# Sperm Retrieval Procedures: Extraction, Aspiration, and Capacitation

This course covers the clinical and laboratory aspects of sperm retrieval procedures used in assisted reproductive technologies (ART), with a focus on TESE, micro-TESE, TESA, MESA, and PESA. Participants will learn when each technique is indicated, how the retrieved sperm differ from ejaculated sperm, and how these sperm are processed and capacitated in vitro for use in IVF/ICSI. The course also covers the biochemical process of sperm capacitation using sodium bicarbonate buffered media and how to optimize lab protocols for poor-quality or immature sperm samples.

**by Fertility Guidance Technologies**

# Overview of Sperm Retrieval in ART

## Key Indications and Considerations

- Indications for surgical sperm retrieval (e.g., azoospermia, obstruction)
- Obstructive vs. non-obstructive azoospermia
- Surgical vs. needle-based retrieval methods
- Ethical and counseling considerations

Sperm retrieval procedures are essential components of assisted reproductive

# Understanding Azoospermia

### Obstructive Azoospermia

Blockage prevents sperm from reaching ejaculate despite normal production in testes

- May be congenital or acquired
- Often treatable with surgical retrieval

### Non-obstructive Azoospermia

Testicles do not produce enough sperm or any sperm at all

- Often genetic or hormonal causes
- Requires specialized retrieval techniques

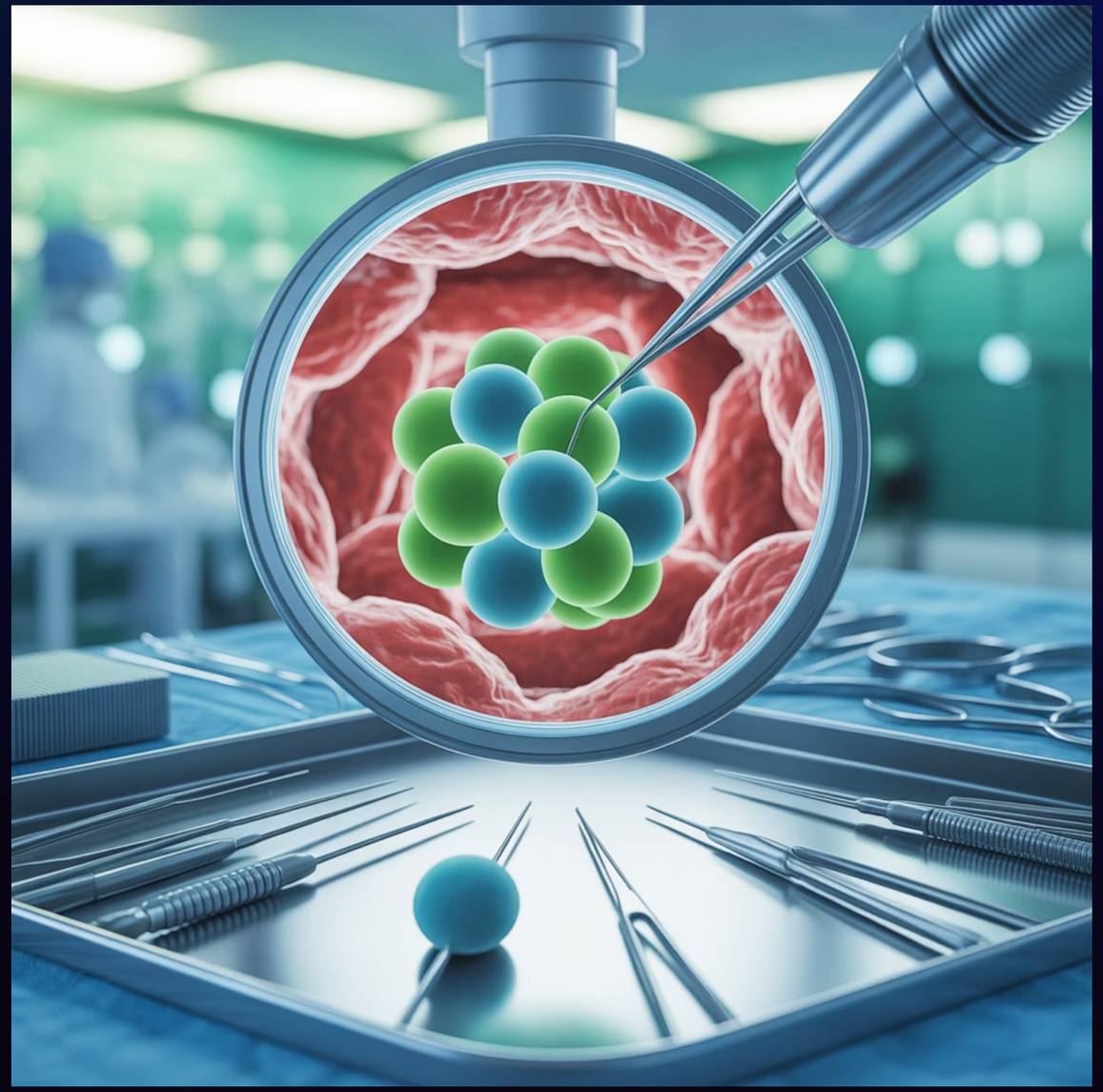
Understanding the type of azoospermia is crucial for selecting the appropriate sperm retrieval technique and counseling patients about success rates.

# TESE: Testicular Sperm Extraction

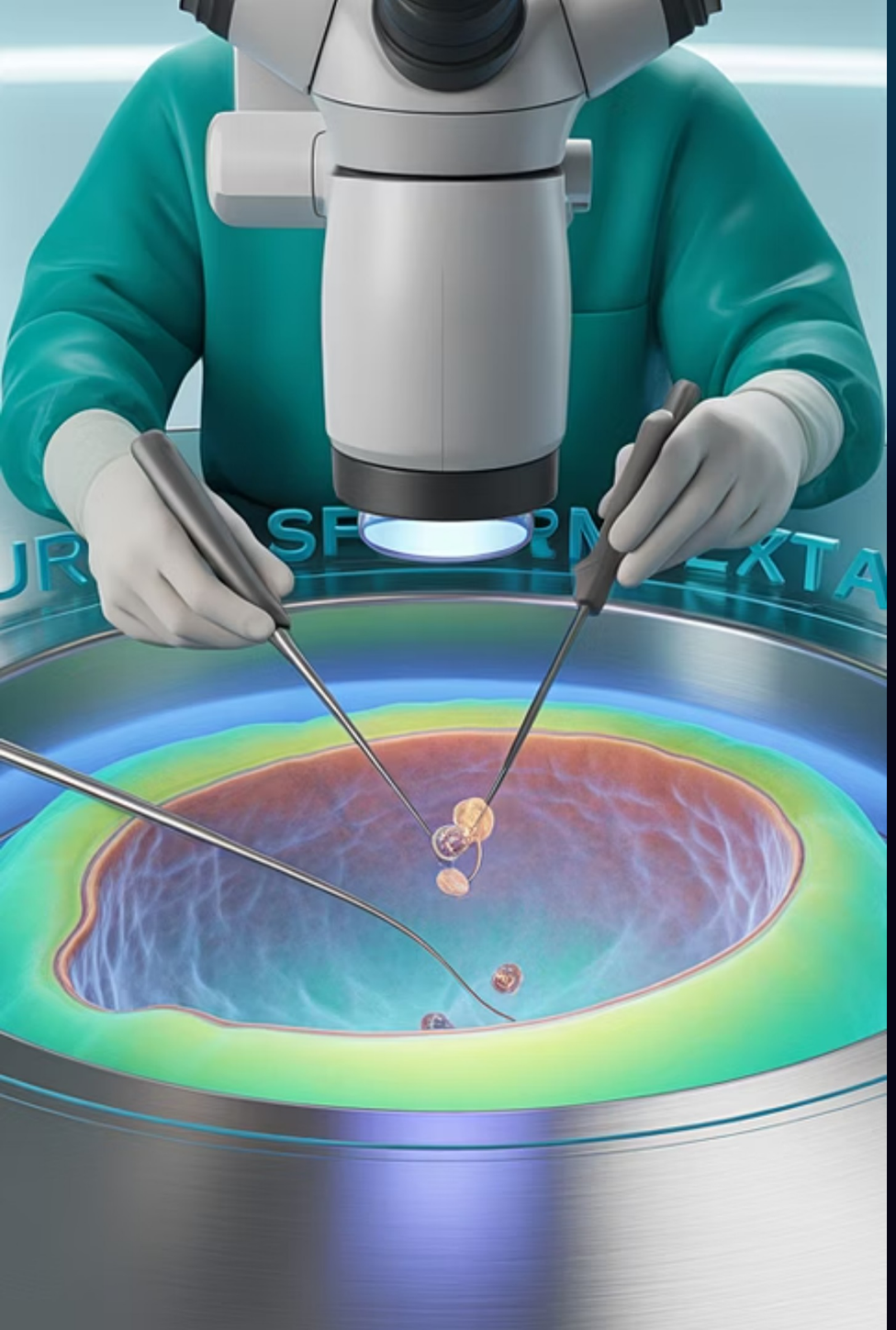
## Procedure Overview

TESE (testicular sperm extraction) is a surgical procedure performed to extract sperm directly from the testicles. This procedure is typically done in cases where the male partner has no sperm present in their ejaculate or has an extremely low sperm count.

- Open surgical biopsy
- Testicular histology and sperm yield
- Performed under local anesthesia



The extracted sperm can then be used for in vitro fertilization (IVF) procedures.



# Micro-TESE: Microsurgical Testicular Sperm Extraction

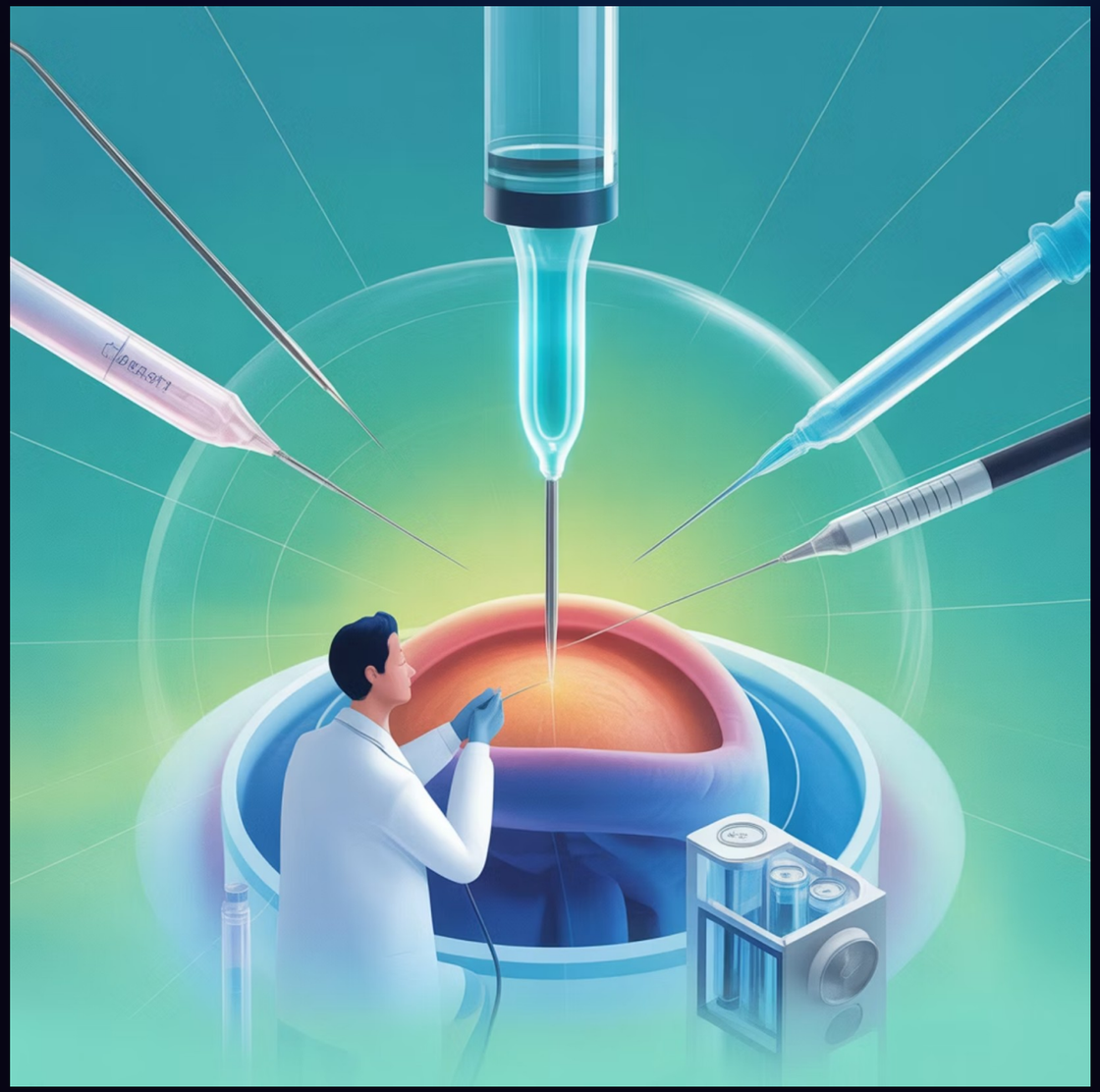
## Advanced Technique for Non-obstructive Azoospermia

Micro-TESE (microscopic testicular sperm extraction) is a variation of TESE that utilizes a surgical microscope to identify and extract individual sperm from the testicles. This procedure is typically used in cases where the male partner has non-obstructive azoospermia, a condition where the testicles do not produce enough sperm or any sperm at all.

### 1 Key Features

- Use of operating microscope (10-25x magnification)
- Advantages in non-obstructive azoospermia
- Higher sperm retrieval rates than conventional TESE
- More precise tissue selection

# TESA: Testicular Sperm Aspiration

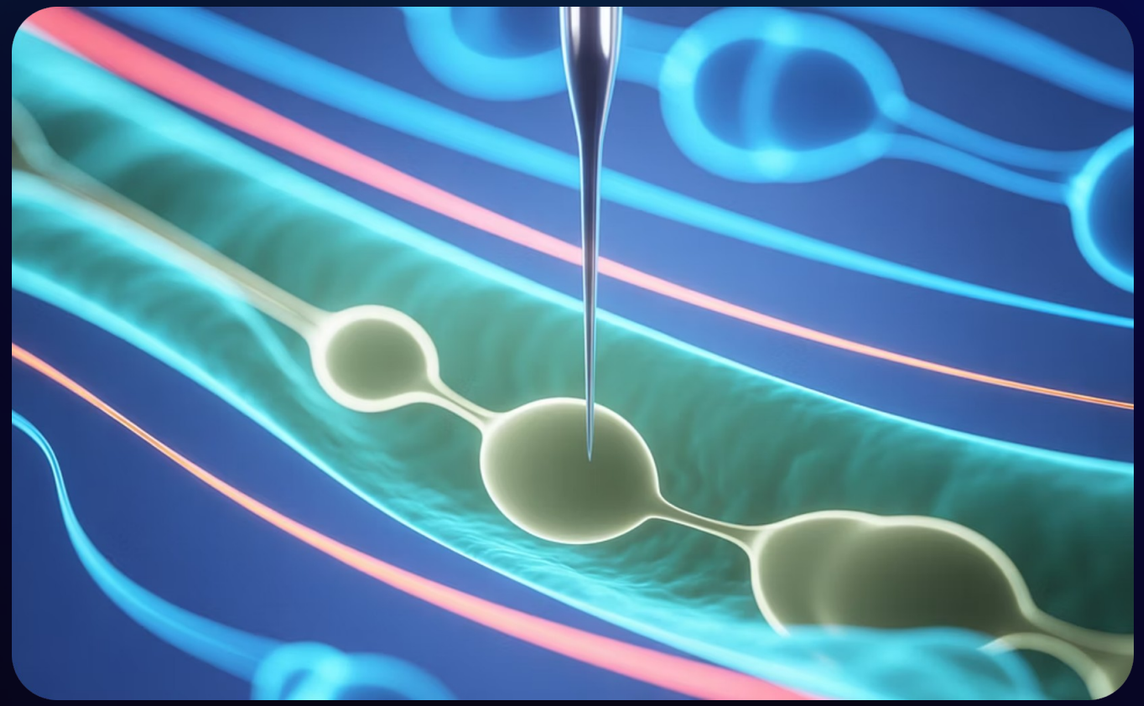


## Minimally Invasive Approach

TESA (testicular sperm aspiration) involves the use of a needle to aspirate sperm directly from the testicle. This technique is less invasive than TESE and may be suitable for certain cases of obstructive azoospermia.

- Needle aspiration under local anesthesia
- Quick outpatient procedure
- Multiple aspirations may be needed
- Lower tissue yield than TESE

# MESA and PESA: Epididymal Sperm Retrieval



## MESA

MESA (microsurgical epididymal sperm aspiration) involves the use of microsurgical techniques to extract sperm from the epididymis, a small organ located next to the testicles where sperm are stored and matured.

## PESA

PESA (percutaneous epididymal sperm aspiration) is similar to MESA but involves the use of a needle to aspirate sperm directly from the epididymis. It is less invasive than MESA.

Both procedures are primarily used in cases of obstructive azoospermia where sperm production is normal but transport is blocked.

# Comparison of Retrieval Techniques

| Technique | Invasiveness | Anesthesia | Best For | Sperm Quality |
|---|---|---|---|---|
| TESE | High | Local/General | NOA/OA | Immature |
| Micro-TESE | High | General | NOA | Immature |
| TESA | Medium | Local | OA | Immature |
| MESA | High | Local/General | OA | More mature |
| PESA | Low | Local | OA | More mature |

NOA = Non-obstructive Azoospermia; OA = Obstructive Azoospermia

The choice of technique depends on the underlying cause of azoospermia, previous retrieval attempts, and laboratory capabilities.

# Comparison of Retrieved vs. Ejaculated Sperm

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## Key Differences

The cells derived by TESE (Testicular Sperm Extraction) can be different from the cells present in the ejaculate, and there are several reasons for this. One of the main reasons is that the sperm in the ejaculate are produced in the testes and travel through the epididymis and vas deferens before being released during ejaculation.

- Differences in maturation, capacitation, and morphology
- Incomplete spermatogenesis in testicular samples
- Common lab observations: low motility, low count, and abnormal morphology
- Risk of aneuploidy and DNA fragmentation

# Developmental Differences in Retrieved Sperm

The cells extracted by TESE are often different from the cells in the ejaculate because they are taken from a different location in the testes and may have undergone a different process of maturation. The sperm cells in the testes are at an earlier stage of development compared to the sperm cells in the ejaculate, and they have not yet undergone the process of capacitation, which is required for fertilization.

**Testicular Sperm**

Early stage of development, often immotile, requires processing

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**Epididymal Sperm**

Partially matured, some motility, still requires capacitation

3

**Ejaculated Sperm**

Fully matured, motile, naturally capacitated in female tract

This means that the sperm cells obtained by TESE may require further processing or treatment before they can be used for IVF procedures.

# Quality and Quantity Considerations

In addition, the cells obtained by TESE can also differ in terms of their quality and quantity compared to the cells in the ejaculate. In some cases, the sperm obtained by TESE may have lower motility, morphology or genetic quality than the sperm in the ejaculate.

However, TESE can be a valuable tool for men with certain types of infertility, and it can provide an alternative source of sperm for IVF procedures when other methods are not successful.

**Clinical Implications**

# Laboratory Handling of Retrieved Sperm

### Sample Receipt

Sample receipt and chain of custody documentation

### Tissue Processing

Mechanical/enzymatic dissociation of testicular tissue

### Sperm Isolation

Use of micromanipulation techniques to isolate sperm

### Cryopreservation

Specialized freezing protocols for retrieved sperm

Laboratory handling of surgically retrieved sperm requires specialized techniques and equipment to maximize the yield and quality of viable sperm for ICSI procedures.

# Special Considerations for ICSI

## ICSI Requirements for Retrieved Sperm

Intracytoplasmic sperm injection (ICSI) is almost always required when using surgically retrieved sperm due to their immature state and limited motility.

- Selection of the most morphologically normal sperm
- Immotile sperm may require hypo-osmotic swelling test
- PICSI or IMSI may be used for enhanced selection
- Careful handling to prevent further damage

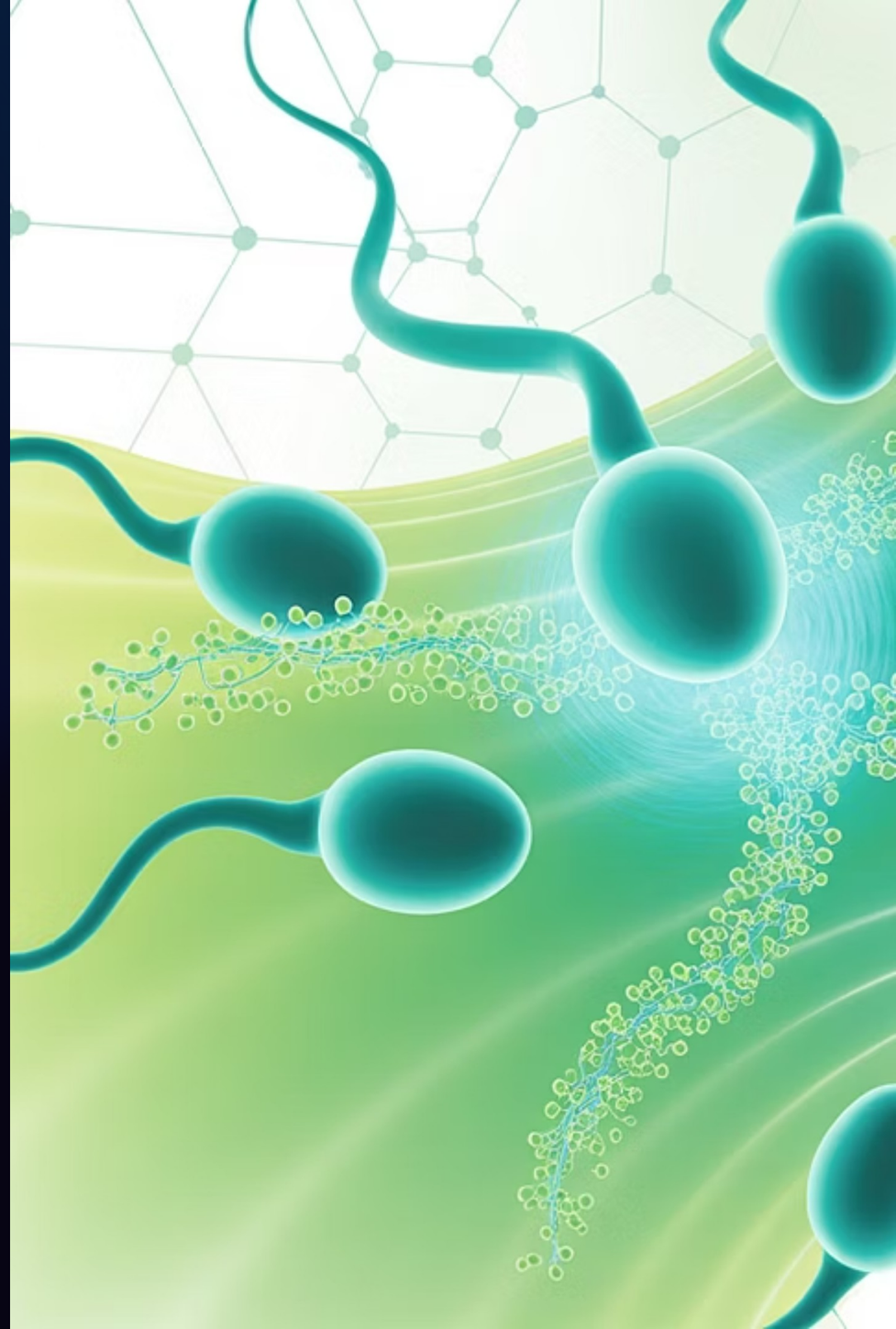
# In Vitro Sperm Capacitation

## The Biochemical Process

Sperm capacitation is a complex process that involves several biochemical and physiological changes in the sperm membrane and cytoplasm. In vitro capacitation of sperm can be achieved by exposing the sperm to a specific culture medium that mimics the physiological conditions of the female reproductive tract.

### 1 Role in Fertilization

- Role of capacitation in fertilization
- Membrane changes that enable zona binding
- Hyperactivation of motility patterns
- Acrosome reaction preparation



# Sodium Bicarbonate Buffered Media

## Key Component for Capacitation

Sodium bicarbonate buffered media is commonly used for in vitro sperm capacitation. The bicarbonate ions in the media help to increase the pH of the media, which triggers a series of signaling events in the sperm that initiate capacitation.

Additionally, the sodium ions in the media are necessary for the regulation of sperm motility and hyperactivation, which are critical for fertilization.


**Biochemical Effects**

# Media Formulation for Capacitation

### Bicarbonate

Primary trigger for capacitation signaling cascade

### Serum Albumin

Facilitates cholesterol efflux from membrane


### Glucose

Energy source for sperm metabolism and motility

### Pyruvate

Alternative energy substrate for sperm

### Amino Acids

Building blocks for protein synthesis

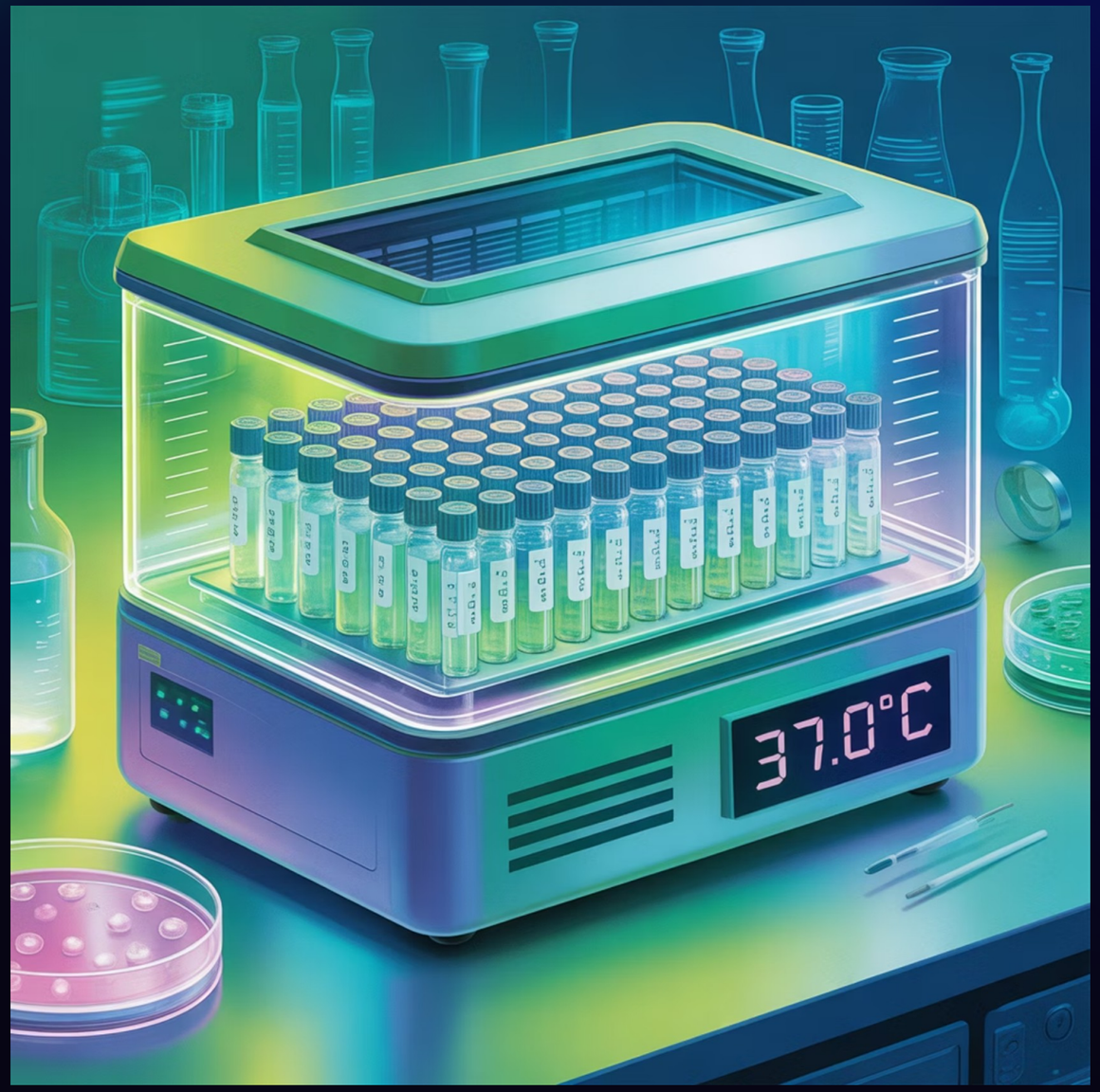
The specific composition of the sodium bicarbonate buffered media used for sperm capacitation may vary depending on the laboratory's protocols and the specific needs of the experiment. However, most media formulations include these key components to provide the necessary nutrients and signaling molecules required for capacitation.

# Incubation Conditions for Capacitation

## Controlled Environment

During in vitro capacitation with sodium bicarbonate buffered media, the sperm are incubated under controlled conditions, such as temperature, pH, and gas composition, to mimic the physiological conditions of the female reproductive tract.

- pH control, temperature, and $CO_2$/$O_2$ gas balance
- Incubation protocols and timing for optimal capacitation
- Typically 37°C to match body temperature
- 5-6% $CO_2$ to maintain proper pH




The sperm are then exposed to the capacitating medium for a specific period, typically

# Optimizing Protocols for Retrieved Sperm

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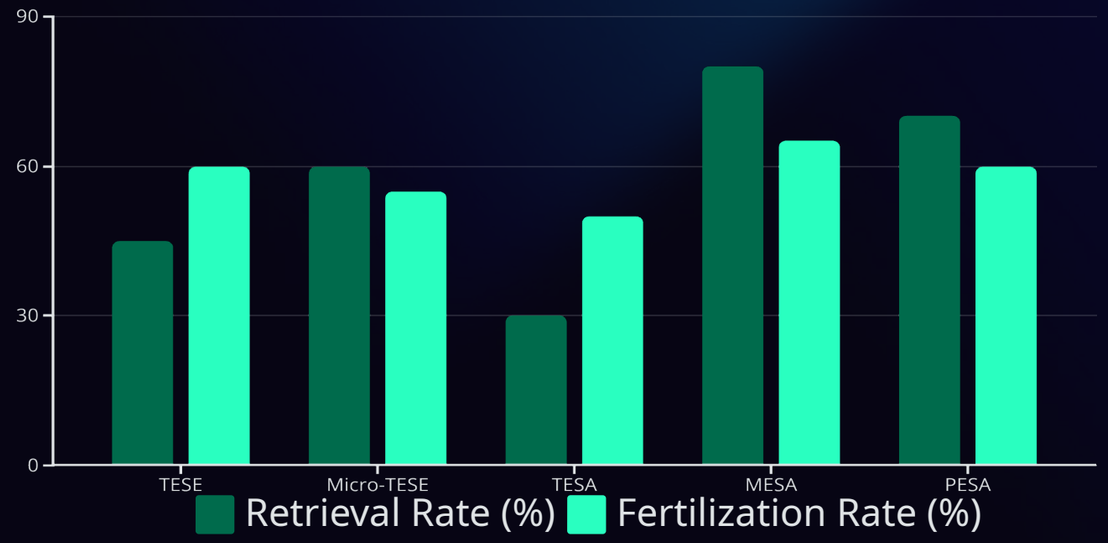
## Special Considerations

Retrieved sperm often require modified capacitation protocols due to their immature state and lower motility.

- Extended incubation times may be necessary
- Higher concentrations of capacitation factors
- Addition of pentoxifylline to enhance motility
- Careful monitoring to prevent over-capacitation
- Specialized media formulations for testicular sperm

# Clinical Outcomes and Success Rates




## Factors Affecting Success

- Underlying cause of azoospermia
- Patient age and hormonal status
- Previous testicular surgeries
- Laboratory expertise in handling retrieved sperm
- Quality of oocytes and female partner factors

Success rates vary significantly based on multiple factors, with obstructive azoospermia generally having better outcomes than non-obstructive cases.

# Course Summary and Clinical Applications

### Sperm Retrieval Techniques

Multiple surgical and needle-based approaches are available for different clinical scenarios, with selection based on the type of azoospermia and previous treatment history.

### Laboratory Processing

Retrieved sperm require specialized handling, processing, and capacitation protocols to optimize their use in assisted reproductive procedures.

### Capacitation Science

Understanding the biochemical process of capacitation allows for optimization of media formulations and incubation conditions for different sperm sources.

This course has provided comprehensive coverage of sperm retrieval procedures and the laboratory techniques required to process and capacitate these sperm for use in assisted reproductive technologies, particularly ICSI.