

Disinfection of Endoscopes & Accessories

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Sources for Transmission of Infections

- Contaminated Endoscope
- Bottle of water for Endoscope or thermo coagulator
- Accessories (biopsy forceps, snare, band-ligators, sphyncterotomes, dilators, etc.)
- Sedative & analgesics vials of multiple use; reutilization de syringes.

Evidence of the Problem

Transmission of Hepatitis B

- 1975: 1 of 62 exposed; sero-conversion 290 days later; EGD; endoscope washed with water.
- 1981: 1 sero-conversion 9 months later; EGD;
- 1983: 1 acute hepatitis; EGD; washed with water and detergent.
- 6 prospective studies: 129 patients; inadequate disinfection with follow-up of 6 months; no cases.
- 4 prospective studies: 722 patients in high prevalence area; sero-conversion equal to the rest of population.
- **CONCLUSION:** with inadequate protocols for disinfection, it is possible to transmit Hepatitis B, but the risk is small.

Transmission of Hepatitis C

- 1993: acute hepatitis C 2 months after; ERCP; inadequate disinfection.
- 1997: 2 acute hepatitis C; colonoscopy; inadequate disinfection & non-sterile biopsy forceps.
- Studies “in vitro” demonstrate complete elimination of hepatitis C virus with “adequate disinfection”.

Transmission of Human Immunodeficiency Virus (HIV)

- There are no reported cases.
- HIV is eliminated completely with “adequate disinfection”.

Transmission of Prions (spongiform encephalitis)

- Prions are resistant to “high grade disinfectants”, Peracetic acid may have some activity; intense washing with water and detergent seems to be adequate.
- The agent of Creutzfeldt-Jakob Disease (CJD) is not present in saliva, gums, intestinal tissue, feces, nor blood. There are no cases transmitted by endoscopy.
- The agent of “mad cow disease” (CJDv) is less infectious, but is present in lymphatic tissue (tonsils, appendix, terminal ileum, & rectum).

Transmission of Salmonella

- 1974: 2 cases ; ERCP; detergent solution & alcohol.
- 1976: 9 cases; EGD; quaternary ammonium.
- 1977: 2 cases; EGD; hexachlorophene.
- 1979: 7 cases; EGD; hexachlorophene
- 1980: 5 cases; EGD; cetrимide
- 1981: 2 cases; EGD & sigmoidoscopy; inadequate disinfection.
- 1982: 15 cases; EGD; unknown source.
- 1987: 8 cases; Colon; Iodoform; non-sterile forceps.

Transmission of Pseudomonas

- 1974: 3 cases (2 fatal); EGD; benzalconium.
- 1975: 1 case; ERCP; detergent solution & alcohol.
- 1980: 14 biliary aspirate (+) en 97 patients = pseudo infection; ERCP; Povidone iodine & alcohol.
- 1980: 7 cases; ERCP; detergent solution & alcohol.
- 1980: 4 cases; EGD; endoscope & water bottle; cetrimine / chlorhexidine.
- 1982: 1 case; ERCP; endoscope & water bottle.
- 1984: 4 cases; ERCP; chlorhexidine
- 1985: 5 cases; sclerotherapy; water bottle.
- 1985: 5 cases; ERCP; glutaraldehyde at end of day.

Transmission of Pseudomonas

- 1987: 10 cases; ERCP; “elevators channel” & “Automatic Endoscope Reprocessor” (AER)
- 1987: 2 cases; ERCP; cetrimide / chlorhexidine
- 1988: 7 cases; ERCP; endoscope & water bottle
- 1990: 5 cases; ERCP; water bottle.
- 1986-88: 16 ERCP & 99 EGD; contaminated AER.
- 1993: 22 cases; ERCP; not disinfected “elevators channel” (AER not contaminated).

Transmission of Helicobacter Pylori

- 1990: 2 cases; EGD; detergent solution & alcohol.
- 1995: 1 case; EGD; benzetonium chloride
- Pre-1989 vs. post-1989 (Taiwan): 8%
(disinfection with alcohol) vs. 0%
(disinfection with glutaraldehyde)

Transmission of SARS CoV

(Gastrintest. Endosc. 2004;60:792-795)

- Usual transmission by large respiratory droplets within 3 feet.
- Can be transmitted by contact with respiratory secretions, feces, and body fluids.
- SARS-CoV can survive in plastics and stainless steel for hours or days.
- No reported cases transmitted by endoscope or bronchoscope.

Transmission of SARS CoV

Preventive Measures

(Gastrintest. Endosc. 2004;60:792-795)

- Patients likely to have SARS should be identified and isolated in a room with negative air pressure.
- Personnel should use: Disposable respirators N95 or better. Eye protection, gloves, gowns, head and shoe covers.
- Hand washing or alcohol hand rub after removal of gloves.

Conclusion

- All cases of Infections Transmitted by Endoscopy were due to:
 - A) Inadequate Disinfection Method (poor manual washing and/or lack of “high grade disinfection”).
 - B) Failure to Disinfect “Irrigation Bottle”
 - C) Failure to Disinfect the “Elevator Channel” of the Duodenoscope.
 - D) Contamination of “Automatic Endoscope Reprocessor”
 - E) Failure of sterilization or “High Grade Disinfection” of Endoscopic Accessories.

Disinfection and Sterilization

Sterilization

- Standardized and strict process which inactivates all type of micro-organisms, including resistant spores, by a factor of 10^{12} , decreasing the risk of infection to 1 in 1 million (10^{-6}).
- Examples: Steam Autoclave, gas (ethylene oxide), hydrogen peroxide, peracetic acid.

High Grade Disinfection

- Process which destroys all micro-organisms, except high concentrations of resistant spores. Reduces highly resistant, non-sporulated, micro-organisms, by a factor of 10^6 (e.g.: *Mycobacterium tuberculosis v. bovis*).
- Kills all vegetative bacteria, fungi, & virus.

Degree of Resistance to Germicides

(6 = highest,, 1 = lowest)

- 6. Bacteria with spores (B. subtilis, C. sporogenes)
- 5. Mycobacterium (Mycobacterium tuberculosis bovis)
- 4. Non-lipidic Viruses (poliovirus, coxsackievirus, rhinovirus)
- 3. Fungi (Trichophyton, Cryptococcus, Candida)
- 2. Vegetative Bacteria (Pseudomonas, salmonella, staphylococcus)
- 1. Lipidic Viruses (CMV, Herpes Simplex, HIV, Hepatitis B)

Factors Modifying Effect of Disinfectants

- **Organic Material:** in the instrument or the solution; protects the micro-organism & inactivates the disinfectant.
- **Micro-organisms Concentration:** increases risk of resistance.
- **Type of disinfectant.**
- **Concentration of the disinfectant.**
- **Exposure Time** (Low Grade disinfection, vs. High Grade disinfection, vs. Sterilization)
- **Temperature of disinfection.**
- **Age of the disinfectant.**

Contamination of Endoscopes After their Use

- **Bronchoscopes** 6.4×10^4 colonies/ml
- **EGD** 1.7×10^5 colonies/ml
- **Colonoscope** 1.0×10^{10} colonies/ml
- Maximal concentration in the suction channel.
- Washing and intense brushing with detergent solution decreases the contamination in a magnitude of 10^5 .

Needed Degree of Disinfection or Sterility

Spaulding Classification

- **Critical Instrument:**
REQUIERES STERILIZATION;
Instrument in contact with blood flow or
penetrating areas normally sterile
(papillotome, snare, biopsy forceps, ERCP
cannula, gastrostomy tube, variceal
ligator, pancreato-biliary guide-wire)

Needed Degree of Disinfection or Sterility

Spaulding Classification

- **Semi-critical Instrument:**
REQUIERES HIGH GRADE DISINFECTION
Enters in contact with mucosa but does not penetrate its surface nor sterile tissue
(Endoscopes, dilators, naso-enteral tubes)
- **Non-Critical Instrument:**
REQUIERES LOW GRADE DISINFECTION;
Enters in contact with intact skin (stethoscope)

Adequate Disinfectants for Endoscopes

	Commercial Name	Time (min.) DGA/Sterilization	Temperature (° C)
Glutaraldehyde 2%	Various	20 / 600	25
Glutaraldehyde 1.12% / Phenol 1.93%	Sporicidin	20 / 720	25
Hydrogen Peroxide 1% / Peracetic Acid 0.08%	Peract 20	25 / 480	20
Hydrogen Peroxide 7.5%	Sporox	30 / 360	20
Hydrogen Peroxide 7.35% / Peracetic Acid 0.23%	EndoSpor Plus	15 / 180	20
Ortho-phthaldehyde 0.55%	Cidex OPA	12 / 1920	20
Peracetic Acid 0.2%	Steris 20	12 / 12	50
Hypochlorite 650-675 ppm	Sterilox	10 / 720	25
Glutaraldehyde 2.5%	Rapicide	5 / 460	35
Electrolyzed Acid Water	Cleantop WM-S	7 /	20

Disinfectants Not Effective in Endoscopes

- Hexachlorophene
- Povidone Iodine
- Quaternary Ammonium (benzalconium, cetrimide, etc.)
- Chlorhexidine
- Chlorhexidine / Cetrimide
- Alkyl-diamino-ethyl-glycine
- Ethylic or isopropyl Alcohol (used only for drying)

Automatic Flexible Endoscope Reprocessors (AFER)

	Liquid Chemical Germicide	# Endoscopes/ cycle	Long drying phase	Price (dollars)
Advanced Sterilization	glutaraldehyde, peracetic acid/ hydrogen peroxide	1 o 2	YES	17,900
Steris	Peracetic Acid	1	NO	16,200
Olympus	Glutaraldehyde, hydrogen peroxide	1 o 2	YES	21,600
Chris Lutz	Glutaraldehyde, hydrogen peroxide	1 o 2	YES	14,030
Customs Ultrasonics	Glutaraldehyde, hydrogen peroxide	1, 2, o 3	YES	19,400-56,000

Cleaning and Disinfection Complexity

- **Grade 1: Solid Instruments;**
 - easy to clean and sterilize
 - magnetic extractor, guide-wire, measuring probe.
 - Can be sterilized by gas (ethylene oxide), Steam Autoclave, or Steris.
- **Grade 2: Have lumen or filaments (only 1 of them);**
 - non-retractable brush, sclerotherapy needle, Heather Probe, Bipolar probe, ERCP cannula, naso-biliary catheter, bilio-pancreatic stent, pre-cut wire, Argon Plasma Coagulation catheter, washing catheter.
 - Use of “ultrasonication” is useful.
 - Can be sterilized by gas (ethylene oxide), Steam Autoclave, Steris.

Cleaning and Disinfection Complexity

- **Grade 3:** have 2 or more of the following: lumen, retractable wires, cutting wire, hinges.
 - biopsy forceps, snares, foreign-body forceps, retractable cytology brush, extraction basket, papillotome [simple or double lumen], lithotripter.
 - “Ultrasonication” is indispensable.
 - Must sterilize with steam autoclave (or with Steris, if for immediate use). ***Do not use gas sterilization***
- **Grade 4:** has a balloon or blind area:
 - Extraction balloon (ERCP), sclerotherapy balloon.
 - ***These Instruments can not be re-sterilized.***

Accessories Requiring Sterilization

- Biopsy Forceps
- Foreign Body Forceps
- Polypectomy Snare
- Sclerotherapy Needle
- Variceal Ligator
- Thermo coagulator (Heather Probe)
- Cytology Brush
- ERCP Cannula
- Biliary Drainage or Washing Catheter
- Papillotome
- Pre-cut Knife
- Pancreato-biliary guide-wire
- Extraction Basket
- APC Catheter

Accessories Requiring High Grade Disinfection

- Dilatation Bugies
- Gastro-intestinal Guide-wire
- Gastro-intestinal Catheter (feeding/decompression)
- Magnetic Extractor

Accessories which can not be Disinfected / Reuse

- ERCP Extraction Balloon

Disinfection Process

- 1. All personnel must be well trained.
- 2. Before disinfection, check for endoscope “leaks” under positive pressure.
- 3. Remove all removable components (valves, biopsy port), protect electrical circuits with a cap, and IMMERSE COMPLETELY under enzymatic detergent.

Disinfection Process

- 4. Immediately clean meticulously, the external surface with enzymatic detergent and sponge/clot. Brush all channels, valves and connection tubes. Irrigate y suction all the channels, activating all the valves. Do not forget to irrigate the duodenoscope's "elevator channel".
- 5. Use only appropriate size brushes; destroy or disinfect them after each use.
- 6. Dispose the enzymatic detergent solution after each use (it is not microbicidal).

Disinfection Process

- 7. Use only endoscope compatible “high grade disinfectant” or sterilizing solution, for the time and at the temperature recommended (see table).
- 8. Immerse COMPLETELY the endoscope and accessories. Non-immersible endoscopes should be retired.
- 9. If using an “Automatic Flexible Endoscope Reprocessor” (AFER), remember that many do not disinfect the duodenoscope’s “elevators channel”; in that case, irrigate and disinfect manually; after disinfection, dry the “elevators channel” with 70-90% alcohol and forced air.

Disinfection Process

- 10. With either “manual disinfection” or AFER, be sure that all channels are connected to the disinfectant/sterilizing solution irrigator.
- 11. Be sure that the recommended “immersion time” or AFER cycle have been completed.
- 12. After disinfection, thoroughly rinse the endoscope and all its channels, with clean water (ideally sterile or filtered); then dry the surface and channels with 70-90% alcohol, and blow the channels with pressured air.

Disinfection Process

- **13. Store the endoscope WITHOUT VALVES, hanging in vertical position, inside a clean, closed cabinet.**
- **14. The “Water Bottle” should be “high grade” disinfected or sterilized DAILY; fill it only with sterile water. For each ERCP is better to use a freshly disinfected bottle.**
- **15. Dispose the “high grade disinfectant” when**
 - **its “chemical indicator” shows that it is below its “minimal effective concentration” or**
 - **when it reaches its “recommended life”, from the time of activation of the original solution (not that of any added solution).**

Disinfection Process

- 16. The disinfection room must be well ventilated, having fume extractors (located below “neck level” for vapors heavier than air, like glutaraldehyde), to minimize toxic fumes concentration.
- 17. Personnel should use protective gear (gloves, impermeable aprons, face (mouth and nose) mask with eyes shield).
- 18. There must be “hangable removable labels” which should indicate which endoscopes have been disinfected and which have not.

Disinfection Process

- 19. Reusable endoscopic accessories which “penetrate the mucosal barrier”, must be carefully brushed, washed, and, if needed, lubricated, and then should be **STERILIZED**.
- 20. “Ultrasonic Cleaners” improve the removal of debris and organic material from difficult to reach areas.

Disinfection Process

- 21. Any case of suspected endoscopy equipment related infection, must be investigated.
- 22. Personnel must be cognitive of the importance of proper disinfection, the risks of the acquired infections, and the risks of the chemical disinfectants.

POINTS TO REMEMBER

- Manual brushing and cleansing is the most critical part of the disinfection process.
- The immersion time and disinfectant temperature are the determinant factors of the degree of disinfection (low-grade, vs. high-grade, vs. sterility)
- The “disinfectant life” should be counted from the activation of the first solution (no add on’s).
- Repeated use of the disinfectant decreases its effectiveness, due to dilution and presence of organic material; the activity of the disinfectant must be confirmed daily.

POINTS TO REMEMBER

- The “Water Bottle” is a common source of infections. It should be sterilized daily, and filled with sterile water. Use a new sterile water bottle for each ERCP.
- The duodenoscope’s “elevator channel” is a common source of infection; must be carefully disinfected and dried.
- Duodenoscopes disinfected longer than 24 hours earlier, must be disinfected before use.



Instrumentos Reusables

Esterilización vs. Desinfección de Grado Alto

Bujías Dilatadoras	Desinfección Grado Alto
Fórceps de Biopsia	Esterilización
Asa de Polipectomia	Esterilización
Extractor Magnético	Desinfección Grado Alto
Fórceps de Cuerpo Extraño	Esterilización
Aguja de Escleroterapia	Esterilización
Cepillo de citología	Esterilización
Termo coagulador (Probeta Caliente)	Esterilización
Catéter de Lavado o Drenaje Biliar	Esterilización

Cánula de CPER	Esterilización
Canasta Extractora	Esterilización
Globo Extractor de CPER	NO REUSAR
Papilotomo	Esterilización
Cuchillo de pre-corte	Esterilización
Guía de alambre pancreato-biliar	Esterilización
Guía de alambre gastro-intestinal	Desinfección Grado Alto
Catéter Gastro-intestinal	Desinfección Grado Alto
Ligador de Varices	Esterilización