
Biolab Medical Unit

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Glutathione Peroxidase Activity in Red Blood Cells

Indications

Glutathione, a tripeptide consisting of glutamic acid - cysteine – glycine, is the substrate for glutathione peroxidase (GSHPx), which is an important enzymatic component of the intracellular antioxidant defences. The action of GSHPx protects cytosolic organelles from the damaging effects of low levels of hydroperoxides formed during normal metabolism – mainly lipid hydroperoxides released from membrane phospholipids by phospholipase A2 activity. GSHPx de-toxifies this H₂O₂ by reducing it to water, while at the same time oxidising glutathione [1]. Any deficiency in this de-toxification cycle (e.g. of GSHPx or of glutathione itself) puts the cell at risk from the potentially mutagenic effects of lipid hydroperoxides. Higher levels of H₂O₂, such as are produced by cellular respiration, are normally reduced by a different mechanism (the enzyme catalase).

GSHPx is found throughout the tissues, being present as four different isoenzymes [2]:

- a) Cellular glutathione peroxidase (cGSHPx, e.g. red cell GSHPx), which is the measurement of choice because of the availability of red blood cells,
- b) Extracellular glutathione peroxidase (eGSHPx),
- c) Phospholipid hydroperoxide glutathione peroxidase (phGSHPx) and
- d) Gastrointestinal glutathione peroxidase (giGSHPx)

GSHPx contains one residue per mole of selenocysteine, an analogue of cysteine in which selenium is substituted for sulphur. Deficiency of selenium therefore greatly decreases the amount and activity of this enzyme. Current concerns about levels of selenium in the soil in the UK, together with concerns about modern agricultural methods, mean that application of this enzyme measurement may be appropriate in a wide variety of subjects.

GSHPx measurement should also be considered in particular with patients who are under oxidative stress for any reason; low activity of this enzyme is one of the early consequences of a disturbance of the pro-oxidant/anti-oxidant balance in favour of the former [3,4,5]. Low activity of GSHPx is thought to be associated with an increase in the incidence of various cancers (especially prostate cancer in the male), and this may therefore be one mechanism for the association between antioxidant depletion and increased cancer risk.

Patient preparation

No special patient preparation is needed.

Specimen requirements

Reduced glutathione peroxidase (GSHPx) is present in blood as an intracellular component of erythrocytes – together with glutathione itself. Concentrations in the plasma water itself are very much lower, representing less than one per cent of the total blood GSHPx activity. Red cell lysates from EDTA blood samples are the sample of choice for GSHPx measurement.

Lavender top tubes (EDTA - available from Biolab on request). If posted, samples must reach us within 24 hours.

Price

The fee is £19. Please make cheques payable to BIOLAB.

Methodology

The oxidation of glutathione in the presence of glutathione reductase and NADPH, monitoring at 340 nm [6].

Turn around time

1-2 working days.

Interpretation

The Biolab reference interval for red cell GSHPx is 67 - 90 international units of activity per gram of haemoglobin. Other laboratories may use different reference intervals to interpret their results.

In exceptional cases of selenium deficiency the red cell GSHPx activity may be below 30 i.u. per gram of haemoglobin. Selenium supplementation can increase the red cell GSHPx activity to values above the reference interval, up to 120 i.u. per gram of haemoglobin.

(March 2000)

References

1. Michiels C, Raes M, Toussant O, Remacle J. Importance of Se glutathione peroxidase, catalase and Cu/Zn-SOD for cell survival against oxidative stress. *Free Rad Biol Med* 1994;17:235-248.
2. Brigelius-Flohe R. Tissue-specific functions of individual glutathione peroxidases. *Free Rad Biol Med* 1999;27:951-965.
3. Zaltzber H, Kanter Y, Aviram M, Levy Y. Increased plasma oxidizability and decreased erythrocyte and plasma antioxidative capacity in patients with NIDDM. *Isr Med Assoc J* 1999;1:228-231.
4. Benabdeslam H, Abidi H, Garcia I, Bellon G, Gilly R, Revol A. Lipid peroxidation and antioxidant defences in cystic fibrosis patients. *Clin Chem Lab Med* 1999;37:511-516.
5. Yang G, Chen J, Wen Z, Ge K, Zhu L, Chen X. The role of selenium in Keshan disease. *Adv Nutr Res* 1984;6:203-220.
6. Paglia DE, Valentine WN. Studies on the quantitative and qualitative characterization of erythrocyte glutathione peroxidase. *J Lab Clin Med* 1967;70:158-169.