

Antithrombin III (Human)

THROMBATE III®

DESCRIPTION

Antithrombin III (Human), THROMBATE III® is a sterile, nonpyrogenic, stable, lyophilized preparation of purified human antithrombin III.

THROMBATE III is prepared from pooled units of human plasma from normal donors by modifications and refinements of the cold ethanol method of Cohn.¹ When reconstituted with Sterile Water for Injection, USP, THROMBATE III has a pH of 6.0–7.5, a sodium content of 110–210 mEq/L, a chloride content of 110–210 mEq/L, an alanine content of 0.075–0.125 M, and a heparin content of not more than 0.004 unit/IU AT-III. THROMBATE III contains no preservative and must be administered by the intravenous route. In addition, THROMBATE III has been heat-treated in solution at 60°C ± 0.5°C for not less than 10 hours.

Each vial of THROMBATE III contains the labeled amount of antithrombin III in international units (IU) per vial. The potency assignment has been determined with a standard calibrated against a World Health Organization (WHO) antithrombin III reference preparation.

CLINICAL PHARMACOLOGY

Antithrombin III (AT-III), an alpha₂-glycoprotein of molecular weight 58,000, is normally present in human plasma at a concentration of approximately 12.5 mg/dL^{2,3} and is the major plasma inhibitor of thrombin.⁴ Inactivation of thrombin by AT-III occurs by formation of a covalent bond resulting in an inactive 1:1 stoichiometric complex between the two, involving an interaction of the active serine of thrombin and an arginine reactive site on AT-III.⁴ AT-III is also capable of inactivating other components of the coagulation cascade including factors IXa, Xa, XIa, and XIIa, as well as plasmin.⁴

The neutralization rate of serine proteases by AT-III proceeds slowly in the absence of heparin, but is greatly accelerated in the presence of heparin.⁴ As the therapeutic antithrombotic effect in vivo of heparin is mediated by AT-III, heparin is ineffective in the absence or near absence of AT-III.^{4–8}

The prevalence of the hereditary deficiency of AT-III is estimated to be one per 2000 to 5000 in the general population.^{4–7} The pattern of inheritance is autosomal dominant. In affected individuals, spontaneous episodes of thrombosis and pulmonary embolism may be associated with AT-III levels of 40%–60% of normal.⁷ These episodes usually appear after the age of 20, the risk increasing with age and in association with surgery, pregnancy and delivery. The frequency of thromboembolic events in hereditary antithrombin III (AT-III) deficiency during pregnancy has been reported to be 70%, and several studies of the beneficial use of Antithrombin III (Human) concentrates during pregnancy in women with hereditary deficiency have been reported.^{9–11} In many cases, however, no precipitating factor can be identified for venous thrombosis or pulmonary embolism.⁷ Greater than 85% of individuals with hereditary AT-III deficiency have had at least one thrombotic episode by the age of 50 years.⁷ In about 60% of patients thrombosis is recurrent. Clinical signs of pulmonary embolism occur in 40% of affected individuals.⁷ In some individuals, treatment with oral anticoagulants leads to an increase of the endogenous levels of AT-III, and treatment with oral anticoagulants may be effective in the prevention of thrombosis in such individuals.^{6,7}

In clinical studies of Antithrombin III (Human), THROMBATE III® conducted in 10 asymptomatic subjects with hereditary deficiency of AT-III, the mean in vivo recovery of AT-III was 1.6% per unit per kg administered based on immunologic AT-III assays, and 1.4% per unit per kg administered based on functional AT-III assays.¹² The mean 50% disappearance time (the time to fall to 50% of the peak plasma level following an initial administration) was approximately 22 hours and the biologic half-life was 2.5 days based on immunologic assays and 3.8 days based on functional assays of AT-III.¹² These values are similar to the half-life for radiolabeled Antithrombin III (Human) reported in the literature of 2.8–4.8 days.^{13–15}

In clinical studies of THROMBATE III, none of the 13 patients with hereditary AT-III deficiency and histories of thromboembolism treated prophylactically on 16 separate occasions with THROMBATE III for high thrombotic risk situations (11 surgical procedures, 5 deliveries) developed a thrombotic complication. Heparin was also administered in 3 of the 11 surgical procedures and all 5 deliveries. Eight patients with hereditary AT-III deficiency were treated therapeutically with THROMBATE III as well as heparin for major thrombotic or thromboembolic complications, with seven patients recovering. Treatment with THROMBATE III reversed heparin resistance in two patients with hereditary AT-III deficiency being treated for thrombosis or thromboembolism.

During clinical investigation of THROMBATE III, none of 12 subjects monitored for a median of 8 months (range 2–19 months) after receiving THROMBATE III, became antibody positive to human immunodeficiency virus (HIV-1). None of 14 subjects monitored for ≥ 3 months demonstrated any evidence of hepatitis, either non-A, non-B hepatitis or hepatitis B.

INDICATIONS AND USAGE

THROMBATE III is indicated for the treatment of patients with hereditary antithrombin III deficiency in connection with surgical or obstetrical procedures or when they suffer from thromboembolism.

Subjects with AT-III deficiency should be informed about the risk of thrombosis in connection with pregnancy and surgery and about the inheritance of the disease.

The diagnosis of hereditary antithrombin III (AT-III) deficiency should be based on a clear family history of venous thrombosis as well as decreased plasma AT-III levels, and the exclusion of acquired deficiency.

AT-III in plasma may be measured by amidolytic assays using synthetic chromogenic substrates, by clotting assays, or by immunoassays. The latter does not detect all hereditary AT-III deficiencies.¹⁶

The AT-III level in neonates of parents with hereditary AT-III deficiency should be measured immediately after birth. (Fatal neonatal thrombo-embolism, such as aortic thrombi in children of women with hereditary antithrombin III deficiency, has been reported.)¹⁷

Plasma levels of AT-III are lower in neonates than adults, averaging approximately 60% in normal term infants.^{18,19} AT-III levels in premature infants may be much lower.^{18,19} Low plasma AT-III levels, especially in a premature infant, therefore, do not necessarily indicate hereditary deficiency. It is recommended that testing and treatment with Antithrombin III (Human), THROMBATE III® of neonates be discussed with an expert on coagulation.¹¹

CONTRAINDICATIONS

None known.

WARNINGS

THROMBATE III is made from human plasma. Products made from human plasma may contain infectious agents, such as viruses, that can cause disease. The risk that such products will transmit an infectious agent has been reduced by screening plasma donors for prior exposure to certain viruses, by testing for the presence of certain current virus infections, and by inactivating and/or removing certain viruses. Despite these measures, such products can still potentially transmit disease. There is also the possibility that unknown infectious agents may be present in such products. Individuals who receive infusions of blood or plasma products may develop signs and/or symptoms of some viral infections, particularly hepatitis C. ALL infections thought by a physician possibly to have been transmitted by this product should be reported by the physician or other healthcare provider to Bayer Corporation [1-888-765-3203].

The physician should discuss the risks and benefits of this product with the patient, before prescribing or administering it to a patient.

The anticoagulant effect of heparin is enhanced by concurrent treatment with THROMBATE III in patients with hereditary AT-III deficiency. Thus, in order to avoid bleeding, reduced dosage of heparin is recommended during treatment with THROMBATE III.

PRECAUTIONS

General

1. Administer within 3 hours after reconstitution. Do not refrigerate after reconstitution.
2. Administer only by the intravenous route.
3. THROMBATE III, once reconstituted, should be given alone, without mixing with other agents or diluting solutions.
4. Product administration and handling of the needles must be done with caution. Percutaneous puncture with a needle contaminated with blood can transmit infectious virus including HIV (AIDS) and hepatitis. Obtain immediate medical attention if injury occurs.

Place needles in sharps container after single use. Discard all equipment including any reconstituted THROMBATE III product in accordance with biohazard procedures.

The diagnosis of hereditary antithrombin III (AT-III) deficiency should be based on a clear family history of venous thrombosis as well as decreased plasma AT-III levels, and the exclusion of acquired deficiency.

Laboratory Tests

It is recommended that AT-III plasma levels be monitored during the treatment period. Functional levels of AT-III in plasma may be measured by amidolytic assays using chromogenic substrates or by clotting assays.

Drug Interactions

The anticoagulant effect of heparin is enhanced by concurrent treatment with Antithrombin III (Human), THROMBATE III® in patients with hereditary AT-III deficiency. Thus, in order to avoid bleeding, reduced dosage of heparin is recommended during treatment with THROMBATE III.

Pregnancy Category B

Reproduction studies have been performed in rats and rabbits at doses up to four times the human dose and have revealed no evidence of impaired fertility or harm to the fetus due to THROMBATE III. It is not known whether THROMBATE III can cause fetal harm when administered to a pregnant woman or can affect reproduction capacity. Because animal reproduction studies are not always predictive of human response, this drug should be used during pregnancy only if clearly needed.

Pediatric Use

Safety and effectiveness in the pediatric population have not been established. The AT-III level in neonates of parents with hereditary AT-III deficiency should be measured immediately after birth. (Fatal neonatal thromboembolism, such as aortic thrombi in children of women with hereditary antithrombin III deficiency, has been reported.)¹⁷

Plasma levels of AT-III are lower in neonates than adults, averaging approximately 60% in normal term infants.^{18,19} AT-III levels in premature infants may be much lower.^{18,19} Low plasma AT-III levels, especially in a premature infant, therefore, do not necessarily indicate hereditary deficiency. It is recommended that testing and treatment with THROMBATE III of neonates be discussed with an expert on coagulation.¹¹

ADVERSE REACTIONS

In clinical studies involving THROMBATE III, adverse reactions were reported in association with 17 of the 340 infusions during the clinical studies. Included were dizziness (7), chest tightness (3), nausea (3), foul taste in mouth (3), chills (2), cramps (2), shortness of breath (1), chest pain (1), film over eye (1), light-headedness (1), bowel fullness (1), hives (1), fever (1), and oozing and hematoma formation (1). If adverse reactions are experienced, the infusion rate should be decreased, or if indicated, the infusion should be interrupted until symptoms abate.

DOSAGE AND ADMINISTRATION

Each bottle of THROMBATE III has the functional activity, in international units (IU), stated on the label of the bottle. The potency assignment has been determined with a standard calibrated against a World Health Organization antithrombin III reference preparation.

Dosage should be determined on an individual basis based on the pre-therapy plasma antithrombin III (AT-III) level, in order to increase plasma AT-III levels to the level found in normal human plasma (100%). Dosage of THROMBATE III can be calculated from the following formula:

$$\text{units required (IU)} = \frac{[\text{desired} - \text{baseline AT-III level}^*] \times \text{weight (kg)}}{1.4}$$

*expressed as % normal level based on functional AT-III assay

The above formula is based on an expected incremental in vivo recovery above baseline levels for Antithrombin III (Human), THROMBATE III® of 1.4% per IU per kg administered.¹² Thus, if a 70 kg individual has a baseline AT-III level of 57%, in order to increase plasma AT-III to 120%, the initial THROMBATE III dose would be $[(120-57) \times 70]/1.4 = 3150$ IU total.

However, recovery may vary, and initially levels should be drawn at baseline and 20 minutes postinfusion. Subsequent doses can be calculated based on the recovery of the first dose. These recommendations are intended only as a guide for therapy. The exact loading dose and maintenance intervals should be individualized for each patient.

It is recommended that following an initial dose of THROMBATE III, plasma levels of AT-III be initially monitored at least every 12 hours and before the next infusion of THROMBATE III to maintain plasma AT-III levels greater than 80%. In some situations, e.g., following surgery,²⁰ hemorrhage or acute thrombosis, and during intravenous heparin administration,^{13,21-23} the half-life of Antithrombin III (Human) has been reported to be shortened. In such conditions, plasma AT-III levels should be monitored more frequently, and THROMBATE III administered as necessary.

When an infusion of THROMBATE III is indicated for a patient with hereditary deficiency to control an acute thrombotic episode or prevent thrombosis following surgical or obstetrical procedures, it is desirable to raise the AT-III level to normal and maintain this level for 2 to 8 days, depending on the indication for treatment, type and extent of surgery, patient's medical condition, past history and physician's judgment. Concomitant administration of heparin in each of these situations should be based on the medical judgment of the physician.

As a general recommendation, the following therapeutic program may be utilized as a starting program for treatment, modifying the program based on the actual plasma AT-III levels achieved:

- a) An initial loading dose of THROMBATE III calculated to elevate the plasma AT-III level to 120%, assuming an expected rise over the baseline plasma AT-III level of 1.4% (functional activity) per IU per kg of THROMBATE III administered. Thus, if an individual has a baseline AT-III level of 57%, the initial THROMBATE III dose would be $(120-57)/1.4 = 45$ IU/kg.
- b) Measure preinfusion and 20 minutes postinfusion (peak) plasma antithrombin III levels following the initial loading dose, plasma antithrombin III level after 12 hours, then preceding the next infusion (trough level). Subsequently measure antithrombin III levels preceding and 20 minutes after each infusion until predictable peak and trough levels have been achieved, generally between 80%–120%. Plasma levels between 80%–120% may be maintained by administration of maintenance doses of 60% of the initial loading dose, administered every 24 hours. Adjustments in the maintenance dose and/or interval between doses should be made based on actual plasma AT-III levels achieved.

The above recommendations for dosing are provided as a general guideline for therapy only. The exact loading and maintenance dosages and dosing intervals should be individualized for each subject, based on the individual clinical conditions, response to therapy, and actual plasma AT-III levels achieved. In some situations, e.g., following surgery,²⁰ with hemorrhage or acute thrombosis and during intravenous heparin administration,^{13,21-23} in vivo survival of infused THROMBATE III has been reported to be shortened, resulting in the need to administer THROMBATE III more frequently.

Antithrombin III (Human), THROMBATE III® should be reconstituted with Sterile Water for Injection, USP and brought to room temperature prior to administration. THROMBATE III should be filtered

through a sterile filter needle as supplied in the package prior to use, and should be administered within 3 hours following reconstitution. THROMBATE III may be infused over 10–20 minutes. THROMBATE III must be administered intravenously.

Parenteral drug products should be inspected visually for particulate matter and discoloration prior to administration, whenever solution and container permit.

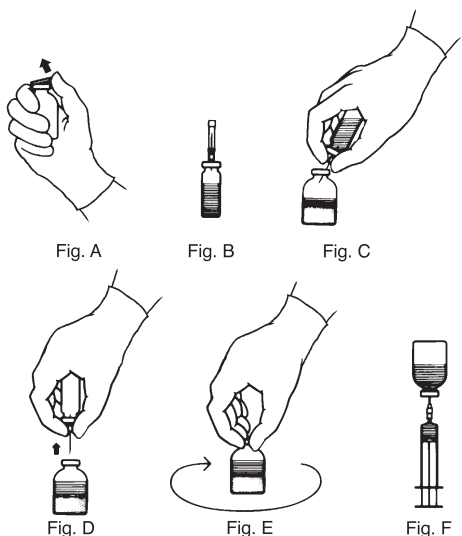
Reconstitution

Vacuum Transfer

Note: Aseptic technique should be carefully followed. All needles and vial tops that will come into contact with the product to be administered via the intravenous route should not come in contact with any nonsterile surface. Any contaminated needles should be discarded by placing in a puncture-proof container and new equipment should be used.

1. After removing all items from the box, warm the sterile water (diluent) to room temperature (25°C, 77°F).
2. Remove the plastic flip tops from each vial (Fig. A). Cleanse vial tops (grey stoppers) with alcohol swab and allow surface to dry. After cleaning, do not allow anything to touch the stopper.
3. Carefully remove the plastic sheath from the short end of the transfer needle. Insert the exposed needle into the diluent vial to the hub (Fig. B).
4. Carefully grip the sheath of the other end of the transfer needle and twist to remove it.
5. Invert the diluent vial and insert the attached needle into the concentrate vial at a 45° angle (Fig. C). This will direct the stream of diluent against the wall of the concentrate vial and minimize foaming. The vacuum will draw the diluent into the concentrate vial.*
6. When diluent transfer is complete, remove the diluent vial and transfer needle (Fig. D).
7. Immediately after adding the diluent, swirl continuously until completely dissolved (Fig. E). Some foaming may occur, but attempt to avoid excessive foaming. The vial should then be visually inspected for particulate matter and discoloration prior to administration.
8. Clean the top of the vial of reconstituted THROMBATE III again with alcohol swab and let surface dry.
9. Attach the filter needle (from the package) to sterile syringe. Withdraw the THROMBATE III solution into the syringe through the filter needle (Fig. F).
10. Remove the filter needle from the syringe and replace with an appropriate injection or butterfly needle for administration. Discard filter needle into a puncture-proof container.
11. If the same patient is using more than one vial of THROMBATE III, the contents of multiple vials may be drawn into the same syringe through the filter needles provided.

*If vacuum is lost in the concentrate vial, use a sterile syringe to remove the sterile water from the diluent vial and inject it into the concentrate vial, directing the stream of fluid against the wall of the vial.



A number of factors beyond our control could reduce the efficacy of this product or even result in an ill effect following its use. These include improper storage and handling of the product after it leaves our hands, diagnosis, dosage, method of administration, and biological differences in individual patients. Because of these factors, it is important that this product is stored properly, that the directions are followed carefully during use, and that the risk of transmitting viruses is carefully weighed before the product is prescribed.

Rate of Administration

The rate of administration should be adapted to the response of the individual patient, but administration of the entire dose in 10 to 20 minutes is generally well tolerated.

HOW SUPPLIED

Antithrombin III (Human), THROMBATE III® is supplied in the following single use vials with the potency in international units stated on the label of each vial. A suitable volume of Sterile Water for Injection, USP, a sterile double-ended transfer needle, and a sterile filter needle are provided.

<u>NDC Number</u>	<u>Approximate Antithrombin III Potency</u>	<u>Diluent</u>
0026-0603-20	500 IU	10 mL
0026-0603-30	1000 IU	20 mL

STORAGE

THROMBATE III should be stored under refrigeration (2–8°C; 36–46°F). Freezing should be avoided as breakage of the diluent bottle might occur.

CAUTION

Rx only

U.S. federal law prohibits dispensing without prescription.

REFERENCES

1. Cohn EJ, Strong LE, Hughes WL Jr, et al: Preparation and properties of serum and plasma proteins. IV. A system for the separation into fractions of the protein and lipoprotein components of biological tissues and fluids. *J Am Chem Soc* 68(3):459-75, 1946.
2. Rosenberg RD, Bauer KA, Marcum JA: Antithrombin III "the heparin-antithrombin system." *Rev Hematol* 2:351-416, 1986.
3. Murano G, Williams L, Miller-Andersson M: Some properties of antithrombin-III and its concentration in human plasma. *Thromb Res* 18(1-2):259-62, 1980.
4. Rosenberg RD: Action and interactions of antithrombin and heparin. *N Engl J Med* 292(3):146-51, 1975.
5. Winter JH, Fenech A, Ridley W, et al: Familial antithrombin III deficiency. *Q J Med* 51(204):373-95, 1982.
6. Marciniak E, Farley CH, DeSimone PA: Familial thrombosis due to antithrombin III deficiency. *Blood* 43(2):219-31, 1974.
7. Thaler E, Lechner K: Antithrombin III deficiency and thromboembolism. *Clin Haematol* 10(2):369-90, 1981.
8. Blauhut B, Necek S, Kramar H, et al: Activity of antithrombin III and effect of heparin on coagulation in shock. *Thromb Res* 19(6):775-82, 1980.
9. Samson D, Stirling Y, Woolf L, et al: Management of planned pregnancy in a patient with congenital antithrombin III deficiency. *Br J Haematol* 56(2):243-9, 1984.
10. Brandt P: Observations during the treatment of antithrombin-III deficient women with heparin and antithrombin concentrate during pregnancy, parturition, and abortion. *Thromb Res* 22(1-2):15-24, 1981.
11. Hellgren M, Tengborn L, Abildgaard U: Pregnancy in women with congenital antithrombin III deficiency: experience of treatment with heparin and antithrombin. *Gynecol Obstet Invest* 14(2):127-41, 1982.
12. Schwartz RS, Bauer KA, Rosenberg RD, et al: Clinical experience with antithrombin III concentrate in treatment of congenital and acquired deficiency of antithrombin. *Am J Med* 87 (Suppl 3B): 53S-60S, 1989.

13. Collen D, Schetz J, de Cock F, et al: Metabolism of antithrombin III (heparin cofactor) in man: effects of venous thrombosis and of heparin administration. *Eur J Clin Invest* 7(1):27-35, 1977.
14. Knot EAR, de Jong E, ten Cate JW, et al: Purified radiolabeled antithrombin III metabolism in three families with hereditary AT III deficiency: application of a three-compartment model. *Blood* 67(1):93-8, 1986.
15. Tengborn L, Frohm B, Nilsson LE, et al: Antithrombin III concentrate: its catabolism in health and in antithrombin III deficiency. *Scand J Clin Lab Invest* 41(5):469-77, 1981.
16. Sas G, Blasko G, Banhegyi D, et al: Abnormal antithrombin III (antithrombin III "Budapest") as a cause of familial thrombophilia. *Thromb Diath Haemorrh* 32(1):105-15, 1974.
17. Bjarke B, Herin P, Blomback M: Neonatal aortic thrombosis. A possible clinical manifestation of congenital antithrombin III deficiency. *Acta Paediatr Scand* 63:297-301, 1974.
18. Hathaway WE, Bonnar J: Perinatal coagulation. New York, Grune & Stratton, 1978, p.68.
19. Peters M, Jansen E, ten Cate JW, et al: Neonatal antithrombin III. *Br J Haematol* 58(4):579-87, 1984.
20. Mannucci PM, Boyer C, Wolf M, et al: Treatment of congenital antithrombin III deficiency with concentrates. *Br J Haematol* 50(3):531-5, 1982.
21. Marciniak E, Gockerman JP: Heparin-induced decrease in circulating antithrombin-III. *Lancet* 2(8038):581-4, 1977.
22. O'Brien JR, Etherington MD: Effect of heparin and warfarin on antithrombin III. *Lancet* 2(8050):1232, 1977.
23. Kakkar VV, Bentley PG, Scully MF, et al: Antithrombin III and heparin. *Lancet* 1(8159):103-4, 1980.

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