Hyperbaric Oxygen for a Thalassaemic Leg Ulcer

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SUMMARY: A thalassaemic ulcer in a male Greek Cypriot patient, resistant to standard medical treatment, was treated using hyperbaric oxygen in a recompression chamber. The patient breathed 100% oxygen by face mask whilst the chamber was compressed with air to a pressure of 2.5 atmospheres absolute. The ulcer became fully epithelialised within three weeks of starting treatment.

Introduction

Thalassaemias are characterized by an imbalance in the production of globin polypeptide chains due to the absence or reduced expression of one or more of the globin genes, and occur particularly frequently in the Mediterranean area. Leg ulcers have been described in both alpha¹ and beta thalassaemia².

We report a patient with thalassaemia intermedia in whom treatment of a leg ulcer was effected by use of hyperbaric oxygen in a recompression chamber.

Case Report

A fit, 24 year old Greek Cypriot male was admitted to hospital with a three month history of an ulcer above his right ankle, resistant to standard medical treatment.

His past history revealed that he had thalassaemia but had declined treatment. There was a known significant family history of thalassaemia (see family tree). Examination showed a 4 cm indurated and pigmented area with a central 2 cm ulcer with no rolled edge, just above the right medial malleolus. No varicose veins could be demonstrated in either leg. The heart and lungs were normal and the spleen was not palpable.

Haematological investigations: Hb 7.8 g/dl, PCV 0.26, MCV 48 fl, MCH 14 pg, MCHC 30 g/dl, WBC 10.8 $\times 10^9/l$; reticulocytes 15%. In the blood film the red cells showed marked anisocytosis and poikilocytosis. Initial haemoglobin electrophoresis was reported as follows: HbA₂ 9%, HbF 26%. HbH negative and HbS negative. More detailed studies on another occasion showed HbA₂ 8.8%, HbF 29.1%, α/β ratio 4.484 and $\alpha/\text{non } \alpha$ 3.279. The haematological diagnosis was considered to be thalassaemia intermedia, probable genotype $\alpha_1\beta\beta$, the patient being homozygous for the β thalassaemic gene and heterozygous for the α gene.

Venography revealed a normal venous system.

A course of hyperbaric oxygen in our recompression chamber, for treatment of his thalassaemic ulcer, was commenced. The recompression chamber used was a

CLUCAS 6 man, twin compartment model. The chamber was compressed with air to a pressure of 2.5 atmospheres absolute. The duration of each session was 90 minutes at depth and throughout the patient breathed 100% O₂, by face mask³. After 14 'sessions' over 3 weeks the ulcer was fully epithelialised. One year later the patient has an area of pigmented good quality skin at the site of the healed ulcer with no induration, tenderness or pain.

Discussion

Leg ulcers are most commonly due to venous insufficiency⁴ and are usually located in the area of the medial malleolus close to the medial perforators. Leg ulcers associated with thalassaemia are relatively rare but they also develop in the area of the medial malleolus². The potential for misdiagnosis of the aetiology of leg ulceration exists, especially in patients of Mediterranean origin. Differentiation between a venous and thalassaemic ulcer can be aided by venography.

The events leading to thalassaemic ulceration are not well established. They tend to occur in young adulthood, often develop after minor trauma, are characteristically slow to heal and are prone to recur. The severity is not apparently related to the severity of anaemia, degree of haemosiderosis or the patient's transfusion requirements². The mechanism may be that indeformable and rigid thalassaemic red blood cells cause venous stasis, venous hypertension and impaired blood flow through capillary beds⁵. A contributing factor² may be impaired tissue oxygenation resulting from the high affinity the thalassaemic fetal Hb has for oxygen. A correlation between the percentage of fetal haemoglobin and the severity of thalassaemic ulcers has been described².

Hyperbaric oxygen causes more oxygen to dissolve in the superficial tissue of the ulcer which enhances healing by stimulating fibroblastic activity and collagen production. It also facilitates fibroblastic proliferation which promotes capillary budding³.

Patient's Family Tree
Patient described is III 6

A local hermetic chamber enclosing the limb with oxygen supplied locally at a pressure not exceeding 22 mmHg above atmospheric pressure has been used to aid the healing of ulcers of many aetiologies⁶. Greater pressures applied locally cause problems of venous stasis and obstruction of capillary blood flow⁶. Local chambers are expensive, require sterilisation and may cause cross infection if shared by several patients⁷. Strong disposable polythene bags have been used to apply local hyperbaric oxygen to limbs⁷. These are cheap, require no sterilisation and are capable of maintaining the required pressure. Using local hyperbaric oxygen it has been shown⁸ that a very high gradient of oxygen saturation exists between the surface and deeper layers of granulation tissue. Patients with poor blood supply to the deeper layers of the ulcer would probably benefit from treatment in a hyperbaric oxygen chamber.

The benefits of systemic hyperbaric therapy follow from its effect on the absorption and transport of oxygen.

Ambient Pressure P Pa	%O ₂	Arterial pO ₂ (approx.) K Pa	O ₂ in simple solution ml/100ml Plasma
101.3	20.9	13.5	0.3
101.3	100	80	1.8
202.6	100	186	4.2
303.9	100	268	6.0

The higher the pO₂ of the inspired gas the higher the arterial pO₂ in an almost linear fashion.

Although oxygen stores are considerably increased when hyperbaric oxygen is given tissue, oxygen is not necessarily commensurate with arterial pO₂. This depends on many factors including the properties of haemoglobin, cardiac output, regional tissue perfusion and upon the diffusion of oxygen from capillaries into the tissues.

We can find no reports in the literature of thalassaemic ulcers being treated in a hyperbaric oxygen chamber.

Conclusion

Thalassaemia should be considered as a possible cause of leg ulceration in patients of Mediterranean origin. Venography can be used as a diagnostic tool to exclude venous ulceration and thus eliminate this potential misdiagnosis. Hyperbaric oxygen by way of a recompression chamber can successfully be used to treat thalassaemic ulceration.

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