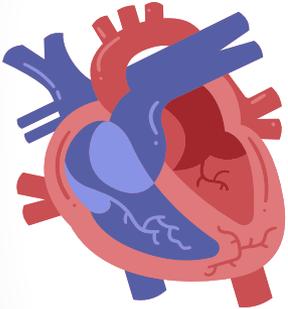
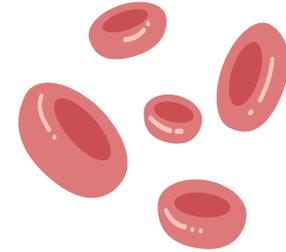




جمهورية العراق
وزارة التعليم العالي والبحث العلمي
جامعة المستقبل
كلية التقنية الطبية والصحية
قسم تقنيات المختبرات الطبية



Practical Hematology / 3rd stage ology



Rusul Mushtaq Talib Al-Muhammadawi

Classroom

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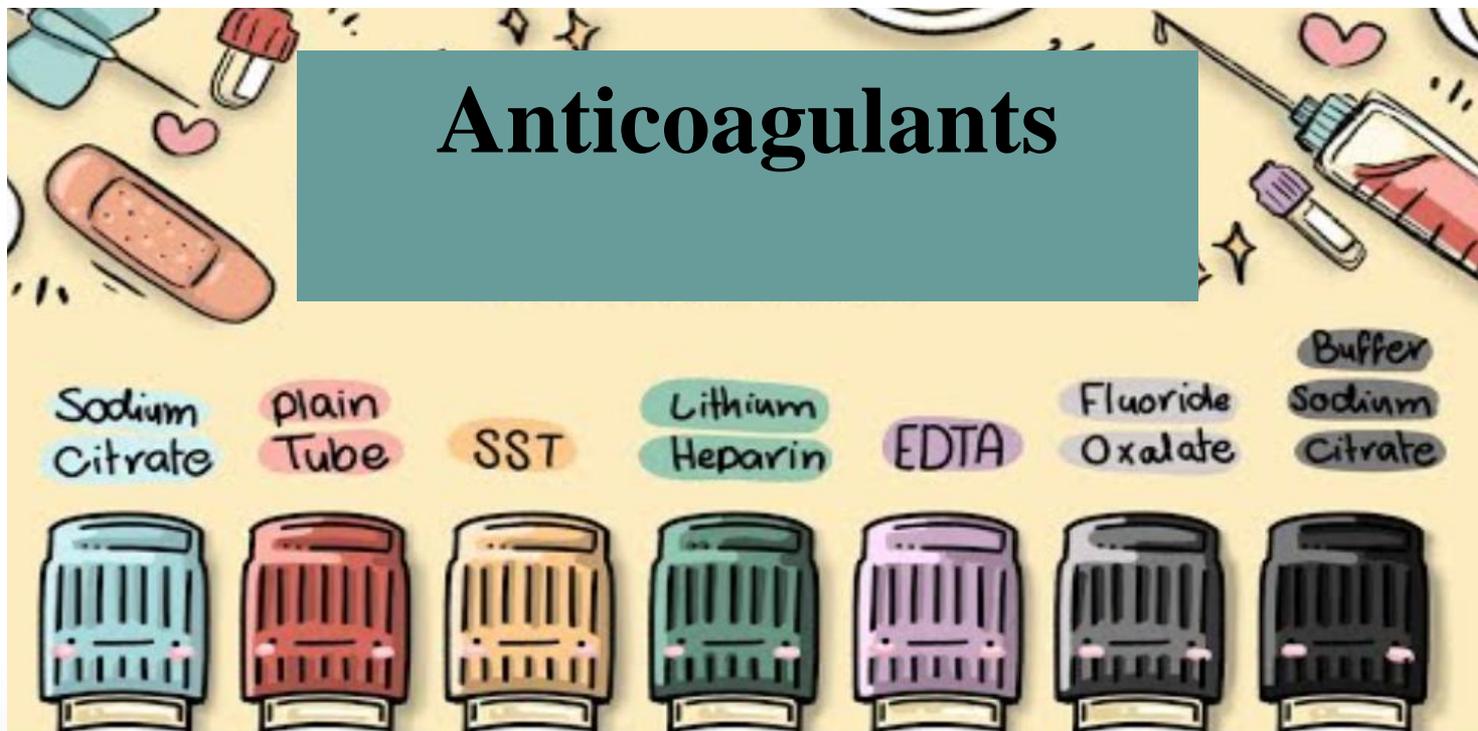
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Class code

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Lecture two: Anticoagulants used in hematology laboratory

Anticoagulants



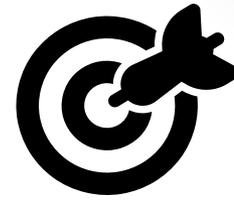
Anticoagulants

General Objective



To enable the student to understand the role of anticoagulants in medical laboratories, and to be able to distinguish their types, mechanisms of action, and specific uses in different laboratory tests accurately.

behavioral Objectives



By the end of the lecture, the student should be able to:

- 1. Define anticoagulants** and explain their importance in preventing blood clotting in laboratory specimens.
- 2. List the common types of anticoagulants** (EDTA, Sodium Citrate, Heparin, Oxalates, Sodium Fluoride) and describe the mechanism of action of each.
- 3. Associate each anticoagulant with its appropriate laboratory test**, such as CBC, ESR, and Blood Gas Analysis.
- 4. Explain the advantages and disadvantages of each anticoagulant** and their effects on blood cells or test results.
- 5. Select the correct anticoagulant** for each type of test to ensure accurate results and specimen integrity.

Question (Individual Activity):

5 minutes.

How do anticoagulants help in obtaining plasma from a blood sample?

كيف تساعد مضادات التخثر في الحصول على البلازما من عينة الدم؟

Can you think of other situations (outside the laboratory) where preventing clotting is necessary?

هل يمكنك التفكير في حالات أخرى (خارج المختبر) يكون فيها منع التخثر ضرورياً؟





Anticoagulants are the chemical substances that prevent the blood from clotting
When mixed with inappropriate concentration with the Blood Specimen.

Anticoagulant materials in the laboratory Uses:

Every anticoagulant is added in fixed proportion to blood -They are used to obtain plasma. -Its uses only in vitro (outside of the body). -They are toxic

Action: Their act to stop blood-clotting mechanism in vitro.

Common Anticoagulant Materials



The common anticoagulant materials which used in the daily lab's work for hematological purposes some are the following:

1. EDTA= (Ethylene diamine tetra-acetic acid)
2. Sodium Citrate: ($\text{Na}_3\text{C}_6\text{H}_5\text{O}_7 \cdot 2\text{H}_2\text{O}$)
3. Buffered citrate (sodium citrate and citric acid)
4. Heparin. And Wintroub
5. Oxalates
6. Sodium fluoride



**Anticoagulant
and
Blood Collecting Tubes**

- EDTA
- HEPARIN
- SODIUM CITRATE
- SODIUM FLUORIDE
- DOUBLE OXALATE

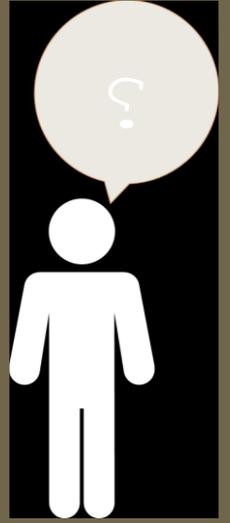


Question

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is the relationship between the
action of anticoagulants and the
natural blood clotting mechanism?

ما العلاقة بين عمل مضادات التخثر وآلية تخثر
الدم الطبيعية؟



Various types of anticoagulants with vacutainer color codes



1. EDTA – ethylene diamine tetraacetic acid edta Is a standard hematology anticoagulant because of its

- very effective and complete anticoagulation**
- lack of effect on the size (morphology) or number of blood cells in the specimen.**

Mechanism of action of EDTA :

This anticoagulant removes free calcium ions, which is essential for coagulation by chelating them .It is effective when used as about 1.2 mg/ml of blood.

Advantages of EDTA



- It gives better preservation to the **cellular morphology of blood cells when observed even after 3 hours of blood collection.**
- It can be used **for platelets counting** as it inhibits the clumping of platelets.
- Uses of EDTA : Following tests are commonly done by using EDTA as an anticoagulant –

1. Complete Blood Count (CBC)
2. PBS
3. Platelet count
4. Red cell Indices, Hemoglobin estimation, Hematocrit or Packed Cell Volume estimation Differential Leukocyte Count
5. ESR by wintrobes method
6. and HbA1C test



Disadvantages of EDTA



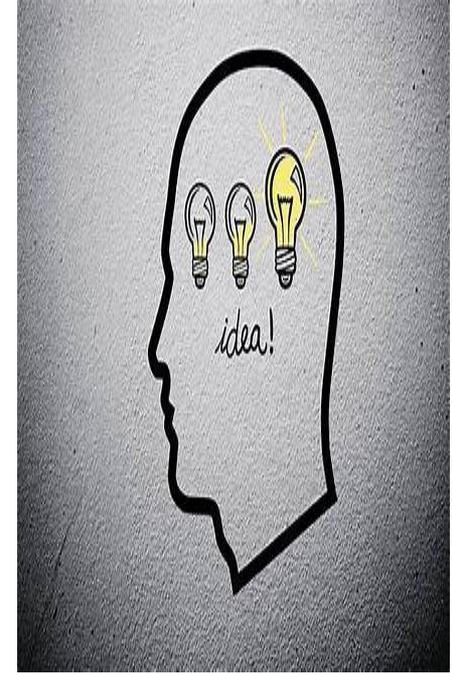
- Not used for coagulation studies because it destroys factor V and VIII. (as it chelates calcium)
- Occurs Platelet satellitism with neutrophils
- Occurs Platelet aggregation
- Excess of EDTA in the blood may lead to **shrinkage of RBCs & WBCs.** , degenerative changes in the blood cells, **decrease in Packed Cell Volume (PCV) & Increase in MCHC** (Mean Cell Hemoglobin Concentration).
- It activates naturally occurring anti-platelet auto-antibodies which cause the platelet adherence to Neutrophils.**

Individual Activity

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3minutes.

What is the practical impact of platelet satellitism caused by using EDTA as an anticoagulant in blood samples, and how can the resulting error in CBC analysis be avoided?



ما الأثر العملي لظاهرة التصاق الصفائح الدموية بالعدلات
Platelet satellitism الناتجة عن استخدام EDTA كمضاد تخثر في
عينات الدم وكيف يمكن تجنب الخطأ الناتج عنها في تحليل CBC

2. TRI-SODIUM CITRATE Sodium



Citrate Chemical Action:

-The anticoagulant removes the free Calcium ions by binding to them to form calcium citrate complex.

Sodium Citrate uses or(Advantages):

1. The anticoagulant of choice in coagulation studies. PT, TT and PTT 2. ESR by Westergren Method

Sodium Citrate Disadvantages



Citrated blood cannot be used for Packed Cell Volume (PCV), Hemoglobin (Hb) Estimation, Total Leukocyte Count TLC, and Differential Leukocyte Count (DLC) because citrate is used as a solution and it alters the concentration of blood.



ESR tube Orange:
Additive: Sodium Citrate
For ESR test



Light blue (vacuum)
Additive :Sodium Citrate
For P.T test

Biological / Natural Anticoagulant Heparin



- 1. an excellent natural anticoagulant**
- 2. sources extracted from mammalian liver or pancreas .**
- 3. more expensive than the artificial ones and has a temporary effect of only 24/ hours .**
- 4. Prevents clotting by inactivating thrombin, thus preventing conversion of fibrinogen to fibrin .**
- 5. used in the proportion of 0.1-0.2mg of the dry salt for 1ml of blood .**

Biological / Natural Anticoagulant Heparin

- 6. Heparin does not alter the size of the red cells**
- 7. The heparinized blood specimen is commonly used to Blood sample without hemolysis , blood gases especially the Arterial Blood Gas Analysis, Erythrocyte Sedimentation Rate (ESR), Red cell enzyme estimation , Packed Cell Volume (PCV), Osmotic Fragility Test (OFT), Immunophenotyping and other Hematological tests**
- 8. Not recommended for cell counting because of its clumping effect on platelets leucocytes**



capillary tube Red

Additive: Heparin
For PCV test



capillary tube Blue

Additive: non
For clotting time test

Discussion Game



2 minutes.

1-Why is Heparin preferred for Arterial Blood Gas (ABG) analysis?

2-Is it possible to use more than one type of anticoagulant in the same blood sample? What would you expect to happen?

4. OXALATES



They can be used as Single oxalates as Sodium Oxalate or Potassium Oxalate or Ammonium oxalate but are commonly used as Double Oxalates because when used alone the Potassium oxalate, when used at a concentration of 2mg/ml of blood causes the Shrinkage of Red Blood Cells (RBCs) whereas the Ammonium oxalate may cause the Swelling of Red blood cells when used at concentration of 2mg/ml.

Oxalates – Mechanism of Action



It acts as a **chelating agent and binds with the calcium ions** present in the blood and forms insoluble precipitates of Calcium Oxalates. Remember that the Potassium oxalate and Ammonium Oxalate should be used in a ratio 2:3 and at a concentration of 2mg/ml of blood.

Uses of Oxalates :

It can be used for the Blood chemistry, Packed cell volume(PCV), Erythrocyte Sedimentation Rate (ESR), Total Leukocyte Count (TLC), Specific gravity etc



5. SODIUM FLUORIDE: It is the anticoagulant of choice for the estimation of blood sugar.



(Yellow) plain tube, vacuum
Additive: None
For serum testing



(Yellow) jell tube
Additive: None
For serum testing

Thank
you