

HDROZONE™

Fleksibl Endoskoplarda Ultra Düşük Sıcaklık Sterilizasyonu: Polimer Stabilitesi, Lümen Fiziyi ve Klinik Risk Yönetimi

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GERÇEK PROBLEM

Fleksibl endoskoplarda:

- Uzun
- Dar
- Polimer bazlı
- Kompleks mekanik yapı

Bu yüzden:

sterilizasyon açısından en zor medikal cihaz sınıfıdır.

Bu sadece teorik değil:

- Bazı çalışmalarda işlenmiş endoskoplarda %32'sinde kontaminasyon bulunmuştur.
- Tek bir kanal bile milyonlarca bakteri taşıyabilir.

Yani problem:

“Temizledik ama gerçekten steril mi?”



KEYLER

Lümen, Polimer, Stabilite, TASS, Kalıntı, Biyofilm, Difüzyon, Penetrasyon, Reaktif Taşınım

1. ENDOSKOP STERİLİZASYONU NEDEN ZOR?

Referans üreticiler:

- Olympus Corporation
- Pentax Medical

Yapı:

1. Lümen (kanal)
2. Polimer dış yapı
3. Optik sistem

Kritik gerçek:

- Dar lümenler: Temizlenmesi zor
- Karmaşık iç yapı: Mikroorganizma saklanır

Bu yüzden:

Sterilizasyon başarısızlığı = sistem hatası değil, fiziksel sınır

2. MEVCUT SİSTEMLER NEREDE TAKILIYOR ?

2.1 Difüzyon Problemi

H₂O₂ sistemleri:

- Gaz yayılımına dayanır
- Lümen içinde zayıflar

Bilimsel gerçek:

Uzun ve dar lümenlerde H₂O₂ yoğunlaşması nedeniyle penetrasyon sınırlıdır.

2.2 H₂O₂ Sterilizasyon Yönteminde Nem Problemi

- Nem: Gaz davranışını değiştirir.
- Döngü iptalleri oluşur.

2.3 Polimer Hasarı

Tekrar sterilizasyon:

Endoskopta wear & tear (yıpranma) oluşturur

3. ASIL KRİTİK KONU: POLİMER FİZİĞİ

Kimse açık söylemiyor ama gerçek bu:

Endoskoplar sterilizasyon yüzünden yaşlanıyor.

3.1 Mekanizma

Yüksek sıcaklık + oksidasyon:

- Zincir mobilitesi artar
- Mikro çatlak (crazing)
- Yüzey pürüzlenmesi

3.2 Klinik zincir

1. Yüzey bozulur
2. Protein tutunur
3. Biyofilm oluşur
4. Sterilizasyon zorlaşır

Bu döngü kendini besler.

4. STERİLİZASYONDA ULTRA LOW TEMPERATURE (37–42 °C) = OYUN DEĞİŞTİREN NOKTA

Mevcut sistemler:

- 45–55 °C

HDROZONE:

- 37–42 °C

Bu fark neden kritik?

Polimer açısından:

- Tg'ye yaklaşmaz
- Zincir yapısı korunur
- Mikroyapı stabil kalır

Klinik karşılığı:

- ✓ Optik kalite korunur
- ✓ Yüzey bozulmaz
- ✓ Biyofilm oluşumu azalır

Bu sadece "daha düşük sıcaklık" değil: Farklı malzeme rejimi

5. STERİLİZASYONDA LÜMEN SORUNU

Klinik gerçek:

Enfeksiyonların çoğu lümen kaynaklı

Problem:

- Gaz ilerledikçe zayıflar
- Yüzeyde kaybolur
- Uç noktaya ulaşamaz

SONUÇ:

- Sterilite güvenilirmez
- Biyofilm kalır

6. HDROZONE™ FARKI

HDROZONE:

- Pasif difüzyon kullanmaz
- Yönlendirilmiş reaktif taşınım kullanır

Bu ne demek?

- Reaktifler lümen merkezinde kalır
- Yüzeye çökmez
- İleri taşınır

KLİNİK SONUÇ:

- ✓ Uç noktaya etki
- ✓ Homojen dağılım
- ✓ Daha stabil sterilizasyon

7. KALINTI VE TASS GERÇEĞİ

Sterilizasyon sonrası risk:

- Toksik kalıntı
- TASS
- Doku irritasyonu

Klinik gerçek:

Sterilizasyon sadece öldürmek değildir: temiz bırakmak zorundadır

HDROZONE yaklaşımı:

- Reaktifler parçalanır
- Kalıntı minimize edilir

8. GERÇEK DÜNYA PAZAR OYUNCULARI:

- Advanced Sterilization Products
- STERIS

Problem	Mevcut Sistemler	HdrOzone
Lümen penetrasyonu	Sınırlı	Geniş
Polimer hasarı	Var	Minimize
Sıcaklık	Yüksek	Düşük
Kalıntı	Risk	Düşük
Nem	Problem	Tolere

Net Yorum

Mevcut sistemler:

✓Çalışır

! Ama limitli fizik kullanır

HDROZONE:

Farklı fizik kullanır.

9. ÖNEMLİ OLAN KLİNİK SONUÇLAR

HDROZONE'un etkisi:

1. Enfeksiyon riski

- Biyofilm azalır

2. Cihaz ömrü

- Polimer korunur

3. Operasyon güvenliği

- Sterilizasyon daha öngörülebilir

10. STERİLİZASYON TEKNİKLERİNDE SEKTÖRÜN GİTTİĞİ YER

Bugün:

- Difüzyon tabanlı sistemler

Yarın:

Yönlendirilmiş reaktif sistemler

11. SONUÇ

HDROZONE:

- ✓ Ultra düşük sıcaklıkta çalışır
- ✓ Polimerleri korur
- ✓ Lümen problemini çözer
- ✓ Kalıntıyı minimize eder

Şu an endoskopi sterilizasyon yöntemlerinde sektör:

"idare eden" teknolojiler kullanıyor

Ama gerçek ihtiyaç:

hasarsız + derin + güvenilir sterilizasyon

KAYNAKÇA

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