Method Article

Emergency Microscope light modification by external source in absence of power supply

ABSTRACT

Introduction: Microscope is an instrument for visualizing fine detail of an object so that observer can observe the object being examined in detail. The object of examination vary from cells (normal or pathologic), microorganism (such as parasite and bacterium), and even non biological part. There are several types of microscope, one of the oldest forms and still used today is the light microscope. A light microscope relied on continuous light source to operate. The most common source for today's microscopes is an incandescent tungsten-halogen bulb, which is solely electric dependent, positioned in a reflective housing that projects light through the collector lens and into the sub-stage condenser. Current situations sometimes require readiness for conducting microscopic examination anytime, anywhere. Unfortunately, problem occur if the electricity goes out, most people will not be able to continue their microscopic observations. This problem raises the question of what if in an emergency it is necessary to carry out a microscopic examination but unfortunately there is no power source. Below we propose emergency modification efforts so that the microscope can still be used even in conditions without a power source.
Aims: to modify an electric light microscope in such a way that it can continue to be used in the absence of an electrical power source using external source of light
Discussion: Adding an external source of light is a brilliant approach in order to make the electric dependent light microscope still useable in emergency condition.
Conclusion: it is possible to modify an electric light microscope in the condition of no electric source available and make it operable

Keywords: emergency lamp, positioning. lenses, objective, ocular, magnification, light emitting diode.

1. INTRODUCTION

The light microscope is an apparatus for apprehending excellent detail of an object being observed [1,2]; by accomplishing a detailed and enlarged portrayal through the use of a sequences of glass lenses [3], which initially adjust a beam of light onto or through an object or section of an object, and flowed thru convex objective lenses to aggrandized the picture captured [4]; in other word, that it accommodates a two-dimensional aggrandized figure of the specimen being observed [3]. In the majority of light microscopes, the image is viewed instantaneously via binocular eyepieces [5] that act as a secondary lens in the form of a magnifying glass to observe the projected image [2,4]. Such apparatus are named ‘compound microscopes’ [6]. The term magnification means the microscope’s ability to make small objects seem larger, such as making a microscopic organism visible [1,2,6-8]. The total magnification is the sum of the objective magnification (can be 5×, 10×, 40× or 100×) multiplied with the eyepiece magnification (usually 10×) [2,7]. The magnification range extends from ×10 to ×1000, with a resolving power of the order of 0.2 µM, depending on the type and numerical aperture (area available for passage of light) of the objective lenses.

Common and regular light microscope rely on light produced from lamp which generated electrically to operate [2,6,8]. The most frequent source for nowadays microscopes is an incandescent tungsten-halogen bulb, which is solely electric dependent, positioned in a reflective housing that projects light through the collector lens and into the sub-stage condenser [5,6].

Sometimes in an unexpected situations, emergency microscopic examination needed. Unfortunately, real problem occur when there is no electricity available, and for most people, it will prevent them from doing microscopic observations [9,10]. This problem actually triggers question regarding whether there is an alternative modification that allows observations to still be carried out in conditions without electricity.

Below we test the emergency modification efforts so that the light microscope can still be used properly, even in conditions without an electric power source. This method is applicable in the field, e.g., when doing field trip, or in limited resources setting.

2. METHODOLOGY

This approach was developed and perfected during the time of laboratory work in the department of Parasitology, Faculty of Medicine, Universitas Kristen Indonesia, Jakarta-Indonesia. We have set a scenario as if it is necessary to carry out a microscopic examination when there is no electrical power source (for example during a power outage)

For the purpose of observation, we prepare light Microscope Olympus CX21 and three Parasitology positive slides of: (1) *Pediculus humanus capitis*, or the head louse, an obligate ecto parasite of man; (2) positive thin blood smear of *Plasmodium vivax*, a hemosporozoan parasite and (3) positive fecal smear of *Entamoeba histolytica* (2 nuclei cyst form). We use combination of bigger object (*Pediculus humanus capitis*) that can easily be seen ini 10×10 or 10×40 magnification with the smaller *P. vivax* and *E. histolytica* that must use 10x100 magnification.

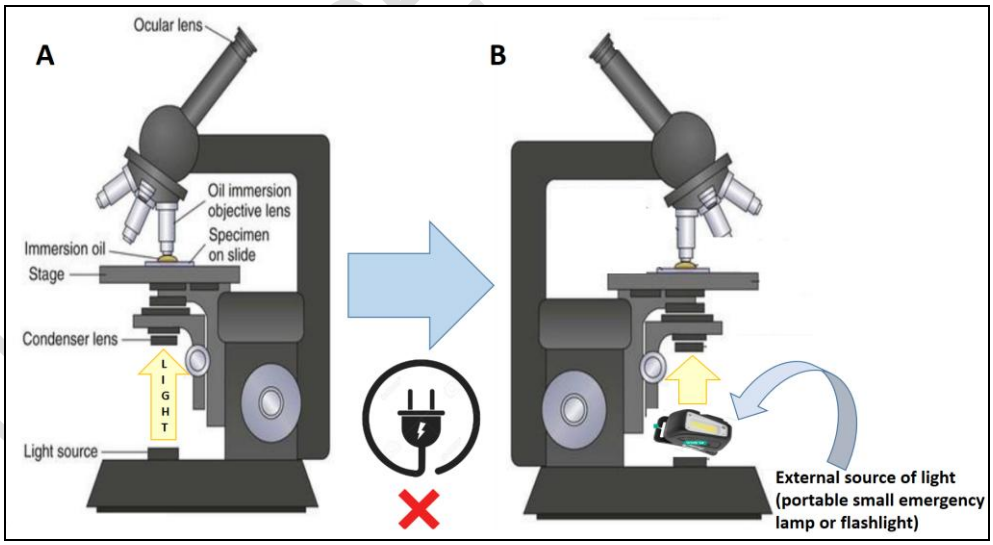

Fig. 1. Schematic part of light microscope.[7 with modification] (A) regular light microscope with its part, (B) simple modification in case there is no electricity available, it is possible to add external light source via emergency lamp or flashlight

This approach only needed emergency lamp or flashlight from hand phone which is used as a substitute of light source. We use two kind of emergency lamp purchased in a local retail

store with specification as follow: the first is a China made APA brand LED 6 watt (32 pcs) white grey emergency lamp equipped with 4V 1600mAh battery, with charging time 12-15 hours, duration of use ~up to 4 hours, 220-240 V/50-60 Hz with dimension 5.26×6.3×19cm and the second a LED head lamp PowerLite brand LED 3 watt 120 lumen that use three AAA battery 1,5V and the third is using flashlights from a Samsung A 23 phone cell with Li-Po 5000 mAh, non-removable and charging: 25 W wired, LED flash with adjustable brightness. The author disclaimer that any product or device being used in the test are the author's personal individual experiences, reflecting real life experiences. The authors did not receive support from any organization for the submitted work; and all the device used are the author's personal belonging (except for the microscope and the slide).

3. RESULTS AND DISCUSSION

As its name implies, the light microscope necessitates sufficient light source, which produces light that can be focused, by a condenser lens, onto the sample [8]. The light that illuminates the specimen reaches a lens known as the objective lens, which creates a magnified image that is inverted, or turned upside down [3].
The method being proposed is simple but substantive modification to existing methods. If an electricity power failure scenario occurs, this simple experiment is aimed at replacing the light source from the lamp pre-installed in the microscope with an external light source, in this case an emergency light or cell phone flashlight.

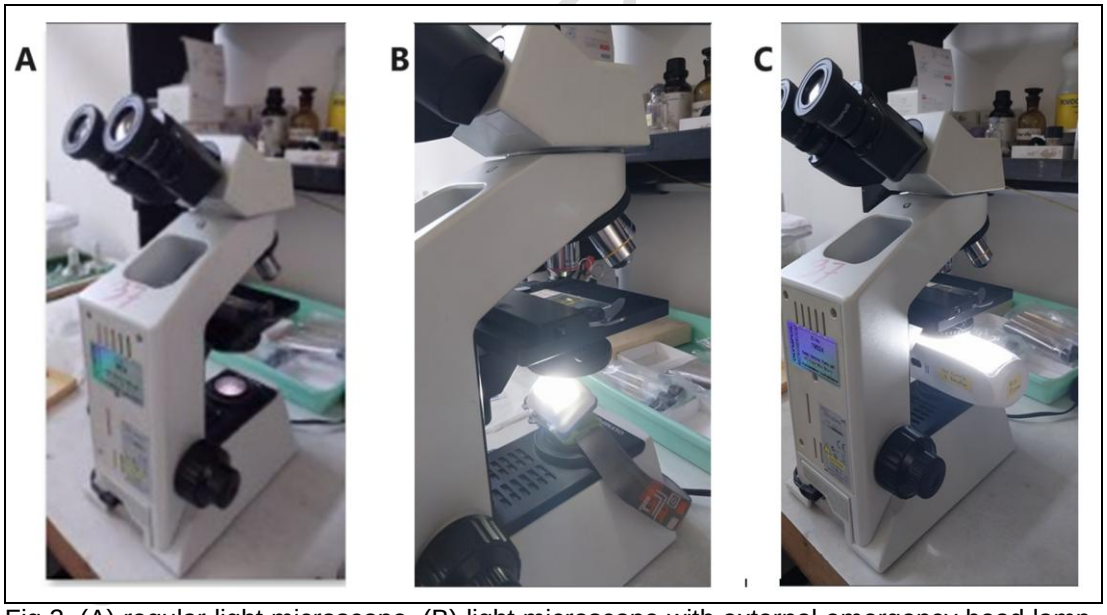

Fig 2. (A) regular light microscope, (B) light microscope with external emergency head lamp, (C) microscope with external portable emergency lamp (small size)

To my experience, external source of light very likely to be used and applicable in the condition of no electricity. From the point of view of installation, external head lamp and portable emergency lamp (small size) is the easiest and most convenient to use because users only need to place it on the surface of the existing non-operable lamp and customarily do not require plenty of adjustment. Once it has settled and turned on, all that needs to be done is to make adjustments on the microscope examination table, as is usually done on

microscopes in normal working conditions. The output of this small LED emergency lamp is around 6W, and is estimated equal to 400 lumens [11].

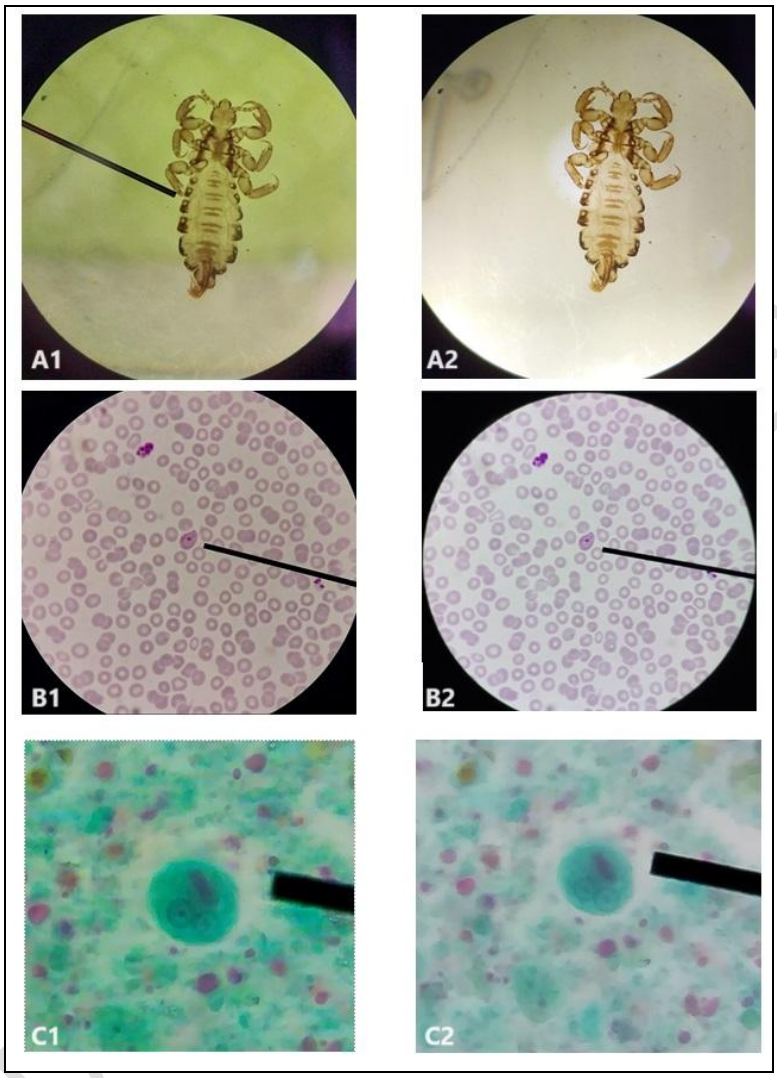

Fig 3. Comparison of parasitic agent taken with cell phone using external emergency head lamp (all the picture with number 1) and small size emergency lamp (all the picture with number 2). (A) *Pediculus humanus capitis* (magnification 10×10), (B) *Plasmodium vivax* mature trophozoite (amoeboid form) (magnification 10x100), (C) *Entamoeba histolytica,* cyst form with two nuclei (all slides are courtesy of dept. of Parasitology, Faculty of Medicine, Universitas Kristen Indonesia, Jakarta-Indonesia)

All picture in fig. 3 actually taken in non-standar condition (using external light source) actually showed remarkable result. Eventhough in terms of lighting quality, there is a slight defect in the photo taken using a headlamp as the light source that it seems to have a slightly green tint when compared to those taken using a small emergency lamp. In my opinion, emergency lamp produces a more natural light compared to head lamp.
These findings reveal that external lights can be used as an alternative light source, when there is no electricity. The list of advantages includes (1) easy to use, (2) convenience, (3)

adjustable to suit user's needs, (4) predictable working time (according to battery life span or after recharging), (5) temporary, non-invasive modifications that will not damage the microscope.

Regarding the use of a cellphone flashlight, it turns out that it is not as easy as an emergency light, because in my experience, the cellphone must be held continuously so it does not fall; Apart from that, the light produced by a cellphone flashlight is not as bright as the light from emergency lights. This is understandable because in fact, cell phone flashlights are not designed to produce a specific light beam that is strong enough to shine through the condenser lens. According to Wuben [12] the output of a phone flashlight is estimated around 40 lumens; which is about the same as a 2.5W filament bulb. The type of light is diffused and does not have a concentrated beam spot. Because phone flashlight beams also tend to be more spread, they will be less disturbing to eyesight but in the meantime that means cell phone flashlight is not designed to make sufficient light beam needed for the microscope.

Cellphone flashlights also provide advantages in the field of health examinations [13-15]. The advancement of the high-resolution smartphone camera provides the prospective to alter dramatically the old fashioned but modern table of top fundus camera for photography that have its own limitation [14,15]. For example, of the advantages is the off-label use of smartphones flashlights for indirect retinal photography and videography that made this approach well received ophthalmic clinical practice for its simplicity, portable, contactless and also universality [13-16] which surely augmented real time tele-medical approach for patient care [17].

Smartphone indirect retinal photography necessitates aiming the bright flashlight from the light emitting diode (LED) source available on the rear side of the phone directly on the patient´s retina [13,14]. Unfortunately, concerns regarding phototoxic hazards of the bright light, especially with LED lighting, on the already compromised patients´ retina raise questions about its safety [18]. A study conducted by Soliman et al [16] revealed that the LED flashlight of the examined smartphones seemed to be inside the limit of safety when used for indirect smartphone retinal photography. However, the high configuration of the minuscule wavelength blue light spectrum could be a concern particularly with prolonged and repeated examinations [19].

It is interesting to explore deeper regarding the application (e.g., during completely dark condition) and placement of external light source in order to get the best visual during observation and also while taking photographs, as the last statement is the limitation of this study.

4. CONCLUSION

This simple method study confirm that an external light source can be used for light microscopy analysis whenever there is no electric source available.

CONSENT (WHERE EVER APPLICABLE)

Not needed

ETHICAL APPROVAL (WHERE EVER APPLICABLE)

Not needed

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