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RESEARCH ON THE CLEANING EFFECTIVENESS OF VACUUM BOILING WASHER DISINFECTOR IN COMPARISON WITH WASHER DISINFECTOR, ULTRASONIC CLEANER AND MANUAL CLEANING

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1. Background

Decontamination method :

1. **Manual cleaning**
2. **Washer disinfector (WD)**
3. **Ultrasonic cleaner**
4. **Vacuum boiling washer disinfector (VBWD)**

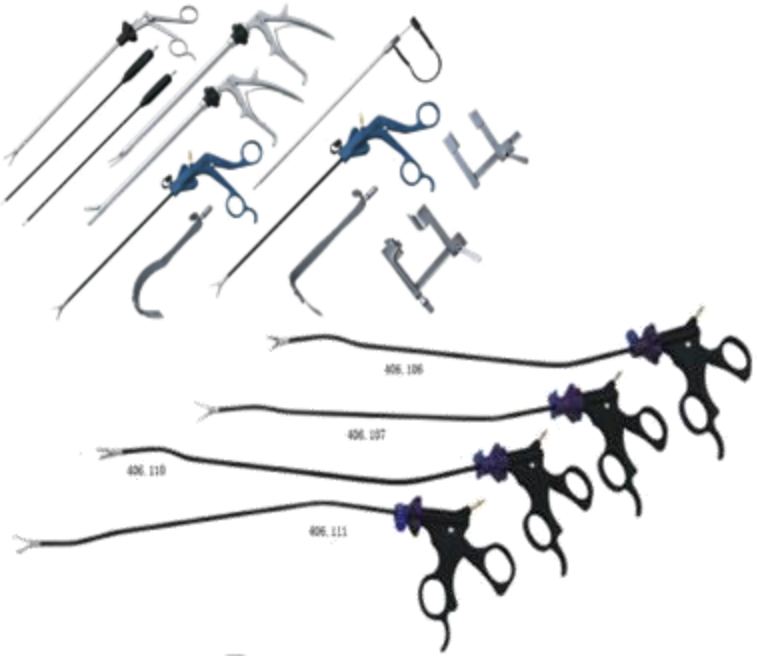
The importance of cleaning:

The key to ensure successful sterilization.

Challenges:

- **Development of medical technology**
- **Instruments with complex structure**
- **Diverse materials**
- **Multiple Lumen**

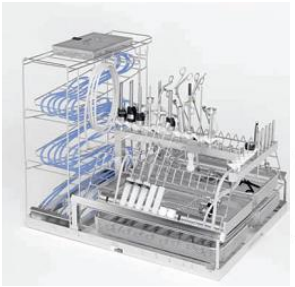
Those factors bring difficulties in cleaning [1]



All kinds of complex new equipment, is difficult or cannot be cleaned by existing cleaning technology!

Reference literature [1]:Masaki Takashina. Development of New Washing Method "Vacuum Boiling Washer" [J]. Medical Device. Vol.81.No.3(2011) (15)

1. Background



Current issues and difficulties in cleaning medical devices:

- **Addition of cleaning rack for different instruments type;**
- **Cannulated instruments need to be connected to the interface one by one, which is laborious [2];**
- **Limited space & Low loading capacity;**

It's hard for women to change cleaning rack

Connecting cannulated instruments is very laborious and time consuming. Oh, no! There are so many that haven't been washed. . . .

The space is so limited in decontamination area!

Reference literature [2]: Shi Lingling, Shi Jing, Gao Zhenbang, et al. Comparison of cleaning effects of two different cleaning methods on luminal instruments [J]. Chinese Journal of Disinfection, 2017, 34 (4): 378-379

2. Objectives

2.1 To compare the cleaning effectiveness of VBWD, WD, ultrasonic cleaner and manual cleaning and using various combination of surgical instruments

2.2 To Investigate the use and popularity of VBWD in China.

3. Process

3.1 Research study

- This study examined the cleaning effectiveness of challenging surgical instruments, including those with cannula or multiple movable joints, such as laparoscopic instruments.
- The soiled instruments collected from clinical areas for evaluation using various cleaning methods.
- A total of 884 instruments were evaluated.

3.2 Cleaning of equipment and tools

- VBWD, WD, Ultrasonic cleaner, Manual cleaning tank set
- Cleaning tools include cleaning brush, cleaning basket for manual cleaning

3.3 Cleaning quality monitoring tools

- ATP biofluorescence detector and ATP Test Swab

3. Process

3.4 Cleaning Method

- For ultrasonic cleaning, the instruments were immersed in an ultrasonic bath for 10 minutes.
- For the WD, the cannulated Instrument were properly connected, with a proper preset program.
- Manual cleaning involves using a soft brush to wipe the contaminated instruments.
- As part of the VBWD cleaning process, the instrument is placed directly on the cleaning rack and undergoes a standard washing cycle.
- All cleaning methods using the same weak alkaline detergents with a pH of 8
- NO Pretreatment and Thermal Disinfection required

3.5 Researchers

- Four frontline staff were nominated to carry out the experiment.
- Provide training and guidance to ensure strict compliance with procedures to ensure consistency of inspection results.
- The cleaning quality of the instrument is tested by double-blind method (the researcher does not know which cleaning method is used and who cleans the instrument)

3. Process

3.6 Assessment of Cleaning Effectiveness

- **ATP Biofluorescence detection**
- **The ATP biofluorescence detector was used to detect the outer surface, joint, tooth and inner cavity of the instrument, and the relative light unit value (RLU) was measured.**
- **If RLU is less than or equal to 200, it is passed as qualified cleaning [3].**
- **Before disinfection, the cleanliness of 884 instruments was evaluated using ATP biofluorescence detector.**

Reference literature [3]: ISO.International Organization for satandardization (ISO)Washer-disinfectors-Part5:tests oils and methods for de-monstrating Efficacy(ISO/TSI5883-5) [S].GENEVA.Switzer-land:ISO.2005

3. Process

3.7 Questionnaire Survey Summary

- Target Group: Staff working in CSSD
- Purpose: Assess opinions on VBWD
- Focus Areas:
  - Ease of loading the equipment
  - Processing capacity
  - Cleaning efficiency
  - Staff willingness to adopt the equipment
- Response Format: Yes/No questions
- Distribution: 286 questionnaires
- Response Rate: 100% (all 286 returned and valid)

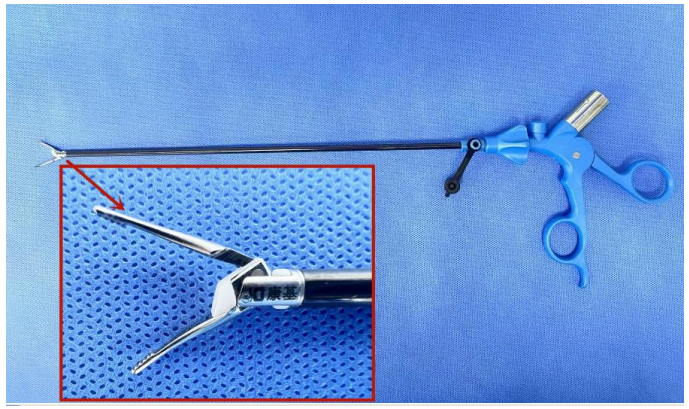
3.8 Statistical methods

- SPSS I7.0 statistical software was used to analyze the two groups of data.
- The count data were described by pieces and percentages, and the inter-group comparison was carried out by chi-square test.
- P <0.05 was statistically significant.

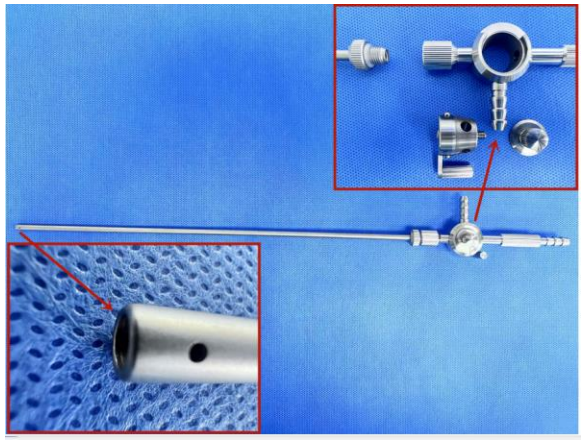
4. Results and discussion

4.1 Sampling area

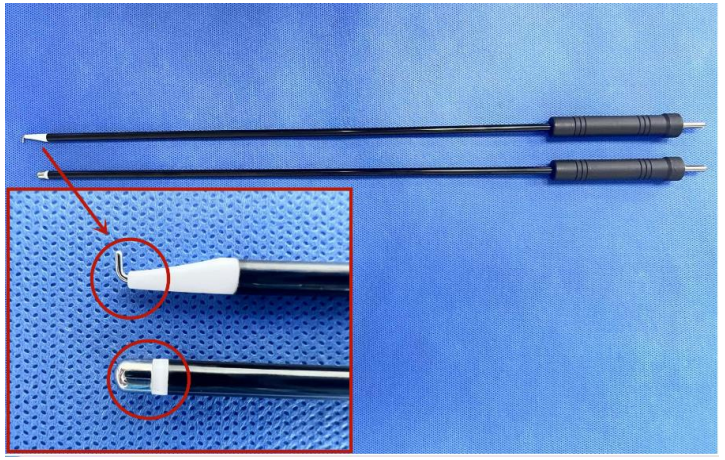
- Focus on the difficult cleaning areas
- Verify the cleaning effectiveness by quantitative method



1. The joint of the instrument



2. Inside the lumen



3. Electrocoagulation hook tip

4. Results and discussion

4.2 Experimental results

Figure: Comparison of ATP test results of four cleaning methods [piece (%)]

Group	Number of qualified (pieces)	Number of defeated (pieces)	Passing Rate (%)	χ^2 Value	P Value
A group Manual cleaning	173	48	78.28%	-	-
B group Washer-disinfector	191	30	86.43%	5.044	0.025
C group Ultrasonic cleaner	187	34	84.62%	2.935	0.087
D group VBWD	218	3	98.64%	24.993	< 0.001

The experimental figure showed that there was a statistically significant difference between vacuum boiling washing disinfection and manual washing (χ^2=24.993, P<0.01).

4. Results and discussion

4.3 Technological Advancement of VBWD

Especially good at processing precision instruments with complex structure and long slender cavity.

Technical advantages:

- The VBWD machine is simple to operate;
- Only needs to put the contaminated equipment into the cleaning tank;
- No need for special cleaning rack;
- No need to connecting cannulated instruments.

Working Principle:

- The vacuum-assisted boiling cleaning system employs negative pressure to lower liquid boiling points;
- Creating intense micro-bubble action at low temperature.

Type of instruments

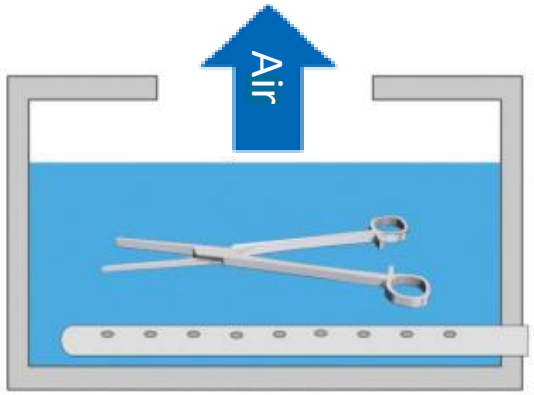
- Laparoscopic instruments
- Various lumen instruments
- Precision instruments
- Conventional surgical instruments

4. Results and discussion

4.3 Technological Advancement of VBWD

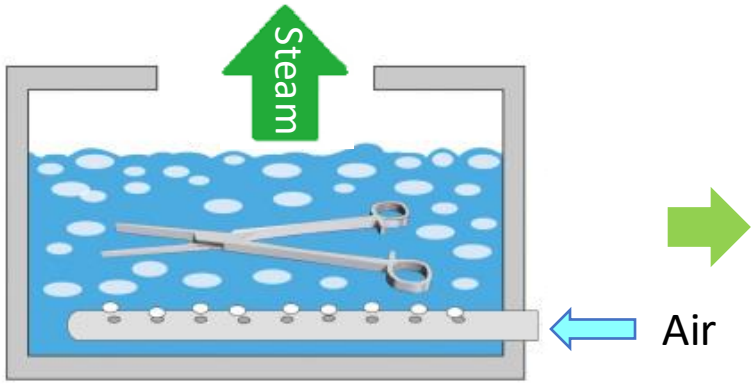
Liquid-phase gas pulsing (Surface cleaning)[4]

1. Heating and Vacuum



The cleaning fluid is heated while air is evacuated, reducing the pressure to the predetermined level.

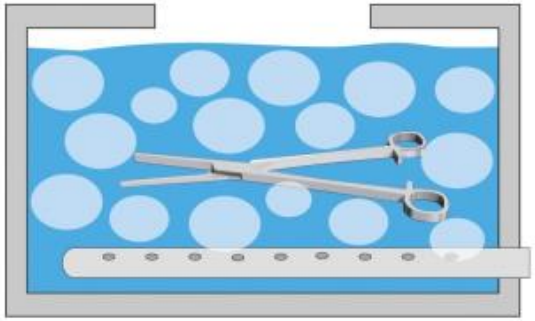
2. Vacuum-induced Boiling



Under sub-atmospheric pressure, the cleaning fluid begins to boil at 45-50°C and steam generated. Air is pulsed injected into the tank through the bubble generator.

Actual effect of cleaning tank

3. Sudden Boiling



Sudden pressure fluctuation induces violent boiling and shaking, and dislodging contaminants from instrument surfaces.

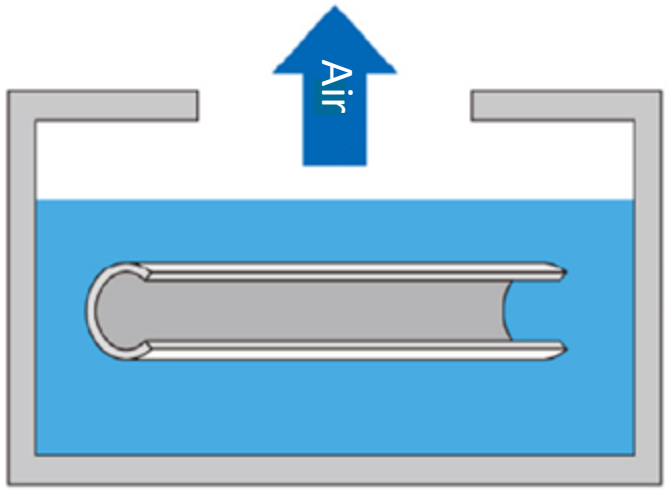
Reference literature [4]: Osaki Takashi. "Technology for Utilizing Pressure Reducing Boiling Washer Disinfector". [J] The Japan Society of Mechanical Engineers, May 2013 Vol. 116 No. 1134

4. Results and discussion

4.3 Technological Advancement of VBWD

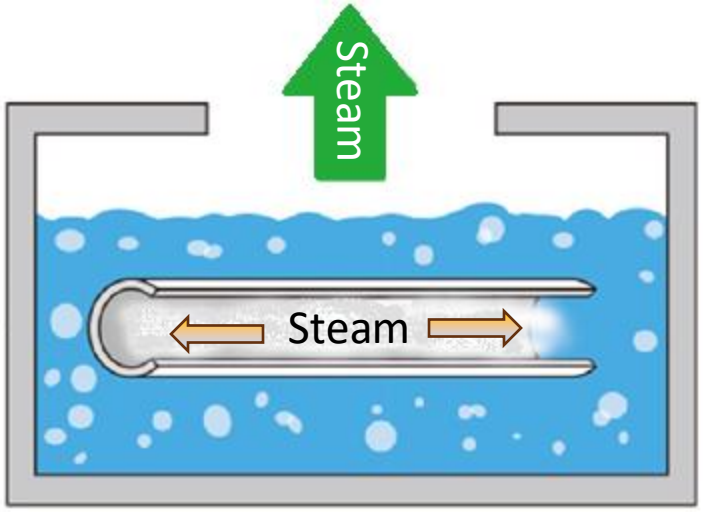
Gas-phase gas pulsing (Lumen Cleaning)[4]

1. Heating and Vacuum



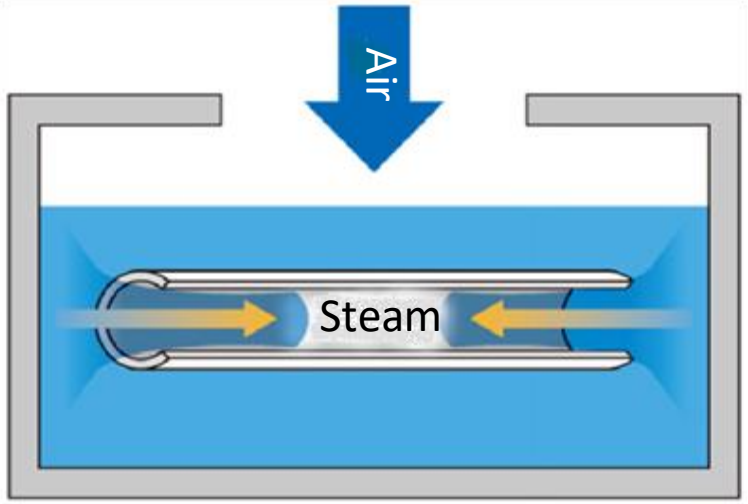
The cleaning fluid is heated while air is evacuated, reducing the pressure to the predetermined level.

2. Luminal Vapor Expansion



Under sub-atmospheric pressure, the cleaning fluid begins to boil at 45-50°. Fluid inside the lumen vaporizes into steam, expands volumetrically and flows outward.

3. Rapid Pressurization



Air is injected from the top, pressure increase rapidly. Abrupt pressurization induces condensation of steam reducing its volume and allowing the fluid to flow inwards, flushing the lumen and removing residual effectively

Reference literature [4]: Osaki Takashi. "Technology for Utilizing Pressure Reducing Boiling Washer Disinfector". [J] The Japan Society of Mechanical Engineers, May 2013 Vol. 116 No. 1134

4. Results and discussion

4.4 Video for VBWD processing

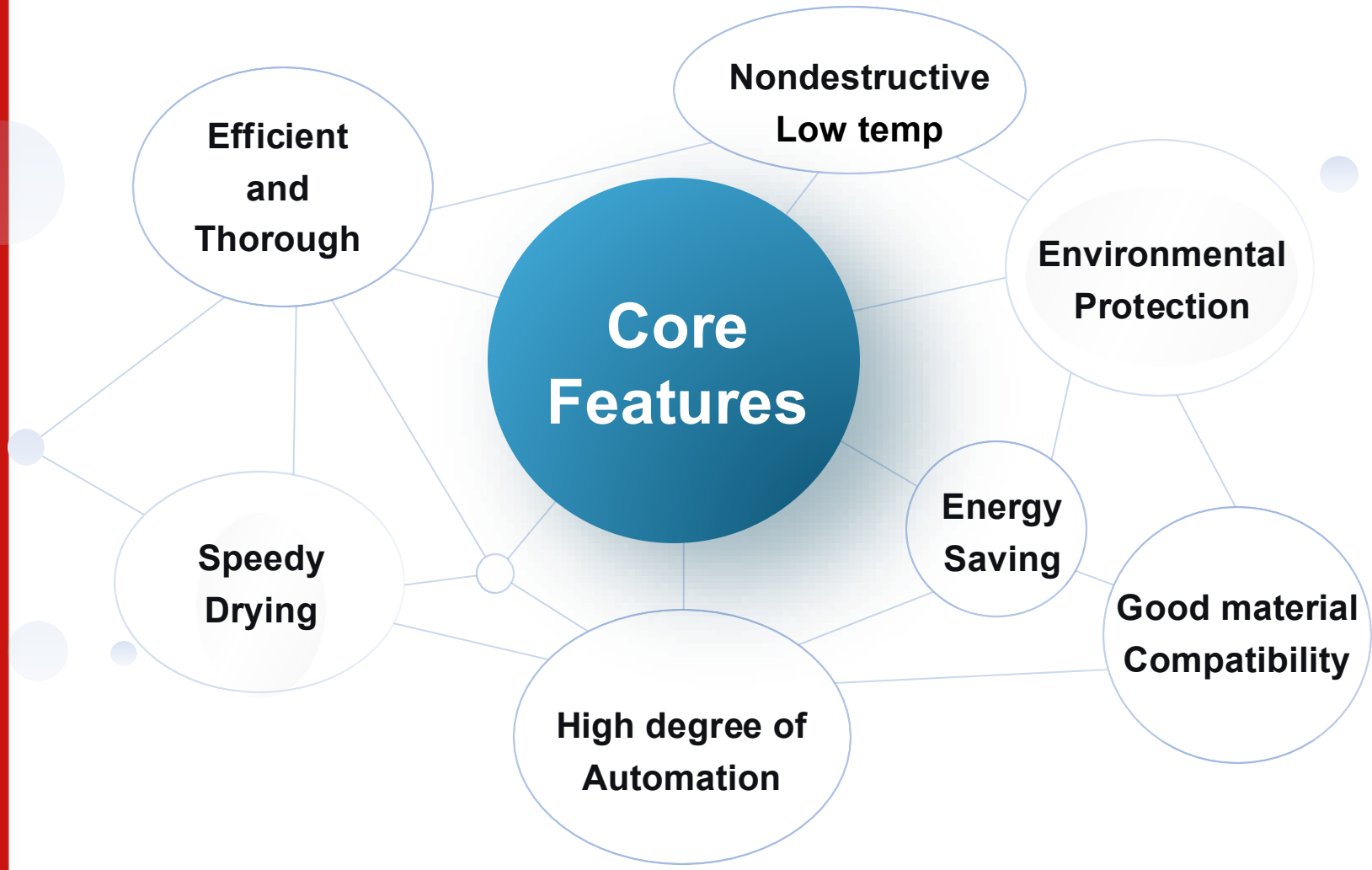
4. Results and discussion

4.5 Demonstration of VBWD cleaning chamber

VBWD cleaning demonstration

4. Results and discussion

4.6 Highlights in VBWD cleaning features



Innovation Tech:

- Lowering the solution boiling point to 50°C , high-efficiency operation

Powerful Bubble Agitation:

- Generates intense bubbles during boiling to enhance mechanical action with detergent

Deep Lumen Cleaning:

- Effectively remove stubborn stains from complex instruments

Efficient and Thorough:

- Ensures no residue, improving cleaning quality

Energy Saving:

- Low-temperature operation reduces energy consumption, ensuring greater safety and reliability

4. Results and discussion

4.7 Special features of various cleaning method

- Ultrasound has poor effect on the soft materials and pre-cleaning is required
- Special loading rack with adaptor are required for WD
- WD needs to use adapters to fix the tube for washing
- Detachment of tubing during the cleaning process during WD washing process
- The cleaning efficacy of Manual Cleaning can never be assured
- VBWD does not require shelves and racking system
- VBWD is the best choice for cleaning Laparoscopic instrument or lumen instruments[5].

Reference literature [5]:Wu Keping, Li Zhengying, Jin Weiduan. Observation on the effect of using a pressure reducing boiling cleaning machine to clean articulated minimally invasive surgical instruments [J]. Chinese Journal of Disinfection,2018,35(4):307-309

4. Results and discussion

4.8 Comparison between VBWD cleaning machine and other cleaning methods

Table: Comparison of pressure reduction boiling and traditional cleaning methods

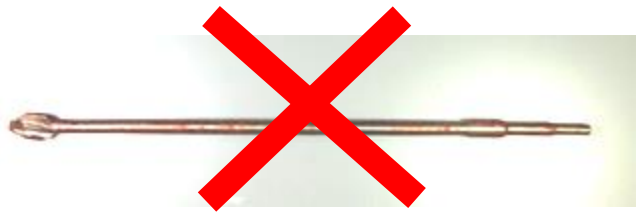
Cleaning Method	Cleaning Mechanism	Limitation	Application
VBWD	Negative pressure reduces boiling point, microbubble permeation and stripping	The pressure varies greatly and may potentially damage some devices.	High precision, complex structure, lumen instruments, hoses, etc
Ultrasonic Cleaner	High frequency sound waves produce cavitation effects	The cleaning effect of deep holes and blind holes is poor, and the drying needs additional steps	Suitable for tubular instruments, etc
Washer Disinfector	Using the principle of fluid dynamics, batch cleaning of instruments is carried out by spraying	Internal complex cavities cannot be cleaned and joints need to be fully opened	Most blood clots and stains on all surfaces of the instrument
Manual Cleaning	Mechanical scrubbing	The quality of cleaning is unstable, subject to subjective influence, individual differences are large, easy to infect	Pretreatment and Water-resistant instruments, etc

4. Results and discussion

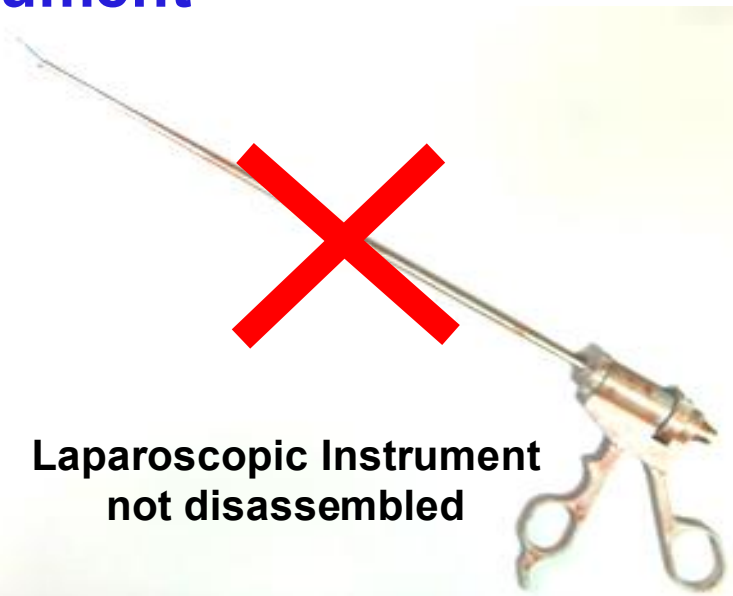
4.9 Limitations in VBWD cleaning

- Flexible bone drill -> may damage its internal structure
- Laparoscopic Instrument cleaning -> requires disassembly[6].
- Needle instruments with inner diameter less than φ0.6mm -> there is a risk of cleaning when water is too little in the lumen.
- Lumen blocked by blood dirt -> requires pre-treatment

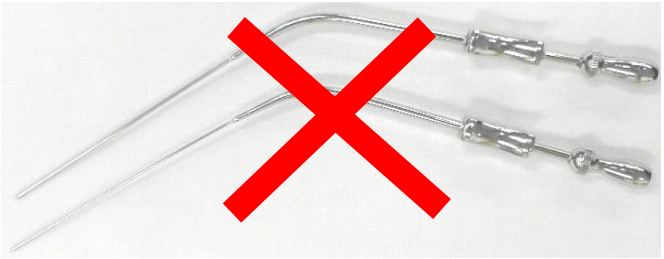
Not recommended Instrument



Flexible bone drill



Laparoscopic Instrument not disassembled



Inner diameter < φ0.6mm

Reference literature [6]:Chen Diping, Wei Jingrong, Ren Xiaomei. Effect of pressure reducing boiling cleaning machine on cleaning laparoscopic instruments [J]. Chinese Journal of Disinfection, 2017, 34(6):578-579

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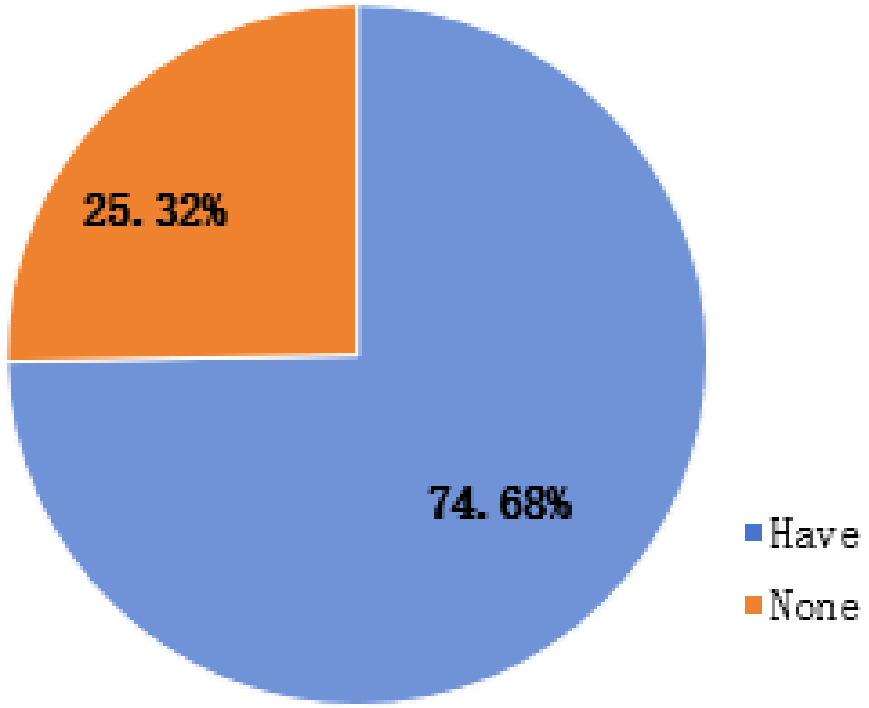
5. Survey on the use and Popularity of VBWD

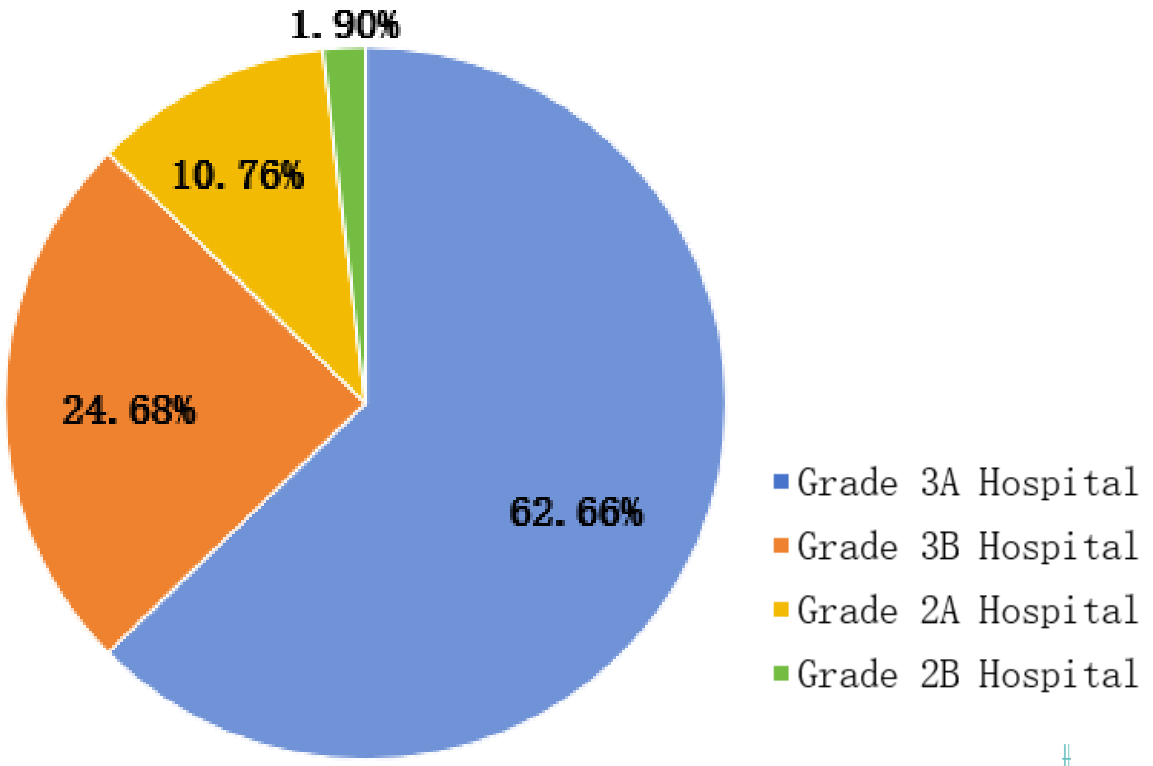
Research on the use of VBWD

- **CSSD with VBMD**



Near 75% of CSSD equipped with VBMD, while only about a quarter of the centers do not have this equipment.

- **Hospital Grade**

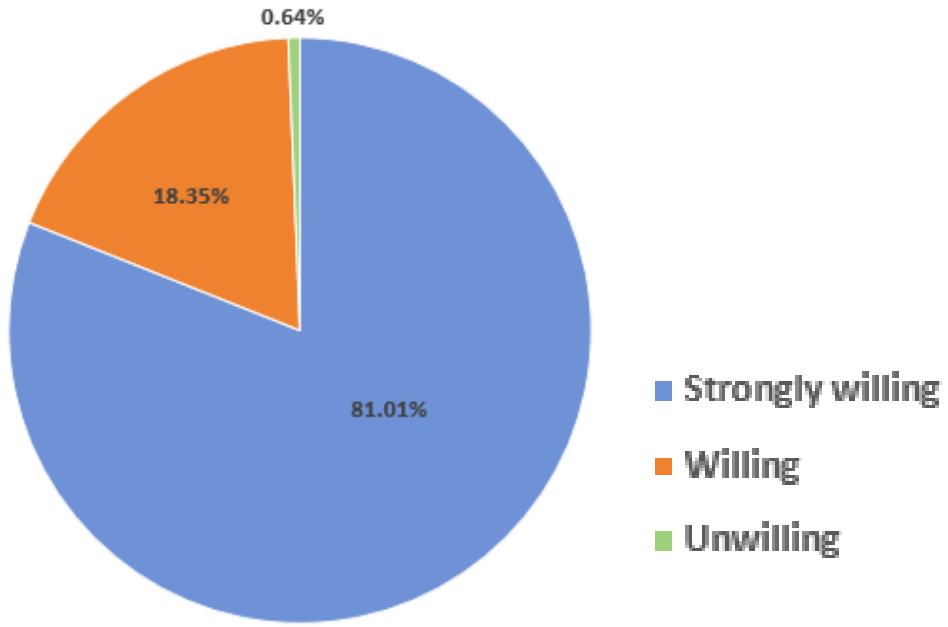


Grade 3A hospitals accounted for the highest proportion-62.66%

5. Survey on the use and Popularity of VBWD

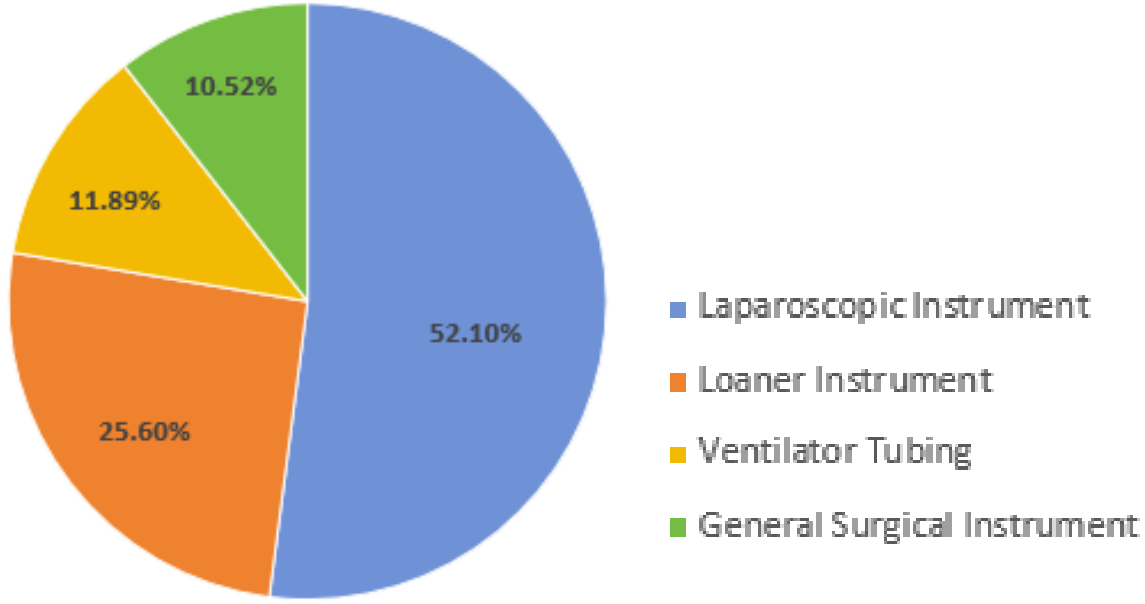
Research on the use of VBWD

- **Staff Preference**



Among all respondents, the highest percentage (over 81%) chose "very willing," while only 0.63% indicated they were unwilling to use it..

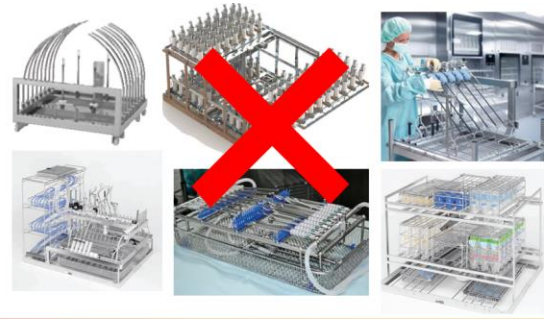
- **Application of VBWD**



Among all respondents, the highest proportion (52.1%) chose to use VBWD for cleaning laparoscopic instruments, making it the largest percentage.

6. Recommendations and conclusions

VBWD – Key Features & Benefits



- Fully compliant with ISO 15883 standards
- Integrates all essential cleaning procedures
- Final rinse includes 90°C thermal disinfection (1–5 minutes duration)
- Innovative mechanism cleaning canulated / complex instruments effectively
- Does not require extra docking, can be cleaned directly after disassembly[7]
- Reduce laborious work and preparation time
- Efficient and practical alternative to traditional washing disinfector
- 81% of CSSD staff prefer VBWD based on survey results

Reference literature [7]: Xue'er Peng, Lihua Huang, Aiqin Chen. Study on the cleaning effects of different cleaning methods on reused electrocoagulation hooks in laparoscopic surgery [J]. Sterile Supply.Volume2.Issue4.December 2023

7. Reference

1. Masaki Takashina. Development of New Washing Method“Vacuum Boiling Washer” [J]. Medical Device. Vol.81.No.3(2011) (15)
2. Shi Lingling, Shi Jing, Gao Zhenbang, et al. Comparison of cleaning effects of two different cleaning methods on luminal instruments [J]. Chinese Journal of Disinfection, 2017, 34 (4): 378-379
3. ISO International Organization for satandardization (ISO)Washer-disinfectors-Part5:tests oils and methods for de-monstrating Efficacy(ISO/TSI5883-5) [S].GENEVA.Switzer-land:ISO.2005
4. Osaki Takashi. "Technology for Utilizing Pressure Reducing Boiling Washer Disinfector". [J] The Japan Society of Mechanical Engineers, May 2013 Vol. 116 No.1134
5. Wu Keping, Li Zhengying, Jin Weiduan. Observation on the effect of using a pressure reducing boiling cleaning machine to clean articulated minimally invasive surgical instruments [J]. Chinese Journal of Disinfection, 2018,35(4):307-309
6. Chen Diping, Wei Jingrong, Ren Xiaomei. Effect of pressure reducing boiling cleaning machine on cleaning laparoscopic instruments [J]. Chinese Journal of Disinfection, 2017, 34(6):578-579
7. Xue’er Peng, Lihua Huang, Aiqin Chen. Study on the cleaning effects of different cleaning methods on reused electrocoagulation hooks in laparoscopic surgery [J]. Sterile Supply.Volume2.Issue4.December 2023

Thank you for your Attention

Let's make cleaning towards perfect!

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- **Mr. Samuel Law, Chairman,**
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