I'm not a robot

Urine test strips

Urine Test Strips Used to Detect Pathological Changes in Urine Given text here The presence of excess urine on a test strip can lead to leakage and mixing of reagents, causing distortion in color results. To avoid this, it's recommended to dry the edges of the strip on absorbent paper. Comparing two strips - one from a patient with uncontrolled diabetes mellitus (pathological) and the other from a healthy individual (unreacted). The pathological strip shows: Leukocytes (-), nitrites (-), urobilinogen (-), proteins (+), pH (5), hemoglobin (+), specific gravity (1.025), ketones (++++), bilirubin (+), glucose (+++). The kidneys regulate the body's acid/alkaline balance through the controlled excretion of acidic hydrogens and reabsorption of bicarbonate. The normal pH range for urine is 4.5-8, with morning urine being more acidic and post-meal urine being more alkaline. The determination of urinary pH has two main objectives: diagnostic and therapeutic. It provides information on acid/alkali balance and identifies substances present in the urine. Certain illnesses require patients to maintain a narrow pH range for treatment purposes. Diet plays a crucial role in controlling urinary pH, with animal protein-rich diets producing acidic urine and vegetable-based diets producing alkaline urine. Commercial brands measure pH in increments of 0.5 or 1 pH units between pH 5 and 9, using a double indicator system to differentiate colors. One of the kidneys' functions is to reabsorb water after glomerular filtration. The specific gravity of urine measures its density compared to H_2O, depending on solute quantity and density. This measurement should not be confused with osmotic concentration, which relates to particle number rather than mass. The specific gravity test measures the change in dissociation constant (pKa) of an anionic polyelectrolyte, such as poly-(methyl vinyl ether/maleic anhydride), in a solution containing hydrogen ions that are released in proportion to cation concentration. The pad uses bromothymol blue to measure this pH change. However, the test strip only measures cation concentration, which may not accurately detect urine with high concentrations of non-ionic solutes or large molecular weight compounds. However, it's crucial to exercise caution when comparing these figures to actual microscopic values, as the absorbent nature of the pad may attract some urine, leading to inaccurate results. False-positive reactions can occur due to various factors such as menstrual contamination, strong oxidizing detergents, vegetable peroxidase, and bacterial enzymes like Escherichia coli peroxidase. Therefore, sediment samples containing bacteria should be thoroughly examined for red blood cells. Traditionally, ascorbic acid has been linked to false-negative reagent strip reactions for blood. However, both Multistix and Chemstrip have modified their reagent strips to minimize this interference. The presence of crenated red blood cells in urine with high specific gravity can cause false-negative reactions. Additionally, decreased reactivity may be observed when formalin is used as a preservative or when medications like captopril or nitrite are present. Red blood cells tend to settle at the bottom of the specimen container, and failure to mix the specimen prior to testing can result in falsely decreased readings. Early detection of symptoms for various conditions, such as kidney and urinary tract diseases, carbohydrate metabolism disorders, liver diseases, and haemolytic disorders, is possible through routine examinations. Regular urinalysis is recommended as a fundamental step in identifying renal damage or urinary tract disease at an early stage, particularly in high-risk populations. Certain kidney and urinary tract diseases can be identified through routine chemical tests performed on urine, including chronic kidney disease, glomerulonephritis, proteinuria, and haematuria. The protein determination test is the most indicative of renal disease, as it often correlates with early renal disease. Normal urine typically contains very little protein, usually less than 100–300 mg/L or 100 mg per 24 hours, primarily consisting of low-molecular-weight serum proteins filtered by the glomerulus and proteins produced in the genitourinary tract. Looking at how a test strip works for protein. Traditional tests work with the protein mistake of an indicator to make something visible. It's not true that indicators only change color in certain pH levels, because some indicators can change even if the pH is still the same. This happens because proteins take hydrogen from the indicator. The test is best at detecting albumin, which has more groups to accept the hydrogen than other proteins. Different strips have different chemicals inside them. Multistix has tetrabromophenol blue and Chemstrip has 3',3',5',5''-tetrachlorophenol. Both of these have an acid buffer that keeps the pH level steady. At pH 3, both look yellow if there's no protein. But as protein shows up, they turn through different shades of green until blue. The amounts of protein in urine are reported using numbers like negative, trace, and 1+, 2+, 3+ or 4+, with each color change corresponding to a certain amount. A reading that's not there is usually less than 30 mg/dL. Finding these readings can be hard sometimes because the indicator might be stuck in its own color for a long time. This happens when urine has too much of something called quaternary ammonium compounds, which come from things like soaps or detergents. The Loxosceles spider's venom can trigger infections and severe physical exertion. A urine test strip detects blood by utilising hemoglobin's pseudo-peroxidase activity to catalyse a reaction between hydrogen peroxide and tetramethylbenzidine, producing a dark blue oxidation product.[6][13] The resulting colour can range from green to dark blue, depending on the amount of hemoglobin present. Hemoglobin acts as a peroxidase catalyst in this reaction: H_2O_2 + Chromogen → Oxidised chromogen (coloured) + H_2O. However, other globins with a heme group, like myoglobin, can also catalyse the same reaction.[13] Myoglobin presence in urine yields a positive test strip result but clear urine with red to brown discoloration. Myoglobin replacement of hemoglobin is often caused by muscle damage pathologies (rhabdomyolysis), including trauma, crush syndrome, prolonged coma, convulsions, progressive muscular atrophy, alcoholism, heroin abuse, and strenuous physical activity. Elevated myoglobin concentrations can lead to acute kidney injury due to its toxic effects on kidney tubules. To differentiate between hemoglobinuria and myoglobinuria, an ammonia sulphate precipitation test is employed. This involves adding 2.8g of ammonia sulphate to 5mL of centrifuged urine, mixing well, and then filtering the sample after 5 minutes. The resulting supernatant analysis for blood with a test strip yields positive results if myoglobin is present and negative if hemoglobin is present. However, the test may produce false positives due to strong oxidants or peroxide residues on laboratory equipment.[13] Glucose - Identified as Glycosuria Ketones - Identified as Ketonuria (also see ketoacidosis and ketosis) Approximately 30-40% of type I diabetics and around 20% of type II diabetics eventually suffer from a nephropathy, making early diabetes recognition crucial for their overall health. Specific carbohydrate metabolism disorders that can be identified include diabetes mellitus, glucosuria, and ketonuria. In normal conditions, nearly all glucose removed by the glomerulus is reabsorbed in the proximal convoluted tubule. If blood glucose levels rise, as occurs in diabetes mellitus, the capacity of the convoluted tubule to reabsorb glucose is exceeded (renal reabsorption threshold). For glucose, this threshold is between 160-180 mg/dL. Glucose concentrations vary among individuals, and a healthy person may experience transient glucosuria after consuming a high-sugar meal; therefore, the most representative results come from samples obtained at least two hours after eating. The detection of glucose by test strips relies on the enzymatic reaction of glucose oxidase, which catalyses the oxidation of glucose by atmospheric oxygen to form gluconic acid and hydrogen peroxide. A linked reaction, mediated by a peroxidase, then catalyses the reaction between the peroxide and chromogen to produce a coloured compound indicating glucose presence. Catalyzed reactions involve glucose oxidase, converting glucose into D-glucono-δ-lactone and hydrogen peroxide. Peroxidase then catalyzes a reaction between hydrogen peroxide and chromogen, resulting in the formation of an oxidized chromogen and water. The process is specific to glucose but can yield false positive results due to the presence of strong oxidizing agents or disinfectants. The term ketones refers to three intermediate products in fatty acid metabolism: acetone, acetoacetic acid, and beta-hydroxybutyric acid. Elevated ketone levels are typically not present in urine, as these compounds are fully metabolized into energy, carbon dioxide, and water. However, disruptions in carbohydrate metabolism can lead to metabolic imbalances and the appearance of ketones as a by-product of fat reserve utilization. Ketonuria is particularly useful for managing diabetes mellitus type 1, indicating an insulin deficiency that requires dosage adjustment. Increased blood ketone concentrations can cause water-electrolyte imbalance, dehydration, acidosis, and potentially diabetic coma if left untreated. Urinary ketone tests involve a reaction between acetoacetic acid and sodium nitroprusside in an alkaline medium, producing a magenta-colored complex. The test is sensitive to acetoacetic acid but not beta-hydroxybutyric acid or acetone, which are assumed to be present based on their derivation from acetoacetic acid. Certain medications containing sulfhydryl groups can yield atypical coloration results. False negatives can occur in samples that have not been properly stored due to volatilization and bacterial degradation. Early diagnosis of liver diseases is crucial for timely therapeutic measures, as these conditions often only manifest at a late stage. Liver diseases, such as cirrhosis, urobilinogenuria, and bilirubinuria, can be identified through this test. Bilirubin is a highly pigmented by-product of haemoglobin degradation, released after the mononuclear phagocyte system withdraws from the liver and spleen. The liver plays a crucial role in degrading red blood cells and converting bilirubin into water-soluble conjugated bilirubin. This process prevents the bilirubin from appearing in urine, as it is typically excreted directly from the intestine in bile. However, when the normal degradation cycle is disrupted due to biliary duct obstruction or kidney damage, the conjugated bilirubin can escape into the circulation and appear in urine. The presence of urinary bilirubin is an early indicator of liver disease, and its levels can be used to determine the causes of clinical jaundice. The accelerated destruction of red blood cells produces unconjugated bilirubin, which does not cause jaundice with bilirubinuria. Instead, the high serum bilirubin levels remain in the unconjugated form. Test strips detect bilirubin through a diazotization reaction, where the bilirubin combines with a diazonium salt to produce an azo dye. However, false positives can occur due to unusual pigments in the urine or poorly stored samples that undergo photo oxidation or hydrolysis. False negatives may also be caused by the degradation of conjugated bilirubin into urobilinogen and stercobilinogen, which are then excreted through the intestine. The recirculation of urobilinogen back to the liver affects the amount of bilirubin that is processed, with a small part being filtered out by the kidneys and appearing in urine. The excess bilirubin in the blood can also be filtered out by the kidneys, leading to increased amounts of urobilinogen in the urine. When hemolytic disorders occur, the amount of unconjugated bilirubin increases, causing an increase in hepatic excretion of conjugated bilirubin and subsequent accumulation of urobilinogen in the urine. Urobilinogen reacts with p-dimethylaminobenzaldehyde, producing pink colours ranging from light to dark. Another method uses a diazo coupling reaction, resulting in white-to-pink hues. The latter is more specific.[17] In an acid medium, urobilinogen combines with p-dimethylaminobenzaldehyde or 4-methoxybenzene-diazonium-tetrafluoroborate to produce red dye or azo dye, respectively. Some substances interfere with the Ehrlich reaction on Multistix strips: porphobilinogen, indican, and others. The test should be performed at room temperature as sensitivity increases with temperature. Poorly stored samples may yield false negative results due to urobilinogen photo oxidation. Formaldehyde used in preservation produces false negatives in both reactions.[16] The test detects urinary infections, including bacteriuria and pyuria, by identifying nitrites. Nitrate-reducing bacteria like Escherichia coli and others convert urine nitrate into nitrite. The reactive strips detect nitrite through the Griess reaction, producing a pink azo dye. However, this test is not reliable, and negative results may occur even with clinical symptoms. Negative results can be obtained in the presence of non-nitrate-reducing microorganisms. Nitrite-reducing bacteria need to remain in contact with nitrate for long enough to produce detectable amounts. The use of antibiotics will inhibit bacterial metabolism, causing false negatives. In urine sediment from patients with urinary infections, leukocytes, erythrocytes, and epithelial cells may be present. The test for leukocyte esterase is indicative and does not replace urinalysis or microscopic examination as diagnostic tools. Microscopic urine examination is often replaced with a simpler method that detects white blood cells, specifically leukocytes, using urine test strips. In healthy individuals, it's common to find up to three leukocytes per high-powered field in a urine sample, with women generally having slightly higher results due to vaginal contamination. A higher count may indicate urinary tract infections. The test strip detects an enzyme called leukocyte esterase present in certain types of white blood cells. This enzyme is not found in other types of cells like bacteria, lymphocytes, or epithelial cells from the genitourinary tract. Leukocyturia can be caused by various factors, including urinary infections, inflammation of renal tissues, and some parasitic or fungal infections. The test strip reaction is based on the breakdown of a specific ester compound, which produces a violet-colored dye. However, this method should not be relied upon solely for diagnosis, as it does not replace more comprehensive examinations like microscopic examination or urine culture. The detection limit of the test may vary depending on the urine sample, but it's defined as the concentration at which 90% of examined urines produce a positive reaction. Urine testing, which involves examining the chemical composition of urine to diagnose diseases, has been used for centuries. Originally, urine was viewed as a mystical fluid, with various uses including wound healing and stimulating the body's defenses. The scientific basis of urinalysis was only studied by doctors interested in chemistry towards the end of the 18th century. The first test strips were developed in 1850 by Parisian chemist Jules Maumené. These early test strips used tin protochloride to detect sugar in urine, and a drop of urine would turn the strip black upon heating over a candle. In the late 19th and early 20th centuries, various improvements were made to urine testing, including the development of wet-chemical methods and spot analysis techniques. The introduction of commercial reagent papers around 1900 and later test strips in the 1950s revolutionized urine testing. Today's urine test strips contain innovations such as new impregnation techniques and stable colour indicators. They have become an established diagnostic tool in clinical and general practice. Urine test strips are widely used in urinalysis to detect various substances in urine. Some test strips contain chemicals that can be affected by ascorbic acid, but others have built-in protection against this interference. Certain test strips also include a separate test for ascorbate levels. During routine screening, if a urine sample tests positive for certain parameters such as leukocytes, blood, protein, nitrite, and a pH greater than 7, further analysis of the urine sediment may be necessary to pinpoint a diagnosis. Automated urinalysis using machine analyzers is now a common practice. These machines can measure multiple parameters in urine, including calcium, blood, glucose, bilirubin, urobilinogen, ketones, leukocytes, creatinine, microalbumin, pH, ascorbic acid, and protein. In addition to manual analysis, automatic analysis of urine test strips is also a well-established practice. Machine analyzers can quickly provide results for various parameters, making it easier to diagnose urinary tract infections or other conditions. Sources: * Various scientific articles and textbooks on urinalysis and body fluids. * Manufacturer's documentation for Bayer Multistix reagent strips. * Medline Plus article on urine specific gravity. * National Kidney and Urological Disease Information Clearing House publication on kidney function. Análisis de orina: Una revisión de la literatura