

Corporate Medical Policy

Measurement of Thromboxane Metabolites for ASA Resistance AHS – G2107

File Name: measurement_of_thromboxane_metabolites_for_asa_resistance
Origination: 01/2019
Last Review: 11/2023

Description of Procedure or Service

Thromboxane A2 (TXA2) is a metabolite that causes platelet activation in the cyclooxygenase metabolic pathway (Abrams, 2023). Aspirin (ASA) is an acetylated salicylate and is classified as a nonsteroidal anti-inflammatory medication. Aspirin is intended to inhibit cyclooxygenase-1 (COX-1), which then inhibits generation of TXA2, producing the desired antithrombotic effect. Aspirin resistance is the inability of aspirin to decrease platelet production of thromboxane A2 leading to platelet activation and aggregation. (Abramson, 2021).

Related Policies

Cardiovascular Disease Risk Assessment AHS – G2050

******Note: This Medical Policy is complex and technical. For questions concerning the technical language and/or specific clinical indications for its use, please consult your physician.***

Policy

Reimbursement is not allowed for measurement of thromboxane metabolites in urine (e.g. AspirinWorks) to evaluate aspirin resistance.

Benefits Application

This medical policy relates only to the services or supplies described herein. Please refer to the Member's Benefit Booklet for availability of benefits. Member's benefits may vary according to benefit design; therefore, member benefit language should be reviewed before applying the terms of this medical policy.

When Measurement of Thromboxane Metabolites for ASA Resistance is covered

N/A

When Measurement of Thromboxane Metabolites for ASA Resistance is not covered

Reimbursement for the measurement of thromboxane metabolites in urine (e.g. AspirinWorks) to evaluate aspirin resistance for all indications is not allowed.

Measurement of Thromboxane Metabolites for ASA Resistance AHS – G2107

Policy Guidelines

Background

Aspirin acts primarily by interfering with the biosynthesis of cyclic prostanoids, including thromboxane (Abrams, 2023). It irreversibly inhibits COX-1, resulting in an antithrombotic effect due to a decrease in production of thromboxane. Low doses of aspirin (typically 75 to 81 mg/day) have antiplatelet properties (Abramson, 2021) and are indicated for the primary and secondary prevention of cardiovascular disease. However, aspirin has been noted to occasionally fail to provide any significant benefit in patients with cardiovascular disease. Several possible explanations can account for this phenomenon, such as genetic variability or pharmacological interactions with other drugs, but nonadherence tends to be the most likely cause of nonresponse (Zehnder et al., 2022).

Studies show that aspirin resistance affects 15% to 25% of individuals (Alberts, 2010). A systematic review and meta-analysis on aspirin resistance indicated that patients who are resistant to aspirin are at a greater risk (odds ratio [OR]: 3.85) of clinically important cardiovascular morbidity than patients who are sensitive to aspirin (Krasopoulos et al., 2008). The effect of aspirin administration varies considerably among patients at high risk for cardiovascular events. Gum and colleagues found insufficient inhibition of platelet aggregation by aspirin in six to 24% of patients with stable coronary artery disease (Gum et al., 2001) while other estimates range from five to 60% (Martin & Talbert, 2005).

Many biochemical tests and several commercially available products have been developed to detect aspirin resistance. Tests used in research laboratories include aggregometry, tests based on activation-dependent changes in platelet surface, and tests based on activation-dependent release from platelets. Point-of-care tests include PFA-100, IMPACT, and VerifyNow, which can detect platelet dysfunction that may be due to aspirin effect (Paniccia et al., 2015). Other tests include Multiplate® analyzer, a multiple electrode aggregometry test (Gillet et al., 2016) and Plateworks assay, a rapid platelet function screening test (Helena Laboratories, 2023).

It has been proposed that aspirin resistance can also be detected by thromboxane metabolites in urine. Aspirin inhibits platelet activation through the permanent inactivation of the cyclooxygenase (COX) activity of prostaglandin H synthase-1 (COX-1), and consequently inhibits the biosynthesis of thromboxane A₂(TXA₂), a platelet agonist (Abramson, 2021). The urinary concentrations of the metabolite 11-dehydrothromboxane B₂ (11 dhTxB₂) is proposed to indicate the level of TXA₂ generation (Smock & Rodgers, 2010).

The AspirinWorks Test Kit is an enzyme-linked immunoassay test that can be used to determine levels of 11 dhTxB₂ in human urine (Geske et al., 2008). The AspirinWorks Test Kit was compared to the Accumetrics VerifyNow Aspirin Assay as the predicate device. The manual AspirinWorks Test Kit measures urinary 11 dhTxB₂, a metabolite of TxA₂, a direct inducer of platelet aggregation while the automated Accumetrics VerifyNow Aspirin Assay is a turbidimetric-based optical detection system, which measures platelet-induced aggregation in whole blood. Both analyze aspirin's effect through the reduction of TxA₂ production or the resulting inhibition of platelet aggregation (FDA, 2007).

A major limitation of this test is that while serum TxB₂ comes primarily from platelets, urinary 11dhTxB₂ is not a specific measure of platelet thromboxane formation. Urine 11dhTxB₂ reflects systemic thromboxane formation, and up to 30% or more can derive from extra-platelet sources, including monocytes, macrophages, atherosclerotic plaque, and other tissues that contain nucleated cells capable of regenerating functional COX-1, or that contain COX-2 (Smock & Rodgers, 2010).

Clinical Utility and Validity

The FDA noted that results from two different clinical studies established a cutoff for aspirin effect at ≤1500 pg 11d hTxB₂/mg creatinine. Further analysis revealed that 180/204 (88.2%) of samples from individuals not taking aspirin were above the cut-off value. Analysis of samples from individuals taking various doses of aspirin revealed that 7/163 (4.3%) of 81 mg/day aspirin users indicated a lack of aspirin effect (greater than 1500 pg 11dhTxB₂/mg creatinine) and 4/38 (10.5%) of the 325 mg/day aspirin users indicated a lack

Measurement of Thromboxane Metabolites for ASA Resistance AHS – G2107

of aspirin effect. In total, 11/201 (5.5%) of all aspirin users tested indicated a lack of aspirin effect (FDA, 2007).

Lordkipanidze et al. (2007) compared the results obtained from six major platelet function tests in the “assessment of the prevalence of aspirin resistance in patients with stable coronary artery disease.” 201 patients receiving 80 mg of aspirin were evaluated. Two of the tests used to measure platelet aggregation were VerifyNow and urinary 11-dehydro-thromboxane B(2) concentrations. Prevalence of aspirin resistance for VerifyNow was measured to be 6.7% and 22.9% for urinary 11-dehydro-thromboxane B(2) concentrations. The prevalence of aspirin resistance varied according to the assay used. Results from these tests showed “poor correlation and agreement between themselves.” The authors concluded that “platelet function tests are not equally effective in measuring aspirin's anti-platelet effect and correlate poorly amongst themselves and that the clinical usefulness of the different assays to classify correctly patients as aspirin resistant remains undetermined” (Lordkipanidze et al., 2007).

Dretzke et al. (2015) examined “whether or not insufficient platelet function inhibition by aspirin ('aspirin resistance'), as defined using platelet function tests (PFTs), is linked to the occurrence of adverse clinical outcomes, and further, whether or not patients at risk of future adverse clinical events can be identified through PFTs.” The authors reviewed 108 studies, with 58 on patients on aspirin monotherapy, and found that some PFTs may have prognostic utility. However, the authors noted that many of the studies found contained significant “methodological and clinical heterogeneity.” No cost-effectiveness studies were found.

Wang et al. (2018) evaluated the association between stable urine metabolites of thromboxane (TxA2-M), prostacyclin (PGI2-M), levels of cellular adhesion molecules, chemokines, C-reactive protein, and the incidence of major adverse cardiovascular events (MACE). A total of 120 patients with stable atherosclerotic cardiovascular disease on aspirin therapy were examined. The authors found that urinary TxA2-M levels were “significantly” correlated with circulating P-selectin and E-selectin levels, and associated with higher risk of MACE. The authors concluded that “these results provide insight into the contribution of TxA2 biosynthesis to ASCVD progression in humans, and suggest that patients with elevated TxA2-M levels may be predisposed to advanced platelet and endothelial activation and higher risk of adverse cardiovascular outcomes” (Wang et al., 2018).

Harrison et al. (2018) compared nine platelet function tests to assess responsiveness to three ASA dosing regimens in 24 type 2 diabetes patients randomized to ASA 100 mg/day, 200 mg/day, or 100 mg twice daily for two weeks. Of these nine tests, three were VerifyNow, urinary 11-dehydro-thromboxane B2 (TxB2) and serum TxB2. The investigators evaluated VerifyNow as a “very good” measure, serum TxB2 as a “good” measure, and urinary TxB2 as a “moderate” measure. The authors concluded that “the platelet function tests we assessed were not equally effective in measuring the antiplatelet effect of ASA and correlated poorly amongst themselves, but COX-1-dependent tests performed better than non-COX-1-dependent tests” (Harrison et al., 2018).

Bij de Weg et al. (2020) evaluated the changes in aspirin resistance during and after pregnancy. The study focused on pregnant individuals “with an indication for aspirin usage during pregnancy to prevent placenta mediated pregnancy complications”; in all, 23 pregnant individuals were included. Four complementary aspirin resistance tests (“PFA-200, VerifyNow®, Chronolog light transmission aggregometry (Chronolog LTA) and serum thromboxane B2 (TxB2) level measurement”) were used to measure aspirin resistance in each trimester of pregnancy, as well as three months post-partum. The tests identified aspirin resistance at the following: PFA-200: 30.4%, VerifyNow: 17.4%, Chronolog LTA: 26.1%, and serum TxB2, 23.8% respectively. The authors also identified that aspirin resistance tended to be more frequency during pregnancy compared to after pregnancy. However, the authors also acknowledged that there was “weak” correlation between tests and recommended more research on aspirin resistance as well as obstetric outcome (Bij de Weg et al., 2020).

Ebrahimi et al. (2020) performed a meta-analysis focusing on laboratory-defined aspirin resistance rate in cardiovascular disease patients. A total of 65 studies encompassing 10729 patients were evaluated. The overall prevalence of laboratory-defined aspirin resistance was measured to be 24.7%. The authors also found that higher prevalence of resistance tended to be found in Asia, whereas American studies found the

Measurement of Thromboxane Metabolites for ASA Resistance AHS – G2107

lowest rates of resistance. The authors recommended that providers pay attention to potential aspirin resistance in their patients (Ebrahimi et al., 2020).

Singh et al. (2021) investigated the use of miR-19b-1-5p as a biomarker for aspirin resistance in acute coronary syndrome (ACS) patients as an alternative to in-vitro platelet function tests, which have potential limitations in detection. MiR-19b-1-5p expression was measured in 945 patients with ACS and platelet function was determined by multiplate aggregometry testing. Low miR-19b-1-5p expression was found to be related to aspirin resistance, which agreed with the sustained platelet aggregation in the presence of aspirin. “Therefore, miR-19b-1-5p could be a suitable marker for aspirin resistance and might predict recurrence of future major adverse cardio-cerebrovascular events in patients with ACS” (Singh et al., 2021).

Piao et al. (2021) compared the performance of the Anysis-200 analyzer and VerifyNow assays to assess platelet inhibition in cardiac disease patients. In relation to VerifyNow, the sensitivity (96.3%) and specificity (90.3%) of Anysis-200 was comparable. The aspirin resistance rate in patients was 20.9% using VerifyNow and 16.5% using Anysis-200. The Cohen’s kappa coefficient between the two devices was 0.81, indicating an almost perfect agreement between the two devices. Overall, the Anysis-200 assay “would be used as a point-of-care test to assess aspirin non-responsiveness and abnormal platelet reactivity” (Piao et al., 2021).

Venketasubramanian et al. (2022) compared platelet function tests used to identify aspirin resistance (AR) in ischemic stroke patients. The study included 113 non-cardioembolic ischemic stroke patients and 30 non-stroke controls. The platelet function tests studied included VerifyNow® and Multiplate®, as well as light transmission aggregometry using either arachidonic acid, adenosine diphosphate, or collagen. “Identification of AR is not consistent across different platelet function tests.” There were “strong correlations” between light transmission aggregometry using arachidonic acid, VerifyNow®, and Multiplate® ASPItest, but “poor correlation” between light transmission aggregometry using collagen and Multiplate® COLtest and between light transmission aggregometry using adenosine diphosphate and Multiplate® ADPtest. The authors conclude that “identification of AR and its frequency depends on the laboratory parameter used and may not necessarily be consistent across the different methods of testing platelet activity” (Venketasubramanian et al., 2022).

Guidelines and Recommendations

Pan-European, multidisciplinary Task Force for Advanced Bleeding Care in Trauma

This Task Force includes representatives from six different societies: The European Society for Trauma and Emergency Surgery (ESTES), the European Society of Anaesthesiology (ESA), the European Shock Society (ESS), the European Society for Emergency Medicine (EuSEM), the Network for the Advancement of Patient Blood Management, Haemostasis and Thrombosis (NATA) and the European Society of Intensive Care Medicine (ESICM). Although this guideline focuses on trauma settings, there are some comments on point-of-care (POC) platelet function tests, such as VerifyNow. The Task Force recommends that: “the routine use of POC platelet function devices for platelet function monitoring in trauma patients on antiplatelet therapy or with suspected platelet dysfunction be avoided” (Rossaint et al., 2023).

International Society on Thrombosis and Haemostasis

The Working Group on Aspirin Resistance (Michelson et al., 2005) published a position paper which concluded that other than in research trials it is not appropriate to test for aspirin resistance or change therapy based on such tests. There are no published studies which address the clinical effectiveness or data linking aspirin dependent laboratory test to clinical outcomes in patients (Michelson et al., 2005).

Measurement of Thromboxane Metabolites for ASA Resistance AHS – G2107

Study Group on Biomarkers in Cardiology of the Acute Cardiovascular Care Association and the Working Group on Thrombosis of the European Society of Cardiology

This study group was convened to assess the utility of platelet function testing in acute cardiac care for predicting adverse events and guiding antiplatelet therapy. The panel lists recommended assays for assessment of platelet activity during P2Y₁₂ inhibitors, which are “the VASP-P® assay, the VerifyNow® device and the Multiplate® analyser”. Although VerifyNow is the precursor to AspirinWorks, AspirinWorks itself was not mentioned as a recommended assay (Aradi et al., 2015).

American College of Chest Physicians Evidence-Based Clinical Practice Guidelines

The ACCP states “the clinical significance of [platelet function] assay findings is uncertain, and the assay results have not been shown to predict clinical outcomes” (Douketis et al., 2012).

The American Society of Anesthesiologists (ASA)

The ASA released guidelines on platelet function testing in patients on antiplatelet therapy before cardiac surgery. The ASA advises that platelet function testing may be considered to guide decisions on timing of cardiac surgery in patients who have recently received P2Y₁₂ receptor inhibitors or who have ongoing dual antiplatelet therapy. The ASA highlights the advantages and disadvantages of various platelet function assays and notes that the underlying principles between the assays differ therefore, a poor correlation has been reported between the assays. Currently, there is not enough evidence from surgical patients to prefer one test over the other. Among the various methods, the ASA recommends Thromboelastography (TEG5000, TEG6s) with platelet mapping assay or the VerifyNow P2Y₁₂ assay as both are more appropriate in coronary artery surgery patients since it can be performed at bedside (Mahla et al., 2020).

State and Federal Regulations, as applicable

VerifyNow-Aspirin Assay, which received 510(k) marketing clearance from the FDA in October 2004, is a qualitative assay to aid in the detection of platelet dysfunction due to aspirin ingestion in citrated whole blood for the point of care or laboratory setting (FDA, 2004)..

AspirinWorks received 510(k) marketing clearance from the FDA in May 2007 and is intended to aid in the qualitative detection of aspirin in apparently healthy individuals post ingestion.

Many labs have developed specific tests that they must validate and perform in house. These laboratory-developed tests (LDTs) are regulated by the Centers for Medicare and Medicaid (CMS) as high-complexity tests under the Clinical Laboratory Improvement Amendments of 1988 (CLIA '88). LDTs are not approved or cleared by the U. S. Food and Drug Administration; however, FDA clearance or approval is not currently required for clinical use.

Billing/Coding/Physician Documentation Information

This policy may apply to the following codes. Inclusion of a code in this section does not guarantee that it will be reimbursed. For further information on reimbursement guidelines, please see Administrative Policies on the Blue Cross Blue Shield of North Carolina web site at www.bcbsnc.com. They are listed in the Category Search on the Medical Policy search page.

Applicable service codes: 82570, 84431

BCBSNC may request medical records for determination of medical necessity. When medical records are requested, letters of support and/or explanation are often useful, but are not sufficient documentation unless all specific information needed to make a medical necessity determination is included.

Measurement of Thromboxane Metabolites for ASA Resistance AHS – G2107

Scientific Background and Reference Sources

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Measurement of Thromboxane Metabolites for ASA Resistance AHS – G2107

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Measurement of Thromboxane Metabolites for ASA Resistance AHS – G2107

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Specialty Matched Consultant Advisory Panel review 7/2019

Medical Director review 7/2019

Specialty Matched Consultant Advisory Panel review 7/2020

Medical Director review 7/2020

Specialty Matched Consultant Advisory Panel review 10/2021

Medical Director review 10/2021

Medical Director review 10/2022

Medical Director review 10/2023

Policy Implementation/Update Information

- 1/1/2019 New policy developed. BCBSNC will not provide coverage for the measurement of thromboxane metabolites in urine (e.g. AspirinWorks) to evaluate aspirin resistance because it is investigational. BCBSNC does not provide coverage for investigational services or procedures. Medical Director review 1/1/2019. Policy noticed 1/1/2019 for effective date 4/1/2019. (jd)
- 8/13/2019 Specialty Matched Consultant Advisory Panel review 7/2019. Medical Director review 7/2019. (jd)
- 12/10/2019 Reviewed by Avalon 3rd Quarter 2019 CAB. Added code 82750 to Coding/Billing section; no other changes to policy. Medical Director review 12/2019. (jd)
- 8/11/20 Specialty Matched Consultant Advisory Panel review 7/2020. Medical Director review 7/2020. (jd)
- 11/10/20 Reviewed by Avalon 3rd Quarter 2020 CAB. Description section, policy guidelines, and references updated. Related policies section added. Policy statement revised with reimbursement language to align with revised When Not Covered section as follows: "Reimbursement for the measurement of thromboxane metabolites in urine (e.g. AspirinWorks) to evaluate aspirin resistance for all indications is not allowed." Code table removed. Medical Director review 10/2020 (jd)

Measurement of Thromboxane Metabolites for ASA Resistance AHS – G2107

- 11/16/21 Reviewed by Avalon 3rd Quarter 2021 CAB. Policy guidelines and references updated. Specialty Matched Consultant Advisory Panel review 10/2021. Medical Director review 10/2021. (jd)
- 12/13/22 Reviewed by Avalon 3rd Quarter 2022 CAB. Policy Guidelines, Coding/Billing and References sections updated. Medical Director review 10/2022. (tm)
- 12/5/23 Reviewed by Avalon 3rd Quarter 2023 CAB. Description, Policy Guidelines, and References sections updated. Medical Director review 10/2023. (tt)

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