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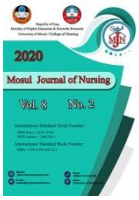

Infection Control of Gastrointestinal Endoscopic Procedures Performed by Nurses at Hawler and Rizgary Teaching Hospitals in Erbil City /Iraq

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Abstract

Background and objectives: Gastrointestinal endoscopy is a valuable diagnostic and therapeutic tool for the care of patients with gastrointestinal and pancreaticobiliary disorders. Compliance with accepted guidelines for the reprocessing of gastrointestinal endoscopes between patients is critical to the safety and success of their use. This study aimed to assess the nurses' infection control practice and identify the prevalence of fungal and bacterial growth on gastroscopy and colonoscopy instruments .

Methods: A descriptive study was carried out on a purposive (non-probability) sample of all nurses who worked in the gastrointestinal endoscopy units at Hawler and Rizgari Teaching Hospitals in Erbil City from January to June 2016 from where the sample specimens were also taken. The questionnaire consisted of three parts. The first part included sociodemographic data, the second part contained nurses' infection control practice before, during and after the endoscopy procedure including pre-cleaning, leak testing, manual cleaning rising, disinfection, rinsing, drying and storing instruments. The third part of the questionnaire was used to document 80 endoscopic specimens, which were collected from the endoscopic instruments .

Results: The findings of the study revealed that the majority of nurses (38.5%) were within the 25-35 years age group, 61.5% were males and having less than 5 years experience. The

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infection control practices for endoscopy procedure showed that a majority (69.2%) of nurses practised at a fair level. The Grams stain smear results showed positivity of 65.62% for fungus and 34.375% for bacteria. All the fungi isolated belonged to the Candida species .

Conclusion: The study concluded that the infection control of endoscopic procedures performed by nurses was inadequate. The swab cultures from the automated endoscope reprocessors, in combination with other bacterial isolates, showed that the Candida species were present in the endoscopic specimens .

Keywords: Infection control; Endoscopic procedure; Fungal infection

Introduction:

Endoscopy refers to a tubular lighted, flexiblescopy inserted directly into the organ. It is used to examine the interior of a hollow organ or cavity of the body and typically refers to looking inside the body for medical reasons, like most other medical imaging devices (1).

Every patient must be considered as a potential source of infection and all endoscopes must be decontaminated with the same degree of rigour after each endoscopic procedure. Lack of knowledge or unfamiliarity with endoscope channels, accessories, and specific steps required for reprocessing has been linked to a risk of infection transmission (2)

Hospital environment pathogens may contaminate the endoscope or accessory equipment and be introduced into the patient during subsequent examination. Contamination occurs through the general hospital environment, the water supply, or endoscope reprocessing machines. Candida infection of immunocompromised patients has been linked to upper gastrointestinal endoscopy. Also, an epidemic of pseudo-infection with the yeast Rhodotorula rubra has been reported in bronchoscopy patients (3). Endoscopes are exposed to very high numbers of enteric microbes during each procedure, and researchers found viable bacteria or fungi on 14% of patient-ready endoscopes (4).

According to the Centers for Disease Control and Prevention, most cases have occurred from a breach in proper cleaning and disinfection of endoscopic equipment. Despite the low risk of healthcare-associated infections from endoscopic procedures, outbreaks of certain hospital-based healthcare-associated infections, such as Clostridium difficile and the Methicillin-resistant Staphylococcus aureus, have brought healthcare-associated infections to the attention of hospital administrators and other stakeholders, and have raised the public's concern over safety in the hospital (5). Fungi are found to be associated with peptic ulcer infection, which is often found to live in the gastrointestinal tract. Thrushes in the mouth spread down to the oesophagus and cause Candidial oesophagitis. Candida albicans is a frequent component of the

human indigenous microbial flora of the gastrointestinal (GI) tract of apparently healthy individuals (6).

Endoscopy related infection may occur under the following circumstances: a) microorganisms may be spread from patient to patient by contaminated equipment (exogenous infections); b) microorganisms may spread from the GI tract through the bloodstream during an endoscopy to susceptible organs or prostheses or may spread to adjacent tissues that are breached as a result of the endoscopic procedure (endogenous infections), c) microorganisms may be transmitted from the patients to the endoscopy personnel or perhaps vice versa (7).

The ability of bacteria to form biofilms on the inner channel surfaces can contribute to the failure of the decontamination process. The reported incidence of bacteremia after colonoscopy with or without biopsies and polypectomies ranges from 0% to 25% (8). The complexity and temperature sensitivity of flexible endoscopes makes cleaning followed by sterilization/disinfection difficult. The instruments cannot be autoclaved. Therefore, optimal processing is achieved by mechanical cleaning, followed by high-level disinfection (HLD), rinsing, and drying. At all times, cleaning must precede high-level disinfection. Endoscopic accessories do require sterilization (9).

Nurses are responsible for medication administration, giving patient instructions about fasting 6-12 hours, monitoring and documentation, setting up the equipment, and assisting the physician with the collection of the cytology specimens and operation of equipment (10). An intravenous tranquillizer may be given before the local anaesthetic is sprayed into the back of the throat to decrease the gag reflex and placing the client in a sitting position. During the procedure, the nurses help the endoscopist and after completion of the procedure, they carry on with the reprocessing of the endoscopic instrument and the devices (11).

The beneficial role of gastrointestinal endoscopy for the prevention, diagnosis, and treatment of many digestive diseases and cancer is well established. Similar to many sophisticated medical devices, the endoscope is a complex, reusable instrument that requires reprocessing before being used on subsequent patients (12). No study in Iraq has been done to assess infection control practices among endoscopic nurses. The researchers realized the importance of this practice in Erbil hospitals and hope to start a simple attempt to guide nurses toward standard care.

Objectives:

1- To identify the demographic characteristic of endoscopic nurses.
2- To assess nurses practice regarding infection control of endoscopy procedure.

3- To assess nurses' role in patient's preparation during an endoscopy procedure.
4- To identify the prevalence of fungal and bacterial growth at components of a flexible gastrointestinal endoscope.

Methods:

A quantitative purposive study was used to assess nurses' infection control practices related to endoscopy procedure. The study was conducted at Hawler and Rizgary Teaching Hospitals in Erbil City from 10th of January to 17th of June 2016 on a non-probability purposive sample of nurses who worked in the endoscopic units during the period of data collection. Data were collected via utilizing an observational checklist. The nurses were observed without being informed for 10-20 minutes at three different times while they worked and the components of their practice were evaluated by an observer as achieved or not achieved. Formal administrative approval to carry out the study was obtained from the General Directorate of Health in Erbil. Furthermore, ethical approval was obtained from the Ethics Committee at the College of Nursing of Hawler Medical University.

The questionnaire for data collection consisted of three parts. The first part gathered demographic characteristics of nurses, which included four variables such as age, gender, years of experience, and level of education. The second part included an observational checklist based on the American Society for Gastrointestinal Endoscopy, and Infection Prevention and Control, and a skills checklist that consisted of 41 items (9). The items were rated using a two-part scale with achieved (score 1), and not achieved (score 0)evaluations. Part three of the questionnaire included swabs specimens obtained to determine the occurrence of fungal and bacterial growth at components of a flexible gastrointestinal endoscope. The data were analyzed via the SPSS program (version 24) for calculating frequency and percentage.

The overall level of nurses' practice was calculated as follows:

1- Poor practice: 0-13.66, 2- Fair practice 13.67- 27.33, 3- Good practice 27.34-41.

Overall mean percentage of nurses role regarding infection control of the endoscopic procedure was calculated by summation of all items' percentile and divided by the number of items.

Materials and methods for swab cultures:

A total number of 80 endoscopic specimens were collected from the endoscopic units in Rizgary & Hawler Teaching Hospitals in Erbil City. A total of 80 swab cultures were taken, including 40 cultures from gastroscope automated endoscope reprocessors (AER) and 40 cultures from a colonoscope AER. The swab cultures were obtained from different

parts of the AER after a full reprocessing cycle. The samples of swabs were immediately processed by standard microbiological methods for isolation and identification.

Gram Staining was done on the Collected specimens, which were then cultured, plates were incubated at 25℃ to 37 ℃, for 24- 48 hours and examined for bacterial and fungal (Candida) growth. The growing yeast was examined microscopically for the production of pseudohyphae. Culture results were reported as positive or negative. Every day the plates were examined for fungal and bacterial growth. The emerged fungal growth was examined further and recorded. The fungal colonies grow in 3-4 days and appear as cream-coloured, smooth and pasty growth. The plates that failed to give any fungal growth even after 21 days of incubation were discarded. The isolated Candida species were treated with serum and further incubated at 37ºC for 2 to 4 hrs. A drop of the suspension was examined under the microscope. Long tube-like projections, with no constriction at the point of attachment to the yeast cell, were seen as a Germ tube test.

Results:

Table 1 shows the sociodemographic characteristics of endoscopic nurses. The results show that the majority of nurses (38.5%) were 25-35 years old. The majority of nurses (61.5%) were males with less than five years of experiences and graduated from the medical institute .

Table1 Sociodemographic characteristics of 13 endoscopic nurses

Endoscopic nurses' sociodemographic characteristics		**F**	**%**
Age of nurses (years)	25-35	5	38.5
	36- 46	4	30.8
	47-57	1	7.7
	> 57	3	23.1
Gender of nurses	Male	8	61.5
	Female	5	38.5
Years of experience	≤ 5	8	61.5
	6- 11	2	15.4
	12-17	0	0
	18-23	3	23.1
Level of education	Secondary nursing school	5	38.5
	Medical institute	8	61.5

Table 2 includes the pre-cleaning and leak-testing items. The results show that pre-cleaning endoscopy instrument items were performed well by the nurses with a total mean of percentage (73.84%). The only item of 'flush all other channels with enzymatic detergent' was never practised while leak-testing items were practised poorly by nurses with a total mean of 9.62%.

Table 2 Precleaning and leak testing items relating to endoscopy procedure

No	1-Pre-cleaning items	Achieved	
		F	%
1	Cleaning outer surface	13	100
2	Flush the air/water channel.	13	100
3	Flush all other channels with an enzymatic detergent.	0	0.0
4	Remove all reusable and removable components from the scope and soak In enzymatic detergent.	9	69.2
5	Install the water-resistant cap and transport it in a covered container to reprocessing area.	13	100
	The total mean of the percentage		**73.84**
	2-Leak Testing items		
1	Attach leak tester.	3	23.1
2	Ensure the endoscope is fully immersed in water do not use any detergent.	2	15.4
3	Perform leakage test. Perform complete manipulation of buttons and lever.	0	0.0
4	Ensure deflation of the endoscope before proceeding to the manual cleaning.	0	0.0
	The total mean of the percentage		**9.62**

Table 2 cont. shows three sub-items which include items related to manual cleaning & rising, disinfection and rinsing, drying, and storing the instrument. The results show that all of the manual cleaning and rising, disinfection and rinsing, drying and storing instrument were poorly practice with a total mean percentage of 35.91%, 15.4%, 46.16% respectively.

Table 2 cont.

	3-Manual cleaning & Rinsing items	F	%
1	Fully immerse the endoscope in enzymatic detergent.	2	15.4
2	Clean outer surface with a lint-free cloth or endoscope sponge.	12	92.3
3	Brush all appropriate channels.	3	23.1
4	Flush all channels with enzymatic detergent and ensure appropriate contact time is respected.	7	53.8
5	Immerse in clean water and rinse all channel with clean tap water.	2	15.4
6	Purge all endoscope channels with air to ensure the removal of water.	2	15.4
	The total mean of the percentage of manual cleaning & rising		**35.9**
	4-Disinfection (HLD) & Rinsing items		
1	Test High-Level Disinfectant or sterile.	2	15.4
2	Fully immerse endoscope in HLD or sterility in the dedicated basin.	2	15.4
3	Fill all channels with HLD or sterile and wipe the endoscope with a soft lint-free cloth to remove any bubbles on the surface of the Endoscope.	3	23.1
4	Ensure adequate contact with all surfaces of the endoscope.	3	23.1
5	Ensure adequate contact time and right respected	0	0.0
6	Purge all channels with air to ensure removal of all HLD or sterile from the endoscope and remove the endoscope from the HLD or sterling.	2	15.4
	The total mean of the percentage of disinfection (HLD) & rinsing		**15.4**
	5-Drying and storing instrument items		
1	Fully immerse the endoscope in a dedicated basin filled with rinse water.	3	23.1
2	Rinse all channels with rinse water.	3	23.1

3	Remove the endoscope from the rinse water and purge all channels with air.	2	15.4
4	Purge all channels with alcohol followed with forced air as indicated.	2	15.4
5	Wipe the exterior surfaces of the endoscope with alcohol moisten the soft lint-free cloth.	13	100
6	Store endoscope uncoiled in a vertical position (i.e., hang in closed ventilated Cabinet). Store detachable and reusable parts (e.g., valves and water-resistant cap) separately from the scope.	13	100
	The total mean of the percentage of drying and storing instrument items		**46.16**

Table 3 shows the nurses' role in patient's preparation before the endoscopic procedure. The results indicated that nurses' role in patient's preparation before endoscopy procedure had the total mean percentage of 60.83%, while items related to patient's privacy and correct position, allergies to drugs or other substances were never practised. The instrument care after the procedure was fairly practised (66.66%), whereas items related to removing a glove and performing hand hygiene were never practised. At the end of the endoscopic procedure, overall infection control nurses practices were fairly practised with a total percentile mean of 45.4%.

Table 3 cont. Nurses' role in patient's preparation before endoscopy procedure

No	6- Nurse's role in patients preparation before endoscopy procedure	Achieved	
		F	%
1	Prepared procedure equipment: Sterile gloves, gown, mask, clean water, patient label, anaesthesia, cannula, an instrument for the vital sign, waterproof, plaster, disinfecting solution, plastic tray.	13	100
2	Checked the patient chart for the type of endoscopy.	13	100
3	Performed hand hygiene using the correct technique.	11	84.6
4	Identified patient using two identifiers.	13	100
5	Performed greeting, introduction and permission procedure.	10	76.9
6	Provided privacy and correct position.	0	0.0
7	Explained the procedure to the patient and answer any question.	2	15.4
8	Asked about any allergies to drugs or other substances.	0	0.0
9	Prevention of infection transmission (staff protection).	13	100
10	During the procedure, everything will be done to help the patient a comfortable as possible blood pressure, pulse and blood oxygen level will be carefully monitored.	7	53.8
11	Gown, a plastic apron is worn during procedures and patient care activities.	5	38.5
	The total mean of the percentage		**60.83**

	7-Instrument care after the procedure		
1	Remove glove and gown performed hand hygiene using correct techniques.	0	0.0
2	Documented the procedure that date and time with result.	13	100
3	Returned equipment to the dedicated area.	13	100
	The total mean of the percentage		**66.66**
Overall items' percentile means of infection control nurses practices regarding the endoscopic procedure		**13**	**45.4**

Table 4 indicates the overall level of nurses' infection control practice. The results show that the majority of nurses (69.2%) had a fair (middle) level of practice and 15.4% of them practised well.

Table 4 The overall level of endoscopic nurse's practice

The overall level of nurses' infection control practice	**F**	**%**
Poor practice	2	15.4
Fair practice	9	69.2
Good practice	2	15.4
Total	**13**	**100**

The overall positive culture rate was 40% (32/80) in swab cultures from AERs after a full reprocessing cycle. For gastroscopy and colonoscopy AERs, the positive swab culture rates were 47.5% (19/40) and 32.5% (13/40) respectively, as shown in Table 5.

Table 5 Rate of positive swab culture from the Automated Endoscope Reprocessors (AER) after gastroscopy and colonoscopy reprocessing

N. of endoscopic specimens	**Rate of positive AER specimens**
Gastroscopy (n = 40)	19 (47.5%)
Colonoscopy (n = 40)	13 (32.5%)
Total (n = 80)	32 (40%)

(AER) Automated endoscope reprocessors

Table 6 shows 32 positive endoscopic specimens screened for fungal and bacterial aetiology. The direct smear - grams stain result showed 21(65.62%) samples were positive for fungus and 11(34.375%) samples were positive for bacteria.

Table 6. Grams stain results of direct microscopic examination

S. No	**Microbes present**	**No of positive specimens (n = 32)**	**Positivity percentage**
1.	Fungus	21	65.62%
2.	Bacteria	11	34.375%

Table 7 shows occurrences of the positive culture on different parts of a flexible endoscope demonstrating that 50% of the positive cultures occurred during storage of the endoscope. Also as shown in this table many genera of fungi and bacteria were identified. It also revealed that most of the fungi isolated belonged to the Candida species by the presence of a creamy white colony and many genera of bacteria belong to Staphylococcus spp. and Pseudomonas spp.

Table 7 Prevalence of fungal and bacterial growth on the components of a flexible gastrointestinal endoscope

		Fungal and Bacterial growth						
Swab Culture Site		growth		No growth		Total		Name of Microorganism
		F	%	F	%	F	%	
AER	Moist channels, accessories, water supply machines during reprocessing	8	47.05	9	52.94	17	21.25	*Staphylococcus aureus Candida albicans*
	Post-reprocessing	3	37.5	5	62.5	8	10	*Staphylococcus epidermidis, Pseudomonas spp.*
	during final handling	5	83.33	1	16.66	6	7.5	*Staphylococcus aureus*
	during cleaning	-	0.00	7	100	7	8.75	*Staphylococcus aureus Enterococci spp*
	during storage	2	50	2	50	4	5	*Candida parapsilosis, Pseudomonas spp*
suction/biopsy channel		3	37.5	5	62.5	8	10	*Staph. epidermidis, Viridians Streptococci, Tricosporon beigelii*
elevator wire channel		5	71.42	2	28.57	7	8.75	*Staphylococcus epidermidis*
water bottle and tubing		4	66.66	2	33.33	6	7.5	*Staphylococcus aureus Candida albicans*
Brushes		1	16.66	5	83.33	6	7.5	*Candida parapsilosis*
HLD after each use		-	0.00	7	100	7	8.75	*Pseudomonas aeruginosa*
Tap water used for the final rinse		1	25	3	75	4	5	*Staphylococcus spp.*
Total		32	435.10	48	664.80	80	100	

(HLD): High-level disinfection

DISCUSSION:

The results of this study show that most participants were 25-35 years old, males, having less than five years of experience and medical institute graduates. This result disagrees with the result of the previous study [13]) done on endoscopic nurses in Egypt that revealed that two-thirds of nurses were more than 40 years of age, had more than 10 years of experience, and were the secondary nursing school graduates

The overall manual cleaning and high-level disinfection or sterility of endoscopic procedure results showed that the overall mean percentile of infection control practice was inadequate and ranked below the middle percentile (Table 3). The overall nurses' level of practice assessment demonstrated that the majority of nurses were practising at the fair level as shown in Table 4. These results may be related to lack of manual cleaning and high-level disinfection guidelines in the hospitals, lack of education of nurses, or negligence regarding the guidelines' recommendations. This result is similar to the previous studies (13, 14) conducted in Egypt, which indicated that the majority of nurses had an unsatisfactory level of practice before, during and after GI endoscopy, and during manual disinfection of endoscopy. Additionally, the current study results disagree with the guidelines (1, 2, 9, 10) that recommended that all medical equipment/devices should be assessed by infection prevention and control personnel and should meet established quality reprocessing parameters. Also, when an endoscope has been correctly disinfected and meticulously dried as per these guidelines no growth of micro-organisms can be detected from the channels of endoscopes stored for up to and in some cases longer than 7 days (7,9). Furthermore other results of other study [15] in Portugal were disagree with results of this study which indicated that there is a good compliance with standard guidelines recommendations concerning quality of reprocessing.

Regarding nurses' practice in patient's preparation before endoscopy, the current results show that it was not optimal as demonstrated in Table 3, No. 6. This result shows that the role of nurses during endoscopic procedures in Erbil does not comply with guidelines [5, 10, 16]. Regarding the overall infection control practices during the endoscopic procedure, which were not satisfactory, this research was in contrast with the results of the studies done in Portugal and Romania (15, 17), which stated that in general, the disinfection and sterilization of the endoscopes and accessories are carried out in good conditions.

Routine microbiological monitoring of endoscope reprocessing has been recommended by several organizations (18). Swab culture is a useful method for monitoring endoscope decontamination after each reprocessing cycle. Fungal & bacterial contamination of endoscope after reprocessing should be taken into consideration [19]).

The overall positive culture rate of swab cultures from endoscopes after a full reprocessing cycle in this study was 40% (32/80) as shown in Table 5. A similar finding was made by another study, which observed during that the period 1974–2004, 70 outbreaks following endoscopy procedures were reported in the USA in 64 scientific articles (20). Further studies [21, 22]) showed that the growth of biofilms inside endoscope channels can result in failure of the endoscope reprocessing and is an important factor in the pathogenesis of endoscopy-related infections. Such events should be prevented by well-instructed personnel, well-functioning washing, disinfection and drying equipment and observance of general hygiene guidelines in the endoscopy centre.

Many genera of bacteria that were identified in the current study belonged to *Staphylococcus spp. and Pseudomonas spp.* as shown in Table 6, which may be related to endogenous or exogenous infection. The endogenous infections are most often results of endoscopic procedures and can be transmitted from previous patients, contaminated reprocessing equipment, endoscopes or their accessory equipment. These results are consistent with the results of other studies [21, 22]) that stated that endoscopes become heavily contaminated with blood, secretions and microorganisms during use, and because each endoscope may be used for different patients in a single day, it is essential to clean and disinfect them effectively between every endoscopic procedure in patients. This study also revealed that most fungi isolated belonged to the *Candida* species by the presence of a creamy white colony. A similar finding was made by another research [23] which concluded that along with other bacterial isolates, *Candida* species are also present in the endoscopic cultures. One condition that favours the growth of fungal species in the gastrointestinal tract is the lower range of acid pH (5-6), but the current finding disagrees with the results of the study, which documented that there are no documented cases of transmission of fungal infections by GI endoscopy (24).

Out of 80 specimens subjected to direct microscopic examination by Grams stain method, 21(65.62%) of fungal samples and 11(34.375%) of bacterial samples were positive as shown in Table 6. This is in an agreement with the results of other studies that concluded that most of the specimens showed the presence of gram-positive budding yeast cells adherent to the +gastro- intestinal epithelial cells with or without septate hyphae (19, 25). The yeast cell adherence may be due to either the active infection status of the patients or the heavy colonization of the *Candida* in the epithelial cells. This study found that of the 1.7% positive cultures from AERs, 50% (3/6) were positive for fungal contamination. The high rate of fungal contamination is most likely due to failure to properly dry the AER after the completion of reprocessing.

Table 7 shows that 50% of positive cultures occurred during the storage of the endoscope. This was due to inadequate drying of the endoscope channels before storage when the endoscope's moist channels after reprocessing can colonize and multiply to high numbers. This was consistent with the results of another research (26) studying the same topic.

The results in Table 7 also reveal the occurrence of positive culture on different parts of a flexible endoscope. A similar finding was made by another study (27), in which researchers observed reservoirs for exogenous microorganisms within a flexible endoscope found in the suction/biopsy channel, other channels in the flexible endoscope (e.g., elevator wire channel in side-viewing duodenoscopes, air/water channel in colonoscopies and any auxiliary channels. In addition, the water bottle and tubing used for endoscopy procedures may also form a reservoir for exogenous microorganisms if these accessories are not properly reprocessed. Components of the reprocessing procedure equipment such as cleaning brushes may also serve as a reservoir if not inspected.

Conclusion:

The study concluded that the majority of nurses were 25-35 years old, males, with less than five years of experience, and graduated with a diploma from the medical institute. Concerning nurses' practice of infection control before, during and after the endoscopy procedure the results show that it was inadequate. Also, positive cultures of fungi and bacteria were identified on the flexible endoscopes, and *Candida spp.* was the predominant fungal species isolated from the endoscopic clinics. The researchers recommend the development of guidelines for infection control of endoscopy procedures, provision of seminars, booklets and

guidelines about infection control, and strategies to ensure nurses' compliance with the standard procedures.

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