Recent advances in the Emergency Vectorcardiography:

(1)Initial spatial QRS vectors in pilots

There have four types of the initial spatial QRS vectors concealed in the normal person:
1. Left-anterior-superior, or
2. Left-anterior-inferior, or
3. Right-anterior-superior, or
4. Right-anterior-inferior
The first three directions were the same as the types of initial activity of the normal depolarization process of the interventricular septum revealed by the intra cardiac mapping in dogs reported in the literature.

These initial spatial QRS vectors have impact on the formation of the R wave in leads V1-2, or Q waves in leads V5-6, in the scalar electrocardiogram.

Carson W, Ho BL. Initial spatial QRS patterns in pilots: A preliminary report. In: Liebman J (ed): Proceeding of the XXIII International Congress on Electrocardiology, World Scientific Publishing Co. Ltd., New Jersey, 1996, p.671-674.

(2)ECG QRS axis calculation versus the VCG frontal plane in pilots

The automatic report from an electrocardiographic (ECG) machine about an abnormal axis may be not reliable. The more co-existing abnormalities, the worst ECG axis results had been obtained. Careful interpretation and manual calculation of the ECG tracings could not compete with prompt and accurate vectorcardiographic (VCG) tracings of the cardiac axis in the Frontal plane.

Carson W, Ho BL. Electrocardiographic QRS axis calculation versus vectorcardiographic data in pilots. In: Roshchevsky MP (ed): Proceedings of the XXVIth International Congress on Electrocardiology, Institute of Physiology of the Komi Science Centre, Syktyvkar, Komi Republic, 1999, p.212-214.

(3) Exercise vectorcardiogram or treadmill exercise electrocardiogram versus Thallium-201 Single-Photon Emission Computed Tomograms in the diagnosis of myocardial ischaemia.

The electrophysiological terminology of "Subendocardium ischaemia" is misleading and suggested to be abandoned. Exercise vectorcardiogram correlates better than the treadmill electrocardiogram with the Single-Photon Emission Computed Tomographic results.

Carson W, Chen YK, Cheng CY. Exercise vectorcardiogram or treadmill exercise electrocardiogram versus thallium-201 single-photon emission computed tomogram in the diagnosis of myocardial ischaemia.In: Bacharova L, Macfarlane PW (eds): Proceedings of the XXIV International Congress on Electrocardiology, World Scientific Publishing Co. Ltd., New Jersey, 1997, p.328-331.

(4)Vectorcardiographic QRS Loop areas: A proposed method in evaluating a medication has potential in protecting the myocardium.

In subjects without previous myocardial infarction, the sum of the vectorcardiographic QRS loop areas' in before versus immediate post-exercise will have no statistical difference whether there has transient ischaemic myocardium or not on the Single-Photon Emission Computed Tomographic images. [1] The sum of the QRS loop areas of the three planes of the vectorcardiogram showed that the acute stage of myocardial infarction was larger than before stress tests. This was due to loss of ventricular mass after myocardial infarction. The immediate post-stress test area was larger than in the pre-stress test. This was due to acute heart dilatation during the stress test.[2]Vectorcardiogram may include blood chambers within the QRS loops but not only the myocardium. [3] There was no statistical significance between dogs received deferoxamine or saline by means of the vectorcardiographic QRS loop areas. This was consistent with anatomical results. [4]

Note: The deferoxamine study was not able to be published from the Toronto General Hospital due to a negative result in 1989. The QRS loop areas' method in evaluating a potential medication could protect myocardium, one should monitor blood volume within the heart has no difference in before versus after the medication.

[1] Carson W, Chen YK, Cheng CY. Vectorcardiograhic QRS loop areas IV. Changes in subjects have treadmill exercise tests and thallium-201 single-photon emission computed tomography. In: Roshchevsky MP (ed): Proceedings of the XXVI th International Congress on Electrocardiology, Institute of Physiology of the Komi Science Centre, Syktyvkar, Komi Republic, 1999, p.240-243.

[2] Carson W. Vectorcardiographic QRS loop area's I. Changes in the patient with first acute inferior myocardial infarction. In: Preda I(ed): Proceedings of the XXV International Congress on Electrocardiology, World Scientific Publishing Co. Ltd., New Jersey, 1998, p.343-345.

[3] Carson W, Soper N. Vectorcardiographic QRS loop areas II. Single photon emission computed tomographic correlation of thallium-201 perfused myocardium and electricity conducting myocardium in patients with first inferior myocardial infarction. In: Preda I(ed): Proceedings of the XXV International Congress on Electrocardiology, World Scientific Publishing Co. Ltd., New Jersey, 1998, p.346-348.

[4] Carson W, Dawood F. Vectorcardiographic QRS loop areas III. Evaluating whether deferoxamine can protect viable myocardium after acute myocardial infarction. In: Preda I(ed): Proceedings of the XXV International Congress on Electrocardiology, World Scientific Publishing Co. Ltd., New Jersey, 1998, p.349-351.

(5)Serial Emergency vectorcardiogram during acute myocardial infarction

Change of the inscription direction of the QRS loop is more frequently in acute anterior myocardial infarction, especially in the Frontal plane. Infarction location had no relation with changes in the inscription direction of the T loop. Isolated reversal of the QRS loop sense of inscription in the Left Sagittal plane found in patients with acute myocardial infarction which in accord with a report in patients with chronic myocardial infarction in the literature.

Carson W, Tseng YZ. Serial vectorcardiographic changes of ventricular electrical activity in patients with acute myocardial infarction. In: De Ambroggi L(ed): Proceedings of the XXVII International Congress on Electrocardiology, Casa Editrice Scientifica Internazionale, Roma, 2000, p.371-374.

(6)Acute pulmonary embolism or acute aortic dissection mimicking acute myocardial infarction

Patients with acute aortic dissection had ST-T changes on the ECG. The emergency vectorcardiography revealed three maximal spatial ST vectors:

1. right-posterior-superior, or
2. right-anterior-superior, or
3. left-anterior-inferior

The last two types of the maximal spatial ST vectors are similar to the types of maximal spatial ST vectors in patients with acute anteroseptal myocardial infarction. However, they failed to meet the vectorcardiographic QRS-loop criteria of anteroseptal myocardial infarction. Therefore, patients having clinical symptoms but without maximal spatial ST vector, a right-posterior-superior maximal ST vector, or maximal spatial ST vector mimicking acute anteroseptal myocardial infarction on the emergency VCG should be excluded from the possible acute aortic dissection before applying thrombolytic therapy.

In patients with acute pulmonary embolism, they have either type C of right ventricular enlargement or right ventricular conduction delay or both, if there has no co-existing other disease.

Carson W, Tseng YZ. Emergency vectorcardiographic study of acute pulmonary embolism and acute aortic dissection among patients with initial suspected acute myocardial infarction. In: Pastore CA(ed) Proceedings of the XXVIII International Congress on Electrocardiology, Atheneu, Sao Paulo, 2001, p.107=110.

(7)Acute strict inferior myocardial infarction

Two types of the maximal spatial ST vector:
{1} right-posterior-inferior, or
{2} left-posterior-inferior
have found in patients with acute strict inferior myocardial infarction. Because the maximal spatial ST vector is nearly perpendicular pointing to the inferior wall that caused Horizontal plane of the VCG had normal QRS loop.

Carson W, Soper N. Patterns of the maximal spatial ST vector in patients with acute strict inferior myocardial infarction. In: Pastore CA(ed) Proceedings of the XXVIII International Congress on Electrocardiology, Atheneu, Sao Paulo, 2001, p.137-141.

(8)Maximal spatial ST-vector patterns in acute anterior myocardial infarction

In the acute localized anterior myocardial infarction subgroup, three patterns of the maximal spatial ST-vector have been found:
{1} right-anterior-inferior, or
{2} right-anterior-superior, or
{3} left-anterior-superior

In both the acute antero-lateral and extensive anterior myocardial infarction subgroups, three patterns of the maximal spatial ST-vector have been found:
{1} left-anterior-superior, or
{2} left-anterior-inferior, or
{3} right-anterior-superior
The directions were the same as the types of initial activity of the normal depolarization process of the interventricular septum revealed by the intracardiac mapping in dogs, or initial spatial QRS patterns in male pilots.

Carson W, Tseng YZ. Maximal spatial ST-vector patterns in patients with acute anterior myocardial infarction. IJBEM 2002, 4: 283-284

(9)3-D animation software in Emergency Vectorcardiography and a palm-like device for the timed vectorcardiogram

3-D animation software for the Emergency Vectorcardiography, and a Palm-like device for recording cardiac dysrhythmias have been proposed.

Carson W. 3-D animation software in emergency vectorcardiography and a palm-like device for the timed vectorcardiogram: A preliminary developing project. In: Pastore CA(ed) Proceedings of the XXVIII International Congress on Electrocardiology, Atheneu, Sao Paulo, 2001, p.157-160.

(10) Vectorcardiogram in Amplatzer occluder closure of atrial septal defects

Over two-third patients had changes of the notch of the P loop. This is highly suggestive of electrophysiological "hibernating" myocardium in these paediatric patients. Nearly half of the patients changed the sense of the inscription of the QRS loop. This may indicate reducing different degrees of the right ventricular enlargement after transcatheter closure of the atrial septal defects.

Carson W, Wang JK, Tseng YZ. Vectorcardiographic features in patients receiving transcatheter closure of atrial septal defect. IJBEM 2002, 4: 341-342

(11)Evidence of the negative sequence voltages before patients with acute myocardial infarction developing spontaneous ventricular fibrillation or flutter.

In patients with acute myocardial infarction, once emergency VCG is documented as partial negative sequence or complete negative sequence of the T-loop with an abnormal L/W ratio, then Cardiologists should be stand by for unexpected ventricular tachyarrhythmia attack.

Carson W, Tseng YZ. Searching for negative sequence voltages before spontaneous ventricular tachyarrhythmia in patients with acute myocardial infarction. (Abstract) The XXXI International Congress on Electrocardiology, Kyoto, Japan, 2004, Abstract Book p.128

(12)Evidence of negative sequence voltages in the Amplatzer occluder closure of atrial septal defects

In "patho-electro-physics-physiology", Amplatzer Occluder can alter negative sequence voltages from atrial septal defect, but Amplatzer Occluder itself can also contribute to iatrogenic negative sequence voltages in the atria.

Carson W, Wang JK, Tseng YZ. Alteration of negative sequence voltages in atria by the amplatzer occluder in patients with atrial septal defect. (Abstract) The XXXI International Congress on Electrocardiology, Kyoto, Japan, 2004, Abstract Book p.128

(13)A proposed new theory of atrial fibrillation, flutter or atrial premature contraction based on negative sequence voltages.

(Revised) **A proposed new theory of AF, flutter or atrial premature contraction based on negative sequence voltages.** Negative sequence voltages appear as an abnormal inscription direction in the depolarization* process of the atria. It could happen in a diseased or ECG 'normal' heart. The heart will generate an atrial premature contraction ('physiological' pacing) or contractions ('physiological' overdrive suppression) to abolish the negative sequence voltages induced abnormal activation propagation. The threshold for when this physiological correction will appear through the autonomic nervous system is variable depending on the individual patient (i.e. heart conditions, body weight, age...etc.). If it is not successful, the flutter from single foci or chaotic AF from multiple foci will ensue. With the help of chamber enlargement and/or abnormal conduction within the atria, the abnormal rhythms will be sustained.

*Note: atrial depolarization and repolarization are not possible to be separated.

Carson W, Tseng YZ. Negative Sequence Voltages in Spontaneous Atrial Fibrillation and Flutter. Int J Cardiol 2008;130:357-366.

(14)Emergency vectorcardiographic findings of acute aortic dissection

Patients with acute aortic dissection who have {1} an abnormal sense of inscription direction of the T-loop in at least one of either the Horizontal or Left Sagittal plane, and {2} an abnormal L/W ratio in at least two planes in the pre-operational emergency vectorcardiogram, have altered ventricular repolarisation and thus are at high risk of post-operationally unexpected ventricular tachyarrhythmia. This information is not available from the electrocardiogram.

Carson W, Tseng YZ, Chu SH. Emergency vectorcardiographic study of acute aortic dissection. Am J Emerg Med 2003; 21: 184-188

(15) Alteration of negative sequence voltages in atria by the Amplatzer occluder

In patho-electro-physics-physiology, Amplatzer Occluder can alter negative sequence voltages from Atrial Septal Defect, but Amplatzer Occluder itself can also contribute to iatrogenic negative sequence voltages in the atria.

Carson W., Wang J.K., Tseng Y.Z. Alteration of Negative Sequence Voltages in Atria by the Amplatzer Occluder in Patients with Atrial Septal Defect. (Abstract) The XXXIII International Congress on Electrocardiology. Cologne, Germany, 28th June- 1st July 2006.

(16) Alteration of negative sequence voltages in the ventricular repolarization by temporary artificial pacemakers

In patho-electro-physics-physiology, temporary artificial pacemaker can alter negative sequence voltages of the T-loops in patients with bradycardia, but temporary artificial pacemaker itself can also contribute to iatrogenic negative sequence voltages in the heart.

Carson W. Alteration of Negative Sequence Voltages in the Ventricular Repolarization by Temporary Artificial Pacemakers in Patients with Bradycardia. (Abstract) The XXXIII International Congress on Electrocardiology. Cologne, Germany, 28th June- 1st July 2006.

(17) New clinical cardio-cerebral resuscitation technique: apply first thump and one-inch punches

Since the negative sequence voltage in a diseased heart is within physics territory, it will react to another physics force from outside the chest wall. The adequacy of the force is the question. In one-person rescue, it would be reasonable to perform first thump as a fist 40cm above the chest wall falling continuously three times to cover a whole cardiac cycle. In two-person rescue, one locks the arms from the back of the patient in standing position. The other performs three continuous 1-inch punches from the right arm like an oriental martial arts specialist. Only the 1-inch punch can produce a whirlpool-like force in anti-clockwise rotation which is similar to normal depolarisation or repolarisation of the heart in vectorcardiographic loops. Theoretically, an anti-clockwise cyclone-like force would drastically reduce the amount of force necessary to be effective. Defibrillator applications in resuscitation have no physics foundation. Therefore, the majority patients cannot be shocked back to normal sinus rhythm. Further studies of the first thump and 1-inch punches are warranted in order to determine whether they can completely replace the defibrillator's role during cardio-cerebral resuscitation.

Carson W. New Clinical Cardio-cerebral Resuscitation Technique: Apply First Thump and One-inch Punches Based on Negative Sequence Voltages in Physics
(Abstract) J Electrocardiol 2007; 40; 4S: S64

(18) A proposed new theory for spontaneous ventricular fibrillation, tachycardia or ventricular premature contractions

Negative sequence voltages appear as an abnormal inscription direction in the repolarisation process of the ventricle. It could happen in a diseased or electrocardiographic ‘normal’ heart. The heart will generate a ventricular premature contraction (‘physiological’ pacing) or contractions (‘physiological’ overdrive suppression) to abolish the negative sequence voltages induced abnormal activation propagation. The threshold for when this physiological correction will appear through the autonomic nervous system is variable depending on the individual patient (i.e. heart conditions, body weight, age...etc.). If it is not successful, the ventricular flutter from single foci or chaotic ventricularl fibrillation from multiple foci will ensue. With the help of chamber enlargement and/or abnormal conduction within the ventricle, the abnormal rhythms will be sustained.

Carson W, Tseng YZ. A Proposed New Theory for Spontaneous Ventricular Fibrillation or tachycardia or Ventricular Premature Contractions Based on Negative Sequence Voltages in Patients with Acute Myocardial Infarction
(Abstract) J Electrocardiol 2007; 40; 4S: S63

(19) Negative sequence voltages evaluation of atria in patients who received coronary artery bypass graft surgery

In patho-electro-physics-physiology, coronary artery bypass graft surgery can alter negative sequence voltages from coronary artery disease, but surgery itself can also contribute to iatrogenic negative sequence voltages in the atria. The figure-of-eight inscription direction of the P-loop in the Horizontal plane can not be classified as normal in physics.

Carson W, Hsu JC, Chu SH, Tseng Y.Z. Negative Sequence Voltages Evaluation of Atria in Patients who Received Coronary Artery Bypass Graft Surgery
(Abstract.) The XXXV International Congress on Electrocardiology. St. Petersburg, Russia, 18th – 21st September 2008.

(20) Negative sequence voltages evaluation of ventricles in patients who received coronary artery bypass graft surgery

In patho-electro-physics-physiology, coronary artery bypass graft surgery can alter negative sequence voltages from coronary artery disease, but surgery itself can also contribute to iatrogenic negative sequence voltages in the ventricles. Because ventricles are closer to the operation area than the atria, it is easier to create iatrogenic negative sequence voltages. The clockwise inscription direction of the T-loop in the F plane can not be classified as normal in physics.

Carson W, Hsu JC, Chu SH, Tseng Y.Z. Negative Sequence Voltages Evaluation of Ventricles in Patients who Received Coronary Artery Bypass Graft Surgery
(Abstract.) The XXXV International Congress on Electrocardiology. St. Petersburg, Russia, 18th – 21st September 2008.

(21) Negative sequence voltages in acute heart failure

Pending

(22) Negative sequence voltages in chronic heart failure

Pending