
Biolab Medical Unit

9 Weymouth Street, London W1W 6DB, U.K. Tel: (+44) 020-7636 5959/5905 Fax: (+44) 020-7580-3910
E-mail: info@biolab.co.uk Internet: <http://www.biolab.co.uk>

Erythrocyte glutathione measurement November 2008

Indications

Glutathione (GSH - a tripeptide consisting of glutamic acid - cysteine – glycine), acts as the substrate for the enzyme glutathione peroxidase. As such it is an important component of the body's intracellular antioxidant defences, protecting cytosolic organelles in particular from the damaging effects of hydroperoxides formed during normal metabolism. In addition, GSH also acts synergistically with ascorbic acid and α -tocopherol to re-cycle these nutrient antioxidant vitamins to their reduced state after their interaction with reducing chemical species inside the cell. Dietary sources of glutathione are found in fresh fruit and vegetables and it has been suggested that deficiency in the consumption of these is an important factor in the development of many cancers [1].

GSH is synthesized in erythrocytes by the action of gamma-glutamyl cysteine synthetase/glutathione synthetase and associated enzymes; it has an intracellular half life of around 4 days. Estimates suggest that this enzyme system normally operates well below its maximum capacity – because of the importance of GSH as an antioxidant. GSH is essential for the life of the cell, being the principal intracellular antioxidant, and is also exported from the erythrocyte to be used in the systemic detoxification of xenobiotics.

Patient preparation

The patient should discontinue nutritional supplements for 24 hours before the collection of a blood sample for glutathione analysis (so that the results do not reflect a post-absorptive peak in the level of GSH).

Specimen requirements

Reduced glutathione (GSH) is present in blood as an intracellular component of erythrocytes, at a concentration of about 1.0 mmol/L. Concentrations in the plasma water are very much lower, representing less than 1.0% of the total GSH in the whole blood. Red cell lysates are thus the sample of choice for GSH measurement and determination of blood GSH is well established as an accurate indicator of whole body GSH status [2].

Blood should be taken into green top tubes (heparinised - available from Biolab on request). If posted samples must reach Biolab within 24 hours.

Laboratory Method

The reaction of sulphhydryl compounds with 5,5'-dithiobis-(2-nitrobenzoic acid) (DTNB) [3]. The turn around time for this analysis is 2-3 working days.

Interpretation

The reference interval is 1.6 - 2.8 mmoles of GSH per litre of red cells.

There are various factors that control the glutathione level in the erythrocyte. For example lack of cysteine decreases GSH production, whereas lack of methione increases GSH synthesis (presumably a compensatory mechanism since methionine is also used in de-toxification reactions). Various genetic factors may decrease GSH production. In glutathione synthetase deficiency (5-oxoprolinuria), as well as in nutritional deprivation, the total level of GSH in the red cells is reduced. Enzyme-deficient subjects may be confirmed by further studies on the stability of GSH synthetase. Affected individuals may suffer from chronic haemolysis and late-onset intellectual regression.

It is well reported that haematological disorders affect GSH production. Anaemia, in particular, tends to increase GSH levels, due to the increased proportion of younger red cells in the circulation (young red cells have higher gamma-glutamyl cysteine synthetase activity than older cells). In particular, patients with granulocytic anaemias and other myeloproliferative disorders have higher-than-normal red cell GSH levels for this reason [4].

References

1. Jones DP, Coates RJ, Flagg EW, Eley JW, Block G, Greenberg RS, Gunter EW, Jackson B (1992). Glutathione in foods listed in the National Cancer Institute's Health Habits and History Food Frequency questionnaire. *Nutr Cancer* 17: 57-75.
2. Richie JP, Skowronski L, Abraham P, Leutzinger Y (1996). Blood glutathione concentrations in a large scale human study. *Clin Chem* 42:64-70.
3. Beutler E, Duron O, Kelly BM (1963). Improved method for the determination of blood glutathione. *J Lab and Clin Med* 61:882-888.
4. Beutler E, Dale GL. Erythrocyte glutathione. In: *Glutathione - chemical, biochemical and medical aspects*. Eds Dolphin D, Poulson R. John Wiley and sons, publishers, 1989.

Price: The test fee for measurement of erythrocyte glutathione is £18.00.