electrocardiology* 47.6 (2014): 922-929.
9. Cairns A., *et al*. "A Computer-Human Interaction Model to Improve the Diagnostic Accuracy and Clinical Decision-Making during 12-lead Electrocardiogram Interpretation". *Journal of Biomedical Informatics* 64 (2016): 93-107.
10. Breen CJ., *et al*. "A clinical decision support tool to assist with the interpretation of the 12-lead Electrocardiogram". *Health Informatics Journal* (2017): 1-11.
11. World Health Organisation. Patient safety data and statistics (2016).
12. Eldridge J., *et al*. "Clinical guidelines by consensus Recording a standard 12-lead electrocardiogram An approved methodology by the Society for Cardiological Science and Technology (SCST)" (2011).
13. Drew B. "Pitfalls and artifacts in ECG". *Cardiology Clinics* 24.3 (2006): 309-315.
14. NHS Choices. "Global obesity rates expected to soar in next decade" (2016).
15. Uppot RN., *et al*. "Effect of obesity on image quality: Fifteen-year longitudinal study for evaluation of dictated radiology reports". *Radiology* 240.2 (2006): 435-439.

16. Bond RR., *et al*. "Improving clinical practice with the introduction of modern teaching tools to an old science". Higher Education Academy (2011): 6.

17. Aueson AJ. "Methods of teaching and evaluating electrocardiogram interpretation skills among cardiology fellowship programs in the United States". *Journal of Electrocardiology* 42.4 (2009): 339-344.

18. Criley JM and Nelson WP. "Virtual tools for teaching electrocardiographic rhythm analysis". *Journal of Electrocardiology* 39.1 (2006): 113-119.

19. Simpson SA and Gilhooly KJ. "Diagnostic Thinking Processes: Evidence from a Constructive Interaction Study of Electrocardiogram (ECG) Interpretation". *Applied Cognitive Psychology* 11.6 (1997): 543-554.

20. Hurst JW. "Methods used to interpret the 12-lead electrocardiogram: pattern memorization versus the use of vector concepts". *Clinical Cardiology* 23.1 (2000): 4-13.

21. Ericsson KA and Kintsch W. "Long-term working memory". *Psychological Review* 102.2 (1995): 211-245.

22. Bond RR., *et al*. "Utility and Accuracy of Online Schematics That Illustrate ECG Electrode Positions". Medicine 2.0 Congress, Malaga. IJMI. 1 (2014).

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