A robotic instrument for atraumatic transvaginal detection of epithelial ovarian cancer

Yiqian Xie[1], Paula Cunnea[2], Christina Fotopoulou[3], George Mylonas[4]
[1]The Hamlyn Centre, Institute of Global Health Innovation. [2]Ovarian Cancer Action Research Centre. Imperial College London, United Kingdom.

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Introduction

Ovarian cancer is the fifth leading cause of death in women in western countries. High-grade serous ovarian cancer (HGSOC) is the predominant subtype of clinical diagnosis, accounting for 70-80% of ovarian cancer deaths.

The focus is now on the early diagnosis of HGSOC. However, a lack of tools to sample the fallopian tubes' precursor cells remains a major barrier.

This project aims to develop a manually or robotically controlled flexible instrument, that will facilitate easy and atraumatic delivery and withdrawal of bio-functional swabs inside the fallopian tubes.

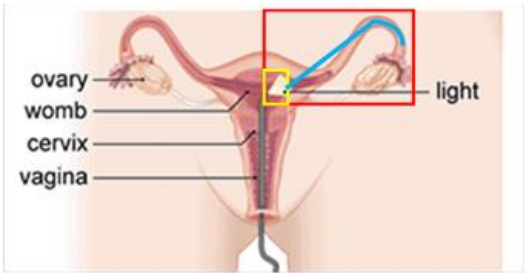
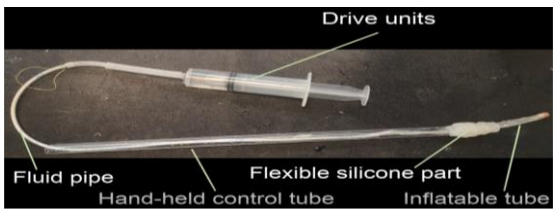


Figure 1 - Working pathways within the reproductive system.

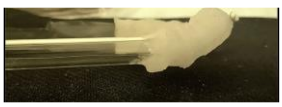
Method

In this project, we use the tip-extending soft robot to sample and remove it without contact with the uterus. The components of the design shown in the diagram.

The introducer brings the overall design into the uterus and then places entrance by bending of the silicone part for entrance placement. The sampling principle consists of extending, foam pop out in the right place, retrieval and removal.



(a)



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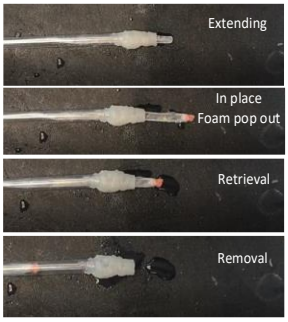

(c)

Figure 2 - (a) Equipment components; (b) Bent silicone part; (c) Working principle demonstration.

Results

We have carried out experiments on a silicone uterus and oviduct model. On the model, our design successfully worked in the sampling area (the fallopian tube at a depth of 3cm-4cm).

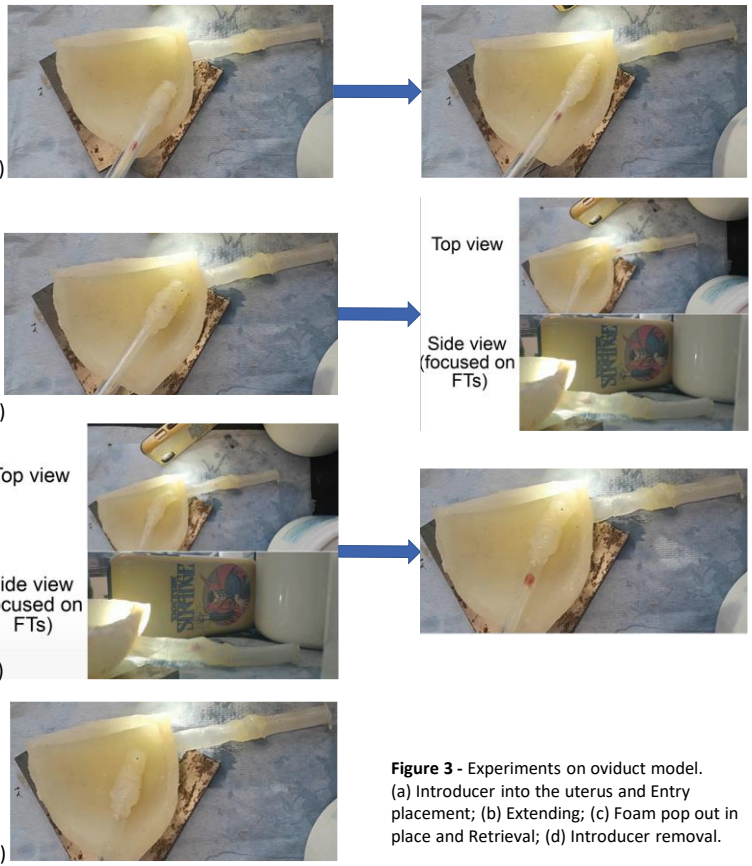

Figure 3 - Experiments on oviduct model. (a) Introducer into the uterus and Entry placement; (b) Extending; (c) Foam pop out in place and Retrieval; (d) Introducer removal.

Discussion

After the proof of prototype's principle and evaluation on the model, our design works well on the task, which can prove that our principle is feasible. Our device has also been evaluated by surgeons and biologists, approving that the design can further develop to fill the gap in the pre-sampling of ovarian cancer.

Future work:

1. Additional wire puller knobs and dual head configurations can be added to improve human-machine interaction, reduce patient examination time and pain.

2. We will do further data collection, for example, testing on animal tissue if possible. Further, we can enhance the design's structural stability and flexibility.

3. In the future, simple feedback add to assist imaging while enhancing automation to reduce failure rate and patient pain. It further uses as an auxiliary instrument such as a guide for in vivo surgery.

References

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