Cell phone microscope for semen analysis

Technology has come a long way since 1677 when Antonie van Leeuwenhoek visualized spermatozoa on a home-built microscope. Interestingly, Leeuwenhoek used homemade spherical glass balls for lenses. Over the ensuing centuries, optical microscopy has progressed with the development of techniques such as phase contrast, differential interference contrast, and electron microscopy. While current standard optical microscopes use flattened glass lenses, the authors have reverted back to spherical ball lenses for their cell phone microscopes. The benefits of this approach are simplicity and low cost. Reports of cell phones used for microscopy began in the 1990s with a variety of approaches described. The approach of Kobori et al. (1) is the simplest, and with a component cost of $7 USD, no doubt the least costly. The authors have demonstrated a significant correlation between the number of sperm counted per visual field with the cell phone images and the actual sperm concentration as determined by computer assisted semen analysis. It is important to understand that the current apparatus records images; it does not analyze them—at least at this point. While it is likely that further development of cell phone app software may allow for automated counting, the current setup requires manual analysis of the images for both sperm numbers and motility. The authors have demonstrated that there is a reasonably high correlation between the number of sperm per visual field image and actual sperm concentration. In addition, they have determined sperm number thresholds correlating with the current World Health Organisation (WHO) reference range lower limit of 15 million sperm/mL. The actual cell phone sperm threshold depends on which cell phone was used—but all three phones correlated well by both approaches. There are clear technical limitations to this simple, low-cost approach. The periphery of the images are not in focus, and the image quality is not likely to match those of high-quality phase contrast microscopy of live sperm. However, sperm are uniquely shaped cells, and one does not need a perfect image to count them or determine motility. In addition, high sperm densities were excluded because of the difficulty in counting many sperm in one image. However, high sperm concentration is not a risk factor for infertility. It is the patients with low sperm concentration who are the targets. Finally, the ability of this approach to evaluate sperm morphology was not examined.

While the described apparatus is a proof of principle and not yet ready for dissemination, of what value is it? The authors describe several potential applications. The most significant is to bring semen microscopy to underserved populations. It is important to remember that the complete evaluation of the infertile male consists of three components—a medical history, physical exam, and semen analysis. Therefore, this cannot serve as a complete male evaluation. What it could provide is an initial screening test for those who may need further evaluation. That is not to say that a normal cell phone semen analysis rules out a male factor. A detailed medical/sexual history is still required—but this apparatus may eliminate the need for the patients to have access to specialized laboratories. The basics of the semen analysis could be brought to locations where there are no andrology laboratories. Patients identified as below WHO thresholds could then be referred for further standard evaluations. In the most basic form, the sperm number and motility thresholds could be used as triggers for referral. Another potential application is self-diagnosis of a male factor. In the United States there already are home sperm count kits for patients to use to estimate sperm concentration. Despite concerns that this approach may delay timely referral, since sperm count is only one of many semen parameters that are important for fertility, the kits are currently used by patients wanting to have private assessments of their fertility. In comparison to those kits, the cell phone microscope could determine count and motility—still not a complete male evaluation, but at least an improvement over count-only assessments. The authors should be congratulated on the development of an innovative apparatus that has significant potential for global outreach for services for the infertile male.

Mark Sigman, M.D.
Division of Urology, Department of Surgery, Warren Alpert Medical School of Brown University and the Miriam and Rhode Island Hospitals, Providence, Rhode Island

http://dx.doi.org/10.1016/j.fertnstert.2016.06.046

You can discuss this article with its authors and with other ASRM members at
https://www.fertstertdialog.com/users/16110-fertility-and-sterility/posts/11010-cell-phone-microscope-for-semen-analysis

REFERENCE

1. Kobori Y, Pfanner P, Prins GS, Niederberger C. A novel device for male infertility screening with single-ball lens microscope and smartphone. Fertil Steril 2016;106:574–8.