HYPERBARIC OXYGEN THERAPY (HBOT) IN PREVENTION OF ISHEMIA-REPERFUSION (I/R) INJURY AFTER TESTICULAR DETORSION SURGERY

A.E. Kartal[1], M.K. Özgök Kangal[2], T. Çaviş [3], S.E. Ünlü Ballı[1], T. Zaman [2], G.B. Bahadır[1], R. Özkan[2], O. Türkmen[2], İ. Sürer[1]

[1]Department of Pediatric Surgery, University Of Health Sciences, Gulhane Training And Research Hospital, Ankara, Türkiye

[2]Underwater and Hyperbaric Medicine, University Of Health Sciences, Gulhane Training And Research Hospital, Ankara, Türkiye

[3] Department Of Radiology, University Of Health Sciences, Gulhane Training And Research Hospital, Ankara, Türkiye

INTRODUCTION

- Testicular torsion is an urological emergency
- The incidence in children is 3.8-8.6/100,000
- There is no accepted clinical protocol to prevent I/R injury after testicular detorsion
- The protective effects of HBOT in I/R injury are well documented and considered an effective treatment modality for I/R due to
  - Its ability to reduce neutrophil infiltration
  - Inhibit the release of proinflammatory cytokines
  - Activate antioxidant enzymes
  - Block lipid peroxidation
- HBOT is currently successfully applied worldwide in many situations characterized by underlying I/R injury, such as crush injuries, compartment syndrome, damaged flaps/grafts, and frostbite
- HBOT has shown promising results in animal models of I/R in testicular torsion-detorsion; ***however, there is only one case report of its clinical application in I/R injury resulting from testicular torsion-detorsion***

We aimed to evaluate the outcomes of patients with testicular torsion who underwent HBOT after surgery.

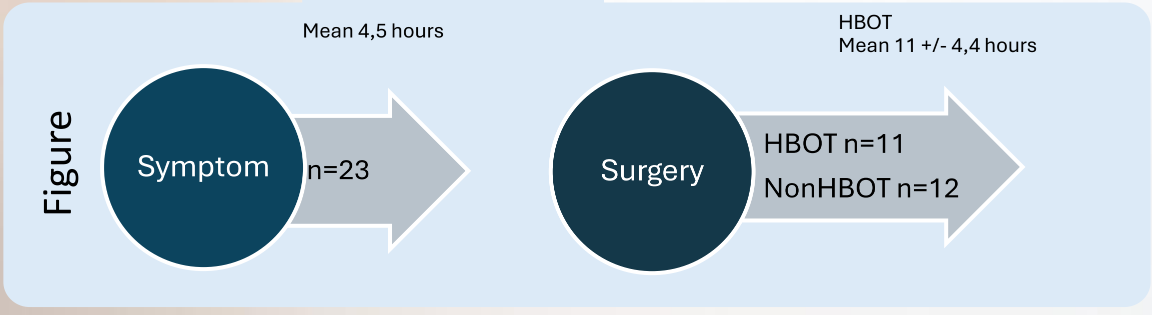
MATERIAL AND METHOD

- Retrospective
- Ethical approval: 2025/35
- January 1, 2017 – December 31, 2024
- 23 patients
- Right testicular torsion 60,9% (n=14)
- Receiving HBOT n=11
  NOT-Receiving HBOT n=12
- Symptom → Mean 4,5 hours → Detorsion → Mean 11+/-4,4 hours → HBOT (Figure)

Exclusion: Lack of preoperative doppler ultrasound, underwent orchiectomy, and unhealthy contralateral testicle

Non-HBOT group: Patients who could not receive HBOT after surgery for any reason (treatment refusal, HBOT contraindication, or intolerance to the session)

Age, duration of torsion, and degree of torsion were similar between the HBOT and non-HBOT groups (Table). However, all patients who did not respond during surgery were in the HBOT group (p=0.012)



	HBOT Group	Non-HBOT Group	P-Value
Age	15.1 ± 1.3	14.1 ± 1.93	0.161
Torsion Duration (hours)	5 (1-11)	4.25 (1 -14)	0.556
Degree of Torsion			
90°	1 (9.1%)	2 (20%)	0.871
180°	1 (9.1%)	0	
360°	6 (54.5%)	4 (40%)	
720°	2 (18.2%)	3 (30%)	
1080°	1 (9.1%)	1 (10%)	
Intraoperative Findings (5 min post-detorsion)			
Response	6 (54.5%)	5 (45.5%)	**0.012***
Sensivity	0	10 (%100)	
Difference between Ipsilateral and Contralateral Testes			
Volume (mL)	12.1 ± 5.6	13.4 ± 3.6	0.652
SWE (kPA)	3.3 (2.5 – 19.9)	2.8 (2.5 – 3.6)	0.371
MVI (%)	6.5 ± 3.9	5.1 ± 2.2	0.476
Ultrasound Parameters for the Contralateral Testis			
Hacim (mL)	13.3 ± 2.1	13.7 ± 2.9	0.745
SWE (kPA)	3.3 (2.5 – 3.7)	2.9 (2.7 – 12.3)	1.000
MVI (%)	5.6 ± 2.3	6.4 ± 4.2	0.698
Difference between Ipsilateral and Contralateral Testesal testis arasındaki fark			
Hacim (mL)	-1.19 ± 4.21	-0.348 ± 1.79	0.686
SWE (kPA)	0.30 (-1.18 – 16.3)	-0.22 (-9.53 – 0.74)	0.170
MVI (%)	0.91 ± 3.12	-1.28 ± 2.19	0.208

RESULTS

- Mean follow-up: 10±5.7 months
- The detection of testicular atrophy through physical examination during long-term follow-up was similar (p = 0.214)
- 12 patients underwent Doppler ultrasound with elastography; the HBOT group (n=7) and the no HBOT group (n=5) showed no significant difference in testicular volume (p = 0.686), shear wave elastography (SWE) (p = 0.170), or microvascular imaging (MVI) (p = 0.208) (Table)

The HBOT and non-HBOT groups were similar in terms of prognostic factors. Still, those with poor intraoperative colour and little or no bleeding were categorised as non-responders, while those with lightened colour were classified as responders. A total of six non-responders (patients with low prognostic expectations) were all in the HBOT group. In the overall sample, three testes atrophied (p = 0.214), and these three patients were classified as non-responders.

DISCUSSION

- Our study is the <u>*first clinical trial*</u> to assess HBOT in human patients with testicular torsion
- All "non-responder" cases had surgery within 12 hours, with torsion from 90 to 360 degrees.
- The median time from surgery to HBOT was 11 hours (3.5–12) in those with atrophy and 2 hours (2–4.5) in those without, suggesting that early HBOT may be more effective in reducing reperfusion injury
  This suggests that HBOT is more effective when administered within hours after torsion relief.

CONCLUSION

- The degree and duration of torsion are the most significant prognostic factors for testicular tissue survival.
- Although no statistically significant differences were found between the HBOT and non-HBOT groups in long-term testicular volume and elastographic parameters, there was a trend indicating improved microvascularity and decreased tissue stiffness in the HBOT group
- **Despite limitations such as a small sample size and a retrospective design, this study provides valuable preliminary data supporting the potential role of HBOT as an adjunctive therapy in testicular torsion. Future prospective studies with larger cohorts should be undertaken to clarify its potential clinical benefits, particularly in patients demonstrating an inadequate intraoperative reperfusion response.**