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The Crux

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CONTENTS

Editorial

This issue's DISEASE DIAGNOSIS features an easily preventable malady. A disease that can be averted by timely use of antibiotics. A disease with serious life-threatening consequences. A disease of the developing world. The famous saying “Licks the joints but bites the heart” is associated with this problem. Yes, you have guessed it right, we are talking about Rheumatic fever. A problem as simple as common throat infection by beta haemolytic Streptococci can cripple a person for the rest of the life. Instead of taking medication for years and perhaps decades, it is better to cover up and control the initial infection by a simple course of appropriate antibiotics for 5 days. Most cardiac valvular diseases found in the world are secondary to the entity discussed in the following pages.
Complete clinic-diagnostic aspects are presented at length.

As the medical world advances, the duration between the sample collection and report generation/interpretation with necessary action initiation is thought and ought to markedly decrease/ diminish. Consequently a new terminology has been evolved -- " Point Of Care Testing" or POCT in short, it implies - testing done by the bed side or at most at the side-room of the ward. This has its own related Quality Assurance (QA) issues as the tests are not performed by fully trained technological experts or Laboratarians but rather by the clinically associated individuals which could be a nurse on duty or a resident doctor on duty or a clinical assistant on duty. Doubt all reports unless accompnaied by QA protocols and certifications by POCT co-ordinators. This issue's TROUBLE SHOOTING segment delves deep into POCT QA related issues.

INTERPRETATION outlines the various serum protein abnormalities with the entities that cause them.

BOUQUET has a descriptive narration about the international language, viz., ENGLISH, laugh it out! Is it a funny language? You decide for yourself. Hear what the wisdom is whispering. Scratch your head to get the answers right under brainteasers. Happy reading!

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DISEASE DIAGNOSIS

RHEUMATIC FEVER

Description
Delayed sequela of upper respiratory infection with group A streptococcus, occurring 2-3 weeks after infection. Characterized by nonsuppurative inflammatory lesions involving primarily the heart, joints, subcutaneous tissues, and central nervous system. Classic form is acute, febrile, and self-limiting. Damage to heart valves can occur, be chronic and progressive, and lead to heart failure and death many years after the initial episode.

Synonyms
Acute rheumatic fever / Rheumatic carditis

Urgent action
Congestive heart failure, a rare complication, requires immediate treatment.

Background
Cardinal features
Acute episodes occur about 2-3 weeks after group A streptococcal pharyngitis. Clinical presentation is highly variable, possibly including carditis, Sydenham's chorea, migratory polyarthritis, erythema marginatum, and subcutaneous nodules. Initial treatment involves eradication of residual group A streptococci, reduction of inflammation, and treatment of congestive heart failure if present. Prophylaxis against additional group A streptococcal infections necessary for at least 5 years (length of treatment reflects degree of cardiac involvement).

Causes
Common causes
In all instances, occurs as a delayed sequela of group A streptococcal pharyngitis, including pharyngitis associated with scarlet fever. Never results from group A streptococcal skin infections.
Contributory or predisposing factors
Repeated upper respiratory infections. Family history of rheumatic fever. Crowded living or working conditions, such as military bases.

Epidemiology
Incidence
The incidence of rheumatic fever is very low in the West (e.g in Scotland, 6/million per year; in the US <2/100,000). In developing countries it may exceed 100/100,000. Overall incidence is 18 per 100,000 in ages 5-17; more rare in adults.

Demographics
Age
In children, peak incidence between ages 5-15. Adults more likely to have recurrent than primary disease. In adults, peak incidence of primary adult disease is end of the second to the beginning of the third decade of life.
Adults: More likely than children to have accompanying severe arthritis. Less likely than children to have accompanying chorea.
Gender
Females more often affected.
Genetics
Familial pattern of occurrence often seen; one or more genes may confer susceptibility
Geography
Rare in developed countries. Rampant in Middle East, Indian subcontinent, and parts of Africa and South America.
Socioeconomic status
Historically linked to inner-city poor.

Diagnosis
Clinical presentation
Symptoms
Nonspecific symptoms: Fever. Aching joints. Abdominal pain, sometimes severe. Possible nosebleeds. Weakness. Fatigue.
Specific symptoms: Arthritis that affects numerous joints but emerges in one joint at a time. Abnormal heartbeat. Chest pain. Possible shortness of breath. Red patches on skin, possibly with normal skin in the center of each patch. Small, painless lumps beneath skin. Rapid, involuntary movements in muscles of extremities and/or face (rare in adults).

Signs
Major manifestations
Carditis (65% of patients):
When present, usually appears early in the course of disease. New murmur of mitral or aortic insufficiency. Mitral regurgitation typically of moderate to high intensity throughout systole. Aortic insufficiency (less common), signaled by basal diastolic murmur. Pancarditis and pericardial friction rub, with pericardial and myocardial involvement, may accompany valvulitis. Cardiomegaly. Congestive heart failure. Transient mitral diastolic murmur.
Migratory polyarthritis (75% of patients):
Most often affects large joints of extremities. Extremely painful, with redness, heat, swelling, and limitation of motion. Typically disappears in less than 4 weeks.
Sydenham's chorea, St. Vitus' dance (5-10% of patients):
Rapid, uncontrolled motions of face and upper extremities. Sometimes cease during sleep. Onset may be delayed for months, presenting after other signs have resolved. Attacks can last 2-4 months. Rare in adult females; almost nonexistent in adult males.
Subcutaneous nodules (10% of patients):
Firm, painless nodules typically on wrists, elbows, knees, and Achilles tendons, from a few millimeters to about 2cm in size. Resemblance to the nodules associated with systemic lupus erythematosus. Nodules nearly always occur in conjunction with carditis. Usually persist 1-2 weeks.
Erythema marginatum (less than 5% of patients):
Nonpruritic, nonpainful eruption. Raised or flat erythematous patches, commonly on trunk and proximal parts of extremities. Evanescent in nature; patterns can change before the observer's eyes. Center of each patch returns to normalcy in advance of the margins. Generally associated with subcutaneous nodules; nearly always seen in conjunction with carditis. Lesions may last minutes to hours; entire process may occur over weeks to months.
Minor manifestations:
Arthralgia. Fever: 101-104ºF (38.3-40.0ºC). Elevated acute-phase reactants (C-reactive protein and erythrocyte sedimentation rate (ESR)). Prolonged PR interval on electrocardiogram. Leukocytosis (indicative of previous rheumatic fever).

Differential diagnosis
Bacterial endocarditis
The main features of bacterial endocarditis are as follows:
Features
Valvular endocardium most often involved. Abrupt onset with high fever and systemic toxicity. New or altered heart murmur in some cases. Endocarditis affecting native valves, most often seen in patients above age 50, frequently with a predisposing cardiac lesion. Bacterial endocarditis can complicate pre-existing rheumatic heart disease.
Viral myocarditis
Features
Usually follows viral illness by two weeks. May present with fatigue, palpitations, dyspnea with exertion, chest pain (35% of cases), fever (20% of cases). Fulminant congestive heart failure in some instances.
Systemic lupus
The main features of systemic lupus are as follows:
Features
Most cases are in women of childbearing age. Nearly any organ system may be affected. Common manifestations are fever, fatigue, rash (often facial 'butterfly' rash), inflammatory arthritis, anemia, cardiopulmonary symptoms (pleuritis, pericarditis, myocarditis, endocarditis), nephritis, peritonitis, and organic brain syndromes. Presence of antinuclear antibodies a cardinal feature.
Serum sickness
Features
Serum sickness occurs 6-21 days after injection of foreign protein or serum.

Usual symptoms are fever, arthralgia, lymphadenopathy, and skin eruption. Possible chest pain and dyspnea. Systemic disease usually preceded by pain, pruritus, and swelling at injection site.

Rheumatoid arthritis

The main features of rheumatoid arthritis are as follows:

Features

Characterized by persistent inflammatory synovitis, usually affecting peripheral joints. Most cases seen in women in fourth and fifth decades. Early morning stiffness, arthritis involving at least three joints, subcutaneous nodules, occasional rash, thick synovium.

Infectious arthritis

The main features of infectious arthritis are as follows:

Features

Presents as a monoarticular process involving large joints. Swelling, pain, warmth, and restricted movement. Predisposing factors include immunosuppression, alcoholism, intravenous drug use, and former joint damage.

Workup

Diagnostic decision

Rheumatic fever should be considered highly probable in patients with evidence of a preceding group A streptococcal infection of the upper respiratory tract in conjunction with either two major manifestations, or one major and two minor manifestations. Lack of evidence of a preceding group A streptococcal infection makes the diagnosis doubtful in nearly all instances. Guidelines not intended to substitute for clinical judgment.

Major manifestations:

Carditis. Polyarthritis. Chorea. Erythema marginatum. Subcutaneous nodules.

Minor manifestations:

Arthralgia. Fever. Laboratory findings of elevated acute phase reactants, ESR, C-reactive protein. Electrocardiographic findings of prolonged PR interval.

Supportive evidence of antecedent group A streptococcal infection:

Positive throat culture or rapid streptococcal antigen test.

Elevated or rising streptococcal antibody titer.

Exceptions to the above criteria:

Chorea may be the sole manifestation of rheumatic fever. Indolent carditis may be the sole manifestation in patients who seek medical treatment months after the onset of rheumatic fever. In individuals with a history of rheumatic fever or rheumatic heart disease, pre-emptive diagnosis of a rheumatic recurrence may be based on a single major or several minor manifestations, provided supporting evidence of a recent group A streptococcal infection exists.

Summary of tests

Throat culture: useful in all cases for evidence of a preceding group A streptococcal infection. Rapid antigen test: commonly used to screen for group A streptococcal infection, but throat culture is more definitive. Serologic antibody tests: used when throat culture and rapid antigen tests are negative. Antistreptolysin O (ASO) titer most commonly used, but anti-DNase B and antihyaluronidase titers may also be obtained. Acute phase reactants: Erythrocyte sedimentation rate (ESR) and C-reactive protein. Test results may assist diagnosis by fulfilling a minor manifestation of the Jones Criteria. Chest X-ray: indicates cardiomegaly and congestive heart failure, if present. Echocardiography: may confirm evidence of cardiac involvement. Electrocardiography: may indicate pericarditis, or prolonged P-R interval, which is identified by the revised Jones Criteria as a minor manifestation of rheumatic fever.

Tests

Throat culture

Description

Swab of pharynx, particularly areas of inflammation or exudates.

Advantages/disadvantages

Advantages:

More sensitive than rapid antigen tests. Relatively noninvasive and inexpensive.

Disadvantages:

Results are often negative by the time patient seeks treatment. Positive result does not differentiate between recent infection and chronic pharyngeal carriage, which is more likely to occur in children than adults.

Normal

No growth of group A streptococcus.

Abnormal

Growth of group A streptococcus. Keep in mind the possibility of a false-positive result.

Cause of abnormal result

Suggests prior infection with group A streptococcus.

Medications, disorders and other factors that may alter results

Time elapsed since initial infection. Rheumatic fever typically latent for 10 days or more following pharyngitis. Accordingly, positive throat cultures seen in only about 25% of patients with acute rheumatic fever.

Rapid antigen testing

Description

Throat culture taken from inflamed, purulent, or ulcerated areas.

Advantages/disadvantages

Advantages:

Faster results than is possible with throat culture. Relatively noninvasive and inexpensive.

Disadvantage:

Results considered less definitive than those of throat culture, particularly if negative.

Normal

Negative results for group A streptococcus.

Abnormal

Positive results for group A streptococcus. Keep in mind the possibility of a false-positive result.

Cause of abnormal result

Suggests that patient had streptococcal pharyngitis prior to the onset of acute disease.

Medications, disorders and other factors that may alter results

Test must be performed precisely according to instructions on the package insert, otherwise its sensitivity and specificity will be reduced.

Streptococcal antibody tests

Description

Venous blood sample. Most frequently used test is antistreptolysin O (ASO). Anti-DNase B used less commonly.

Advantages/disadvantages

Advantages:

Relatively inexpensive and noninvasive. Elevated or rising titers indicated by any of these tests fulfill the Jones Criteria for evidence of a recent group A streptococcal infection.

Disadvantages:

Mild discomfort associated with blood draw. About 20% of patients evaluated within the first 2 months of acute onset of rheumatic fever have low or borderline ASO titers. However, when three different antibody tests are used, about 95% of patients show an elevated titer in at least one test.

Abnormal

Elevated or rising titers. A significant increase is defined as a rise in titer of two or more dilution increments between acute-phase and convalescent-phase specimens. ASO titer equal to or above 240 Todd units in adults is considered elevated. Anti-DNase B titer equal to or above 120 Todd units in adults is considered elevated. Antihyaluronidase titer above 1:256 is considered elevated. Keep in mind the possibility of a false-positive result.

Cause of abnormal result

Recent infection with group A streptococcus.

Medications, disorders and other factors that may alter results

Time elapsed since infection. A patient who waits months or years before seeking medical attention is less likely to show an elevated titer.

Erythrocyte sedimentation rate

Description

Venous blood sample.

Advantages/disadvantages

Advantages:

Relatively noninvasive and inexpensive. If elevated, fulfills a minor manifestation

for the Jones Criteria.
Disadvantages:
Results not in themselves of significant diagnostic value. Can be elevated by many different causes of systemic inflammation.
Normal
Males: 0-15mm/h. Females: 0-20mm/h.
Abnormal
Values above normal. Keep in mind the possibility of a false-positive result.
Medications, disorders and other factors that may alter results
Pregnancy. Advanced age. Increase in globulin proteins. Extensive tissue necrosis. Anemia. Heparinized blood.

C-reactive protein
Description
Venous blood sample.
Advantages/disadvantages
Advantages:
Relatively inexpensive and noninvasive. Positive result fulfills a minor diagnostic criteria for rheumatic fever.
Disadvantage:
Can be elevated by many different causes of inflammation.
Normal
Negative.
Abnormal
Positive. Keep in mind the possibility of a false-positive result.
Cause of abnormal result
In patients with other indications of acute rheumatic fever, abnormal result increases cause to suspect this diagnosis.
Medications, disorders and other factors that may alter results
Elevation likely to occur in response to a variety of acute insults, including surgery.

Chest X-ray
Advantages/disadvantages
Advantages:
Noninvasive, relatively inexpensive. Reveals cardiomegaly and congestive heart failure.
Disadvantages:
Low-level radiation exposure (about 6nrem). However, the risk of harmful effects is low. Findings not specific to rheumatic fever.
Abnormal
Cardiomegaly. Congestive heart failure, Kerly B lines. Increased pulmonary vascularity, possible pleural effusion. Keep in mind the possibility of a false-positive result.
Cause of abnormal result
Myocardial dysfunction secondary to carditis; valvular malfunction such as mitral regurgitation.
Medications, disorders and other factors that may alter results
Patients with coronary artery disease, viral myocarditis, or any other cause of cardiomyopathy can exhibit similar results.

Echocardiogram
Description
Ultrasound waves are used to produce a visual image of intracardiac structures, allowing for evaluation of cardiac function and valvular integrity. Transthoracic echocardiogram is accomplished via a transducer that is passed over specific areas of the thorax. Transesophageal echocardiogram is accomplished via a transducer introduced into the patient's esophagus; this procedure may require sedation and intravenous access.
Advantages/disadvantages
Advantages:
Relatively noninvasive. Can detect valvular dysfunction and pericardial effusions, and can evaluate myocardial performance.
Disadvantages:
Moderately expensive. Results are not specific to rheumatic heart disease: any disorder that causes valvular abnormalities, pericardial effusion, or myocardial dysfunction can produce similar results.
Abnormal
Valvular regurgitation most likely abnormal finding with rheumatic fever. Valvular thickening and/or restriction of leaflet mobility. Focal valvular nodes reported in acute stage of rheumatic fever. Pericardial effusion. Global or segmental myocardial dysfunction.
Cause of abnormal result
Inflammation associated with carditis can cause pericardial effusion. Myocardial involvement or severe valvular regurgitation can lead to cardiac dysfunction. Inflammation of cardiac valves can lead to structural or functional abnormalities.
Medications, disorders and other factors that may alter results
Any disorder involving cardiac valvular abnormalities (including congenital heart disease), myocardial inflammation (including viral infections), and myocardial dysfunction (such as coronary artery disease) can produce similar results.

Electrocardiogram
Advantages/disadvantages
Advantages:
Noninvasive, relatively inexpensive. May demonstrate ST or T wave changes suggestive of myocarditis or pericarditis, or prolonged PR interval, a minor diagnostic manifestation of rheumatic fever.
Disadvantage:
Nonsensitive, nonspecific test.
Normal
Normal PR interval: 0.12-0.20. Isoelectric ST segments, normal T wave repolarization.
Abnormal
PR interval in excess of normal range. Diffusely elevated ST segment changes, or T wave inversions. Keep in mind the possibility of a false-positive result.
Cause of abnormal result
Carditis can result in diffuse inflammation with generalized ST segment and T wave changes, and prolonged AV block.
Medications, disorders and other factors that may alter results
Hyperthyroidism. Any cause of pericarditis, or myocarditis. Pre-existing conduction system disease. Any drug associated with increased PR interval: beta and calcium channel blockers, procainamide, digitalis, quinidine, amiodarone, etc.

Clinical Hallmarks
Avoid use of echocardiography to 'overdiagnose' valvular regurgitation in the absence of clinical manifestations. Myocarditis or pericarditis in the absence or valvular involvement is not likely to be rheumatic fever. Failure of the arthritis to respond dramatically to anti-inflammatory agents should cause a re-evaluation of the diagnosis.

Treatment
Goals
Reduce constitutional symptoms. Monitor cardiac function and refer as necessary. Provide long-term prophylaxis.
Immediate action
Congestive heart failure requires immediate treatment.

Therapeutic options
Summary of therapies
Penicillin: 10-day course of therapy is recommended for all patients with acute rheumatic fever even though throat culture is likely to be negative. Following this treatment, patient should begin long-term prophylaxis with penicillin. Erythromycin: possible alternative for patients allergic to penicillin; used both for initial 10-day therapy and subsequent long-term prophylaxis. Sulfadiazine: possible alternative to penicillin for long-term prophylaxis. Aspirin: used in patients with mild or no carditis to relieve joint pain. Corticosteroids: used in patients with significant carditis. Bed rest: recommended for all patients during acute phase.

INTERPRETATION

SERUM PROTEINS

Relevant normal values

Serum Total proteins: 6.0 - 8.0 gm/dL
Serum Albumin : 3.7 - 5.3 gm/dL
Serum Globulins: 2.3 - 3.6 gm/dL
A/G ratio: 1.0 - 2.5

Causes of Hypoalbuminemia

Reduced Synthesis
Malnutrition. Malabsorption syndromes. Chronic inflammatory diseases. Acute hepatitis (lasting 14 days or more). Chronic liver disease. Genetic abnormalities.
Increased loss
Nephrotic syndrome. Massive burns. Protein-losing enteropathy.
Increased catabolism
Massive burns. Widespread malignancy.
Multifactorial
Cirrhosis. Congestive heart failure.

Disorders associated with polyclonal gammopathies

Chronic liver disease
Nutritional cirrhosis. Primary biliary cirrhosis. Chronic active hepatitis. Viral hepatitis.
Collagen diseases
Rheumatoid arthritis. Systemic lupus erythematosus. Sjogren's syndrome. Felty's syndrome. Polymyositis. Scleroderma.
Chronic infections
Tuberculosis. Osteomyelitis. Deep fungi. Syphilis. Bronchitis. Pregnancy.
Miscellaneous
Metastatic carcinoma. Cystic fibrosis. Recovery from trauma.

Causes of Monoclonal gammopathies

Multiple myeloma. Waldenstrom's macroglobulinemia. Benign idiopathic monoclonal gammopathy. Heavy chain diseases. Collagen disorders, autoimmune diseases. Certain lymphomas. Cirrhosis liver. Neoplasms of colon, prostate, breast, female genital tract, stomach and lungs. Myeloproliferative disorders-CML, polycythemia, myelofibrosis, erythrimic myelosis, erythroleukemia, other acute leukemias. Aberrations in lipid metabolism. Diabetes mellitus.

Note: A minor correction to be noted in the Interpretation section of last issue, the values of Serum iron is to be read as _g/dl instead of the printed g/dl.

BOUQUET

In Lighter Vein

ENGLISH!
The English Language
Have you ever wondered why foreigners (non English) have trouble with the English Language?
Let's face it

Is English is a stupid language?
There is no egg in the eggplant
No ham in the hamburger
And neither pine nor apple in the pineapple.
English muffins were not invented in England
French fries were not invented in France.

We sometimes take English for granted
But if we examine its paradoxes we find that
Quicksand takes you down slowly
Boxing rings are square
And a guinea pig is neither from Guinea nor is it a pig.
If writers write, how come fingers don't fing.
If the plural of tooth is teeth
Shouldn't the plural of phone booth be phone beeth
If the teacher taught,
Why didn't the preacher praught.

If a vegetarian eats vegetables
What the heck does a humanitarian eat!?
Why do people recite at a play
Yet play at a recital?
Park on driveways and
Drive on parkways You have to marvel at the unique lunacy
Of a language where a house can burn up as
It burns down
And in which you fill in a form
By filling it out
And a bell is only heard once it goes!
English was invented by people, not computers
And it reflects the creativity of the human race
(Which of course isn't a race at all)

That is why
When the stars are out they are visible
But when the lights are out they are invisible
And why it is that when I wind up my watch
It starts
But when I wind up this observation,
It ends.

Wisdom Whispers

- "Stay is a charming word in a friend's vocabulary."
- What is a friend? A single soul dwelling in two bodies."
- "For what is the best choice, for each individual is the highest it is possible for him to achieve."
- "No great deed is done by falterers who ask for certainty."
- "Three grand essentials to happiness in this life are something to do, something to love, and something to hope for."
- "To live we must conquer incessantly, we must have the courage to be happy."
- "The less routine the more life."
- "We cannot advance without new experiments in living, but no wise man tries every day what he has proved wrong the day before."
- "Every man who is high up loves to think that he has done it all himself; and the wife smiles, and lets it go at that."

Brain Teasers

1. In an Oncocytoma the oncocytes have
   A. Sac-like mitochondria B. Large phagosomes
   C. Disrupted Golgi apparatus D. Water logging
2. Enzymatic fat necrosis may be associated with
   A. Acute pancreatic necrosis B. Acute appendicitis
   C. Ulcerative colitis D. Sarcoidosis
3. Term used to denote nuclear fragmentation in necrosis is
   A. Pinocytosis B. Pyknosis C. Karyolysis D. Karyorrhexis
4. Midzonal necrosis in liver may be seen in
   A. Yellow fever B. Enteric fever C. Scarlet fever D. Blackwater fever
5. Drumstick is found in
   A. Neutrophils B. Lymphocytes C. Monocytes D. Basophils
6. Which of the following breast malignancies has the highest survival rate?
   A. Invasive lobular carcinoma B. Schirrhous carcinoma
   C. Lymphoma D. Medullary carcinoma
7. Multinucleated Giant cells in kidney may be seen in:
   A. Diabetes B. Chronic interstitial nephritis
   C. Hypertension D. Multiple myeloma
8. Chloromas are found in association with:
   A. ALL B. AML C. Plasma cell leukemia D. Stem cell leukemia

Answers : 1. A, 2. A, 3. D, 4. A, 5. A, 6. D, 7. D, 8. B

TROUBLESHOOTING

POCT Quality Assurance (QA)

Quality Assurance is a vast subject and is of fundamental importance to every laboratory department. It could be argued that QA involvement in POCT is of even greater significance, since laboratory testing is being performed by non-laboratory professionals whose training in quality issues may have been less rigorous than that given to laboratory professionals. This argument presents a strong case for mandatory competency.

Quality Assurance is an overview and examination of a complete system, from approaching the patient with the intention of obtaining a sample to looking at the subsequent result report from the laboratory or POCT analyser.

Large parts of Quality Assurance involve Quality Control (QC), correlations and External Quality Assessment (EQA). Without successful QC results, correct patient results cannot be assumed.

Although not covered in the table below, attention must be given to analyser maintenance schedules, hardware and software replacements and upgrades, service records, annual preventative maintenance reports, complete documentation records and quality control records.

A good approach is to divide the QA process into three phases, Pre-Analytical, Analytical and Post-Analytical:

Pre-analytical	Analytical	Post-Analytical
patient ID confirmation	analyser operation	correct sample disposal
sample quality	operator and patient ID entry	cleanliness and tidiness
aseptic technique	sample mixing and preparation before analysis	examination and interpretation of results
correct collection tubes	CO-Ox haemoglobin measurements	notification of abnormal results
order of draw	correct analysis technique	inclusion in patient record
capillary samples	analyser maintenance	audit trails
sample labelling	calibrations	competency records
sample transport	quality control troubleshooting	proficiency testing

All staff who operate POCT equipment should have an awareness of and be responsible for:

- identifying the patient correctly
- the quality of the patient's sample to be analysed
- ensuring the analyser or procedure is calibrated correctly
- analysing any required Quality Control (QC) samples
- regular analyser or procedure maintenance
- documentation of all QC results, patient results, maintenance records, troubleshooting records, error messages
- their current competency requirements for all relevant POCT processes

Pre-Analytical Technique

Patient ID confirmation

To confirm the ID of a patient, two points of ID must be cited. The acceptable choices are in descending order of importance: NHI number, e.g., XYZ9876; hospital temporary allocated number; surname and given name; date of birth.

Sample quality

Regardless of whether the puncture site be a heel, digit, ear lobe or elbow, it is important for the sake of a good sample that the puncture site be:

- clean
- dry
- healthy
- ***not*** from the drip arm
- free from contaminants, e.g., saliva, sugar (from sweets, drinks, etc)
- alcohol free (from sterilizing swabs)

Other types of samples, like CSF, urine, stool, drain fluids, wound swabs, skin scrapings, etc must also be collected in as careful, aseptic manner as possible. The quality of the sample determines the quality of the results.

Aseptic technique

- Always wash your hands before approaching the patient
- Wear gloves (and wash your hands between patients, even if wearing gloves).
- Wear prescribed protective clothing if dealing with infectious patients.
- Prepare the puncture site as described above.
- Always wash your hands after leaving the patient.

Correct collection tubes

Although Phlebotomy staff collect most patient samples via venepuncture, it is important for clinical staff to know which collection tubes are appropriate for which blood test.

The order of draw is also very important.

From first to last, in sequence: blood cultures, red top, SST, blue, green, lavendar, gray. The reason for this sequence is to minimise tube contamination from additives and anticoagulants. Sterilise the entry point of the blood culture tubes before inoculating them.

These colour codes relate to Becton-Dickinson brand products, whether for macro-collecting (venepuncture) or micro-collecting (capillary) samples:

Blood culture tubes	Blood cultures
Red top (Plain tube- no additives) SST(serum separator tube)	Some Biochemistry, Serology, Virology, crossmatching.
Dark blue (chemically clean)	Trace Metal tests
Light blue top (citrate)	Haemostasis tests
Green top (Lithium heparin)	Routine Biochemistry tests
Lavendar or purple top (EDTA)	Haematology; blood lead testing, crossmatching
Gray top (fluoride)	Glucose, lactate

Capillary blood gas samples

Capillary blood gases need to be collected into special balanced-heparin blood gas capillary collection tubes.

Always make sure your sample is WELL MIXED. Try not to expose a blood gas capillary sample to ambient air as gas partial pressures in the sample may change. Mix your capillary blood gas sample by holding the tube horizontally and rolling it back and forth between finger and thumb. Don't slosh it back and forth along the tube. Do not use pO_2 readings- capillary blood collects are exposed to too much ambient oxygen. In addition, peripheral perfusion is too variable for consistent pO_2 readings.

Sample labeling

All collection tubes and request forms must be labelled clearly with the patient's ID sticker. When this is not available, their IP No./Op no. or temporary hospital number, surname and date of birth must be written on the tube(s). The request form must state clearly which tests are required and include the same patient information as the sample collection tubes. The request form should also include the date and time of sample collection as well as a clear indication of the requesting doctor and location of the patient.

Sample transport

A long delay can occur when samples sent to the laboratory for analysis are delivered tardily. This may be for a variety of reasons- a delay in pickup from the ward or delivery forgotten *en route* to the lab. A delay of several hours may result in lowered blood glucose, raised potassium, phosphate and CK- all a result of cellular metabolism or perhaps, haemolysis. If a blood gas is delayed more than 30 minutes, the results may be useless.

Many hospitals now utilise a pneumatic tube delivery system which solves the transport delay times. However, tube breakdowns can occur, for a variety of reasons, human, electronic or mechanical.

Point of care testing obviates any need for sample transport to the laboratory.

Analytical Technique

Analyser operation; operator and patient ID entry

Please refer to the relevant operator's manual for analyser operation. All clinical staff operating POCT analysers should have a current competency which includes instructions on how to operate POCT equipment.

All POC Tests must be able to be traced or audited. This means that print outs, transcriptions or electronic results must contain the POCT operator's ID (or initials at the very least) and the patient's ID. The date and time of analysis and sample type must also be noted on the results.

Sample mixing and preparation

After collecting your venous sample, gently invert the collection tubes at least five times, to thoroughly mix the anticoagulant in the tube with the blood.

If a blood gas sample, at the blood gas analyser, mix the arterial or capillary blood gas sample by holding the tube horizontally and rotating it between fingers and thumb. Alternate this action with gentle inversions of the syringe. There must be ***no air bubbles*** present in the syringe or capillary sample.

Try not to slosh the blood back and forth along the length of the capillary tube. Keep the blood/air contact to a minimum. Remove caps and any metal flea or mixer before aspirating the sample.

If you are analysing an arterial blood gas sample for CO-Oximetry:

i.e., (haemoglobins and oxygen saturation parameters), it is vitally important that the sample be well-mixed. Gently rotate and invert the blood gas syringe for *at least 30 seconds* before aspirating the sample. The blood must be as homogenous as if it were still in the patient. (The reason for this is in the method of analysis of the haemoglobins- a sample of blood is electronically haemolysed and the intensity of the clear red solution of blood is measured at certain wavelengths).

Correct analysis technique

Always follow the manufacturer's guidelines on sample analysis. Clear simple instructions should be given in the Operator's Manual near the analyser. Failure to analyse the sample properly will lead to erroneous quality control and patient results.

Analyser maintenance

Where an analyser is in use, correct maintenance schedules must be maintained. Always fulfill any daily maintenance criteria required and sign and date the maintenance logs. Note any consumable replacements, e.g., reagents or calibrators and also make note of any changes in lot numbers. **Any change in the status quo of the analyser, like reagent changes, cartridge or test strip lot number changes, etc, MUST be followed by a successful calibration and after that, a successful quality control sample result.**

Calibration

All analytical procedures, whether POCT or laboratory-based in nature must be calibrated before use. Calibrating a procedure means that you are defining a starting point from which all other results flow. A quality control (QC) sample tests the correctness of the calibration. Many people confuse these two concepts.

Most blood gas analysers self-calibrate every 30 minutes. If analyser conditions have not altered between timed calibrations, no QC is necessary.

Manual POC testing that does not involve analysers may not need to be calibrated: a visually interpreted urine test strip is an example of this. Wherever possible though, a quality control sample should always be analysed daily before patient testing begins, or if the conditions of analysis change, as mentioned above.

Quality Controls

Quality Control (QC) samples and patient samples should be analysed using identical techniques and under identical conditions. The only difference is that the value(s) of the QC sample are known, whereas the patient 's values are not. If the correct QC samples are obtained, we can say with confidence that the last calibration was successful, the analyser or process is functioning correctly and that the patient's results will therefore be correct.

If you have not analysed a QC sample and obtained acceptable results, you cannot assume that the patient results will be correct.

Troubleshooting

Each POCT analyser is accompanied by a Users' Manual, compiled by the POCT Coordinator. Within this Manual will be a rudimentary section on troubleshooting. Often a problem that seems insurmountable can be easily resolved by restarting the analyser- turn it off, wait 10 seconds and turn it on again. On the other hand, a blood clot can be tricky to remove from a blood gas analyser.

An Error Log can be found in each Manual. Please take the time to document any problems that occur. This is important, as a documented history of problems can be very useful for warranty or replacement purposes. It is also **a Certification requirement** that all errors be documented and that a complete audit trail exists for each entry, including resolution of the error or problem.

If you have a problem that you cannot resolve or you have insufficient time to repair the problem, please contact the POCT Coordinator who is there to be used as a resource and a source of assistance.

Post-Analytical Technique

Correct sample disposal; cleanliness and tidiness

All samples must be discarded into Medical Waste containers. Any body fluid-contaminated tissues or other waste must also be discarded into Medical Waste containers.

DO NOT throw any body fluid-contaminated waste into regular paper waste containers.

All sharps- needles and so forth must be discarded into a Sharps Container.

Always clean up any spills - use Surfax or sodium hypochlorite based disinfectant - to ensure the analyser and surrounds are maintained in a clean and tidy condition. Always leave the POCT analyser or place of work in the same condition as you would expect to find it.

Examination, interpretation, notification , inclusion.

- All POCT operators should have an awareness of the meaning of the results they generate. The results should be examined with respect to units of measurement, reference intervals, meaning of abnormal results, implication to the patient and so on.
- Abnormal whole blood results that are not expected or do not fit with the clinical picture of the patient should be confirmed before being reported. Use a new sample- it is possible that the initial sample is contaminated in some way- tissue fluid, drip arm, clots, etc. If the result is still abnormal, send a *venous sample* to the laboratory for plasma analysis. (There are several shortcomings to whole blood analysis).
- Please take note and document ANY ERROR CODES generated and how the results may be affected. Please contact the POCT Coordinator for advice, if required.
- Any abnormal results should be referred to the patient's physician or senior ward/clinic staff for action and advice.
- All results should be recorded in, transcribed or affixed to the patient's notes, along with the operator ID , and the time and date of analysis.

Audit trails

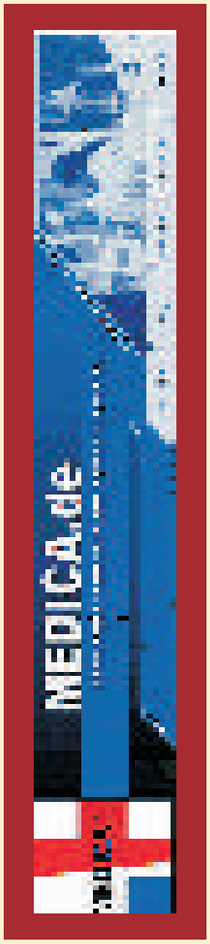
All POCT results must be of the same standard as laboratory results. This statement lies at the heart of successful POCT. One of the requirements of laboratory testing is the successful passing of audits. All POCT results must be able to pass an audit. This means that the results must be able to be traced to:

- the patient
- the operator
- the machine or process used
- relevant maintenance and QC logs
- the date and time
- current competency records held by the operator

External Quality Assessment and Proficiency Testing

All POCT must be quality controlled (QC) regularly. While QC is generally regarded as a day-to-day procedure for each analyser or procedure, External QA is performed at less regular intervals, typically monthly.

Proficiency Testing or sample correlation testing is another approach to QC. Proficiency testing can involve more than a single laboratory or POCT site.



Tulip Group Exhibits Its Products At Medica 2007

39th International Trade fair with Congress World Forum for Medicine was held at Dusseldorf from 14th to 17th November 2007. The event attracted 137,000 visitors from around 100 countries and over 4300 exhibitors. This year Medica Congress had a whole range of themes in store from disease prevention to state-of-the-art diagnostics through to telemedicine upto emergency medicine or also legal issues.

Tulip Group of Companies take active participation in this annual event year after year. The entire range of CE marked *in vitro* diagnostics products were exhibited in this

international event, The main focus, however was newly developed, innovative Accumix range of dehydrated culture media and High technology disinfectants manufactured by BioShields. The response was excellent and enquiries have started pouring in."Tulip Group", an established name nationally and internationally, is determined to make its world class quality products reach every nook and corner of the world.

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