Review Article

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Aspartate Aminotransferase a Credible Salivary Biomarker of Periodontal Disease Status

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ABSTRACT

Background: Saliva can be used as a diagnostic fluid in medicine. Components of saliva proposed as disease markers include enzymes (alkaline phosphatase, esterase, glucuronidase, aminopeptidase), immunoglobulins (IgA, IgG), and hormones (steroid hormones). Many of these salivary components appeared to be useful biochemical markers of the evolution of periodontal disease, for which salivary analysis can offer a cost-effective approach for monitoring the disease.

Keywords: Aspartata aminotransferase, periodontitis, salivary biomarker.

INTRODUCTION

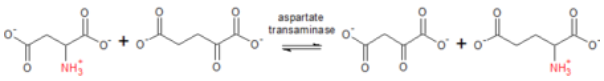
Host response to periodontal disease includes the release of different enzymes from stromal, epithelial or inflammatory cells. The enzymes which are produced from these cells are associated with cell injury and cell death (Aspartate aminotransferase (AST), Alanine aminotransferase (ALT), Alkaline phosphatise (ALP) and Blood urea nitrogen (BUN). Normal enzymatic activity of these enzymes is necessary for healthy functioning of gingiva and periodontium) [.2]

It is also known as AspAT/ASAT/AAT or serum glutamic oxaloacetic transaminase (SGOT), is a pyridoxal phosphate (PLP)-dependent transaminase enzyme (EC 2.6.1.1) that was first described by Arthur Karmen and colleagues in 1954. [3]4[5] AST catalyzes the reversible transfer of an α-amino group between aspartate and glutamate and, as such, is an important enzyme in amino acid metabolism. AST is found in the liver, heart, skeletal muscle, kidneys, brain, and red blood cells. Serum AST level, serum ALT (alanine transaminase) level, and their ratio (AST/ALT ratio) are commonly measured clinically as biomarkers for liver health. The tests are part of blood panels.

Function

Aspartate transaminase catalyzes the interconversion of aspartate and αketoglutarate to oxaloacetate and glutamate.

Aspartate (Asp) + α-ketoglutarate ↔ oxaloacetate + glutamate (Glu)



Reaction catalyzed by aspartate aminotransferase

AST relies on Vitamin B6 as a cofactor to transfer the amino group from aspartate or glutamate to the corresponding ketoacid.[6] The amino group transfer catalyzed by this enzyme is crucial in both amino acid degradation and biosynthesis. In amino acid degradation, following

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the conversion of α-ketoglutarate to glutamate, glutamate subsequently undergoes oxidative deamination to form ammonium ions, which are excreted as urea. In the reverse reaction, aspartate may be synthesized from oxaloacetate, which is a key intermediate in the citric acid cycle.[7]

Clinical significance

Aspartate Aminotransferase (AST) is similar to alanine transaminase (ALT) in that both enzymes are associated with liver parenchymal cells. The difference is that ALT is found predominantly in the liver, with clinically negligible quantities found in the kidneys, heart, and skeletal muscle, while AST is found in the liver, heart (cardiac muscle), skeletal muscle, kidneys, brain, and red blood cells.[8] As a result, ALT is a more specific indicator of liver inflammation than AST, as AST may be elevated also in diseases affecting other organs, such as myocardial infarction, acute pancreatitis, acute hemolytic anemia, severe burns, acute renal disease, musculoskeletal diseases, and trauma.[9]

AST was defined as a biochemical marker for the diagnosis of acute myocardial infarction in 1954. However, the use of AST for such a diagnosis is now redundant and has been superseded by the cardiac troponins.[10] AST is commonly measured clinically as a part of diagnostic liver function tests, to determine liver health. However, it is important to keep in mind that the source of AST (and, to a lesser extent, ALT) in blood tests may reflect pathology in organs other than the liver. In fact, when the AST is higher than ALT, a muscle source of these enzymes should be considered. For example, muscle inflammation due to dermatomyositis may cause AST>ALT. This is a good reminder that AST and ALT are not good measures of liver function because they do not reliably reflect the synthetic ability of the liver and they may come from tissues other than liver (such as muscle).

Ast in Diseases

Potential Diagnosis

Increased In:

AST is released from any damaged cell in which it is stored, so conditions that affect the liver, kidneys, heart, pancreas, red blood cells, or skeletal muscle, and cause cellular destruction demonstrate elevated AST levels.

Significantly Increased in (greater than five times normal levels)

- Acute hepatitis (AST is very elevated in acute viral hepatitis)
- Acute hepatocellular disease (especially related to chemical toxicity or drug overdose; moderate doses of acetaminophen have initiated severe hepatocellular disease in alcoholics)
- Acute pancreatitis, Shock

Moderately Increased in (three to five times normal levels)

- Alcohol abuse (chronic), Biliary tract obstruction,, Cardiac arrhythmias
- Cardiac catheterization, angioplasty, or surgery
- Cirrhosis, Chronic hepatitis, Congestive heart failure, Infectious mononucleosis,
- Liver tumors
- Muscle diseases (e.g., dermatomyositis, dystrophy, gangrene, polymyositis, trichinosis)
- Myocardial infarct, Reye's syndrome
- Trauma (related to injury or surgery of liver, head, and other sites where AST is found)

Slightly Increased in (two to three times normal)

- Cerebrovascular accident
- Cirrhosis, fatty liver (related to obesity, diabetes, jejunoileal bypass, administration of total parenteral nutrition), Delirium tremens, Hemolytic anemia, Pericarditis,
- Pulmonary infarction.

Decreased In:

- Hemodialysis (presumed to be related to a corresponding deficiency of vitamin B_6 observed in hemodialysis patients)
- Uremia (related to a build up of toxins which modify the activity of coenzymes required for transaminase activity)
- Vitamin B_6 deficiency (related to the lack of vitamin B_6, a required cofactor for the transaminases) [11]

AST and Periodontal Diseases

Periodontitis is a chronic infectious condition of the supporting tissues of the teeth that is caused by a complex of anaerobic, Gram-negative bacteria. Various biomarkers like saliva, blood are used for screening and predicting the early changes in the periodontal tissues and also to determine the efficacy of the treatment.[12] Saliva is widely used as a biomarker to determine the periodontal disease activity because it allows rapid screening, provides accurate information, and enables reliable evaluation of periodontal disease condition. The advantage of saliva is the ease of collection and contains various microbial and host response mediators. Estimation of the risk of disease onset and severity, monitoring of disease progression, and evaluation of therapeutic efficacy of the periodontal disease can be performed by analyzing an array of constituents within saliva. Enzymes, proteins, and immunoglobulin's are the most abundant constituents of saliva. Their value as biomarkers has been recognized and extensively explored using proteomic methods.

Various biomarkers of chronic inflammation have been detected in the whole saliva of patients with oral disease. The early inflammatory changes of the tissue may promote early diagnosis and aid in monitoring the treatment.[13] Salivary examination reveals the changes of the entire oral cavity rather than the specific areas. Researchers involved in periodontal disease diagnostics are currently investigating the possible use of saliva for disease assessment. Because of its importance in oral biofilm formation and host defense, secreted saliva may have a significant role in the establishment and progression of periodontal disease.[14]

Many enzymes have been used as a biomarker to assess the progression of periodontal diseases. The enzyme AST is one such marker, which has been used as a diagnostic adjunct in human disease conditions such as myocardial infarction, hepatic necrosis, and many other acute, chronic, or necrotic conditions. Levels of the enzyme activity can be correlated with active tissue destruction of periodontal tissues since it is contained in the cytoplasm of cells and released on cell death. Thus, the above correlation indicates that the diagnostic test based on AST levels may be useful in assessing periodontal inflammation.[15].[16]

Todorovic T et al. (2000) [17] studied the activity of various enzymes including AST in saliva from patients with periodontal disease before and after periodontal treatment and in saliva from healthy patients. They concluded that activities of all the studied enzymes including AST were significantly increased in relation to those healthy. This is probably a consequence of pathological processes in periodontal tissues from where these intracellular enzymes are increasingly released into the secretion which surrounds them that means saliva. After periodontal treatment the activity of examined salivary enzymes was decreased, probably as a result of periodontal tissues repair.

Cesco et al. (2003) [18] evaluated the relationship between aspartate aminotransferase levels in saliva measured by reflotronTM system of diagnosis and periodontal condition indicated by community periodontal index of treatment needs (CPITN). They concluded that levels of AST in saliva from patients presenting CPITN code 4 were higher than from patients coded lower and could be detected by the evaluated diagnostic system. Periodontal destruction such as periodontal pockets, gingival bleeding and suppuration seems to be related to higher AST levels in saliva, similarly Totan et al. (2006) [19] Zappacosta b et al. (2007) [20] demonstrated that periodontal destruction such as periodontal pockets, gingival bleeding and suppuration are related to higher level of marker enzymes including AST in saliva therefore they suggested that salivary AST could be used as a useful marker for monitoring periodontal disease.

Dabra s. et al. (2012) [21] and Luke r. et al. (2015) [22] studied host responses to periodontal disease which included the production of different enzymes released by stromal, epithelial or inflammatory cells. Important enzymes associated with cell injury and cell death, aspartate aminotransferase, alanine aminotransferase (AST, ALT), alkaline phosphatase, acidic phosphatase (ALP, ACP), and gama glutamyl transferase (GGT)and blood urea nitrogen(BUN) significant increased activity in the saliva from patients with periodontal disease a significant reduction in the enzyme levels was seen after conventional

periodontal therapy and concluded that it can be assumed that the salivary enzymes (AST, ALT, GGT, ALP, and ACP) can be considered as bio chemical markers for evaluating the diagnosis and prognosis of the functional condition of periodontal tissues in disease and health, and in the evaluation of the therapy effects in periodontal disease.

CONCLUSION

There are compelling reasons to use saliva as a diagnostic fluid to monitor health and diseases. As a clinical medium, saliva has many advantages over serum. Saliva is easy to collect, store and ship and can be obtained at low cost in sufficient quantities for analysis. For patients, the non-invasive collecting techniques dramatically reduce anxiety and discomfort and simplify procurement of repeated samples for longitudinal monitoring over time. For professionals, saliva collection is safer than venepuncture, which could expose health care providers to HIV or hepatitis virus. Saliva is also easier to handle for diagnostic procedures since it does not clot, lessening the manipulations required. Saliva-based diagnostics are therefore less invasive, less expensive and present less risk to both the patient and the provider than current methodologies. For all patients suffering from periodontal disease, the clinical use of routine salivary biochemical tests will be useful to identify the disease status.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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