WEARABLE VIDEO DOCUMENTATION DEVICES IN ANATOMIC PATHOLOGY AUTOPSIES

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ABSTRACT

INTRODUCTION: In the past decade, many wearable devices for video documentation have been released on the free market. However, they have seldom been implemented into autopsy practice.

AIM: This research aimed to compare several different types of video recording devices and compare their feasibility, both in regards to their form factor and video quality, in everyday autopsy practice.

MATERIALS AND METHODS: Five separate wearable devices for video documentation devices were used in the standard autopsy practice of a single pathologist – two box-style sports cameras - Kitvision Escape KVESCAPE4KW (Kondor, Hapton, Lancashire, England) and GoPro Hero 7 Silver (San Mateo, California, USA), a pair of camera glasses – NCS0002 (Spardar Smart Technology Co., Ltd., Shenzhen, China), a pair of smart glasses – Cloud-I II (Topsky Digital Technology Co., Ltd., Shenzhen, China), and Google Glass – XE V2 (Google LLC, Mountain View, California, USA). The five devices were compared both for their pros and cons and for their feasibility in autopsy and educational practice.

RESULTS: Only the box-style sports cameras and Google Glass provided sufficient video resolution on the initial test to be considered efficient aids. A total of sixty-five full autopsies were documented, using the box-style sports cameras and Google Glass, with ten autopsies being recorded simultaneously with the two devices. Flaws present in both types of recording devices were in their relatively short battery life and the limitation of data that could be stored.

CONCLUSION: Video documentation of autopsies using new generation wearable devices is a feasible option for both individual autopsy cases and educational purposes of both students and young pathologists. The different designs are susceptible to individual preferences, however, box-style sports cameras seem to be best suited for autopsy practices.

Keywords: *autopsy, pathology, video documentation, Google Glass, education*

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INTRODUCTION

Autopsies are among the most well-defined procedures in medicine, with minimal differences between institutions and room for personalization (1). Depending on the region and institution, anatomic pathology autopsies are often scarce, limiting the abilities of individual pathologists to perfect their technique and for newcomers to observe enough autopsies before beginning their practice (2).

On the other hand, some regions depend on highly outdated guidelines and criteria, often in the set of manuals, poorly preserved and out of print for decades. This often poses as a challenge for the novice pathologists as the manuals are often cited in the laws and regulations regarding autopsy practice and even the minimal differences with foreign-language literature, such as cardiac dissection, can prove detrimental both for passing the practice part of the specialty exam and in a case of a medical lawsuit regarding the diseased patient's conditions and the adequacy of the autopsy finding.

In the past decade, many wearable devices for video documentation have been released on the free market. Implementation of such devices has been scarce in autopsy practice, however, due to their relative inability to capture the point of view of the pathologist (POVP), their video resolution limitations, price, or their relative discomfort to wear whilst performing an autopsy.

Such devices and other video documentation capabilities have seldom been used in autopsy practice, while they have been widely accepted by surgical and other medical specialties (3–8).

AIM

This research aimed to compare several different types of video recording devices and compare their feasibility, both in regards to their form factor and video quality, in everyday autopsy practice.

MATERIALS AND METHODS

Five separate wearable video documentation devices were used in the standard autopsy practice of a single pathologist. The first two devices were box-style sports cameras - Kitvision Escape KVESCAPE-4KW (Kondor, Hapton, Lancashire, England) and GoPro Hero 7 Silver (San Mateo, California, USA), fixed on the forehead of the pathologist with head straps or via the adhesive mount on a protective helmet. The third device was a pair of camera glasses – NCS0002 (Spardar Smart Technology Co., Ltd., Shenzhen, China). The fourth device used was a pair of smart glasses – Cloud-I II (Topsky Digital Technology Co., Ltd., Shenzhen, China). The fifth device used was Google Glass – XE V2 (Google LLC, Mountain View, California, USA).

The five devices were compared both for their pros and cons and for their feasibility in autopsy and educational practice, whilst being compared to one another in simultaneous autopsy recordings when possible.

Before implementation in video documentation of autopsies, the devices were tested for their video resolution qualities on a section of fixated specimens, to determine whether the quality is sufficient enough to document organ changes and hence be of use in both the finalization of the protocol and as an educational tool.

RESULTS

Only the video parameters of the box-style sports cameras and Google Glass XE V2 were sufficient in documenting organ changes – resolution, image clarity, color saturation, and image stabilization made it impossible to obtain sufficient documentation of organ changes with the other devices. Further criteria for exclusion of the other devices included their proneness to blurring of the lense from exhaled air, dependent on the type of protective mask worn by the pathologist, a much narrower viewing angle, proneness for slipping out of position and inferior audio quality. As there were too many instance-related cons to the implementation of these two devices, they were excluded from autopsy recordings. Hence, no autopsies were recorded using them.

The sports cameras had a 10-megapixel sensor with a minimum factory resolution of 1080p in 60 frames per second (fps), 1440p at 60fps, and 4K at 30fps is available, whilst Google Glass XE V2 had a 5-megapixel sensor, capable of only 720p at 60pfs.

A total of sixty-five autopsies were documented, using the other two form factors, with ten autopsies being recorded simultaneously with the two devices.

The most commonly encountered problem for the box-style sports cameras was the difficulty of an-

gle placement so that the proper POVP was recorded, due to the nature of fixation. However, the device presented details on a wide-angle (Google Glass XE V2 at 80° and the sports cameras at 120°-170°, depending on the presets), with sufficient video (resolution, stability, and color saturation) and audio quality.

Google Glass performed inferiorly in capturing the POVP due to the lower video parameters, viewing field (80°), fixed forward-facing nature of the camera, and the fact that autopsies are performed predominantly whilst looking down (Fig. 1). The audio quality between the two form factors was comparable, allowing for proper audio note dictation.

The recordings from both types of devices were also implemented in student seminars, where topically possible, and were well received by students, including those not wanting to attend an autopsy, when possible during the seminars.

Both form factors performed nearly identically in their pros and cons and were feasible in practice. However, the box-style sports cameras performed superiorly in video quality and, as of February 2020, Google Glass XE V2 will no longer be supported and only preset units can still be used.

Price comparison between the form factors showed that the box-style sports cameras were a much cheaper option with a multitude of brands

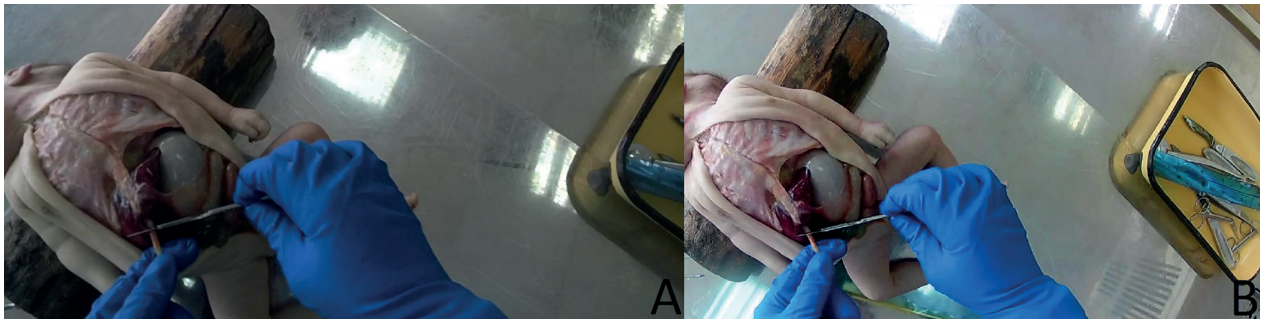

Fig. 1. Neonatal abdominal cavity and section of the venous duct with Google Glass (A) and Kitvision Escape KVESCAPE4KW (B)

Note: Both images are snapshots from the video recording and have been trimmed to show only the relevant information

Both form factors, with their respective connectivity apps and software, allow for a distant live connection with a consultant. However, only Google Glass allows for a live two-way video and audio connection.

Flaws present in both types of recording devices were their relatively short battery life, about one and a half hours each, and the limitation of the amount of data that could be stored, without the need for a transfer to another device, since a one-hour recording can be between 20 and 40 gigabytes, depending on the presets.

Both form factors, however, proved extremely useful in documenting the gross finding and technique used by the pathologist. This proved extremely helpful in the protocol report, especially in cases with two or more autopsies carried out on the same day by the pathologist, or in cases with minimal gross changes.

available, whilst smart glasses such as Google Glass were several times more expensive and there were only a few brands commercially available.

DISCUSSION

Whilst local laws are widely different and, in some cases, do not recognize video documentation as evidence, in some regions such recordings can still be used in medical lawsuits. Video evidence in such cases would be much preferred over photographic one, which can easily be tampered with (9).

The implementation of wearable video documentation devices is to be preferred in all cases to video documentation from a second person or a tripod or otherwise fixed camera, as all wearable devices record the findings from the POVP.

The remote live connection can be helpful in cases where a consultant is needed, but cannot physically attend, or in cases where students do not want

to attend the autopsy directly. In such cases, a live two-way connection proves superior to the standard video documentation capabilities of other recording devices.

The feasibility of the two types of devices is unquestionable, both for the autopsy practice and pathology seminars. Using the recording the students can observe topical autopsies during the seminars, which is rarely possible and young pathologists can have a database from which to observe the autopsy technique and adapt it faster.

Furthermore, such recording can be used as an examination tool for the pathologist performing the autopsy concerning the technique and ability to recognize certain gross changes in a wide set of cases, rarely possible during individual evaluations by superiors (1,6).

CONCLUSION

Video documentation of autopsies using new generation wearable devices is a feasible option for both individual autopsy cases and educational purposes of both students and young pathologists. Autopsy video records may be kept for a long time in an archive as an objective and valuable illustration. The different designs are susceptible to individual preferences, however, box-style sports cameras seem to be best suited for autopsy practices based on the current comparison.

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