Static Telepathology in a rural African hospital setting: a pilot experience by Makerere University Faculty of Medicine

I G K Munabi, M M Isyagi, Julia Royall and N K Sewankambo

Abstract—

Introduction

In Uganda there is one pathologist for every 1.5 million nationals. Rural physician takes 14-90 days to receive Biopsy results. The internet is accessible at most remote rural hospitals.

Objective

To pilot use of static telepathology in a remote rural African hospital setting

Methods

Touch imprint smears were made from routine biopsy samples at a rural hospital in a burkits lymphoma endemic area. They were stained with H &E then photographed using a 1.3 mega pixel digital photo microscopy camera. The images were viewed, captured and emailed to a pathologist, 600km away for comment on quality of image and possible diagnosis. The time interval between sending the image and receiving the response was noted.

Results

Within an hour, response and feed back on how to improve the imaging were received. All the specimens were identified as non specific chronic inflammation and not burkits lymphoma. Diagnosis was confirmed by subsequent pathological sectioning and staining. All participants felt this was a better method for handling biopsy specimens.

Conclusion

Static telepathology works and can reduce the waiting time for biopsy results in remote rural African settings.

Key words: telepathology, lymphoma, diagnosis, Africa

I. Introduction

Telepathology is the use of digital technology to obtain gross and microscopic images of a pathologic condition and or send diagnostic reports over a telephone on internet link between two or more geographically separate sites of origin.[1]. The technique was initially used in Boston in 1968 [2] and later over larger distances in 1973 from a ship docked in Brazil sending bone marrow smear images via a satellite link to Washington DC [1]. Telepathology has then been put to use in various locations in the USA [3] and in other less developed settings like Hungary [4], Iran [1] and India [5]. The reasons for the use of the technology have ranged from the prohibitive cost associated with training ,employing and retaining highly skilled professionals locations where their time and expertise will least be maximised [3], to attempts to overcome the great distances between those in need of pathology services and the providers of the services [5]. There are even attempts to use mobile phone technology in the diagnosis of malignant melanoma [6]. While telepathology is used predominantly for diagnosis (frozen section and permanent section) [1], there is a rapidly developing potential for consultation and continuing medical education [5].

Telepathology can either be static or dynamic. Static telepathology is the simplest form the transmission of static images via email to a central location for interpretation. The challenges of using this method range from image field selection to the speed of internet connection, which can reach less than a kilobyte per second in less developed settings. Dynamic telepathology involves the use of a dedicated remotely controlled computerised digital microscope to transmit real time over a dedicated internet connection. Both methods give high quality diagnostic image results similar to those obtained when viewing a well prepared slide on an analogue microscope [1], [7].

Uganda is one of the least developed countries in the world with about one pathologist to each of it 1.5 million people. The country's 20 pathologists work in the main regional referral hospitals. Despite the attempts to increase the rate at which specimens are processed, delays occur in the time taken by specimens to reach the processing centre and the reverse for the results. These delays can prove fatal in rapidly progressive conditions like Burkitt's lymphoma where a definitive rather than presumptive diagnosis is essential before treatment or a referral can be made [8] - [10]. The wait can be very frustrating in hospitals that have the drugs for treating the condition. This frustration started the search for a reliable, faster and cheaper means of making and communication of biopsy results to a physician in a rural or a remote location.

II. METHOD

For this pilot we selected a rural hospital located in a burkits lymphoma endemic area of Uganda approximately 600 kilometres' north west of the Kampala city based national pathology referral lab. The hospital routinely treats patients with confirmed burkits lymphoma. On the appointed day of visitation, the resident medical doctor performed two lymph

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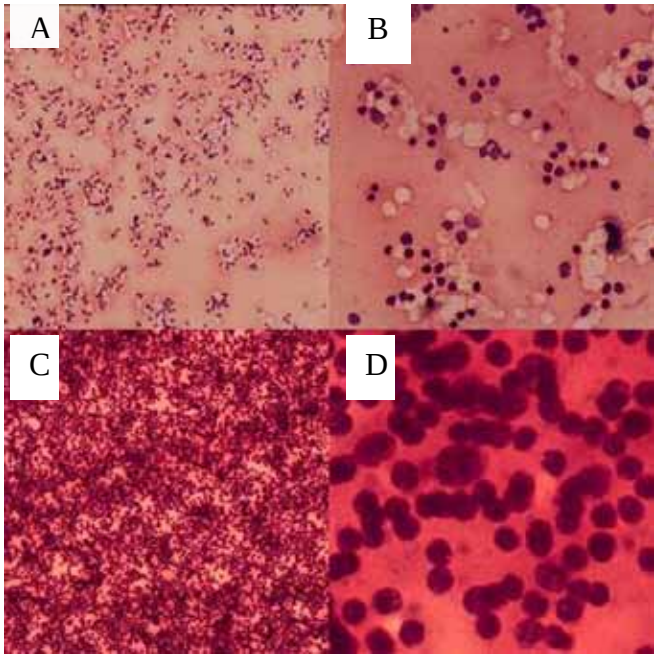
node biopsies on two patients with enlarged lymph nodes and working diagnosis of lymphoma.
The samples were placed in a 0.9% normal saline solution immediately following biopsy and transferred to an adjacent lab where the lead investigator bisected the lymph node and made a touch imprint smear. The remaining biopsy specimens were placed in specimen containers containing 10% formal saline for fixing and later routine processing on return to Kampala.
The imprints were air dried and then fixed in methanol for two minutes before staining using freshly prepared haematoxylin and eosin stains. The stained glass slides were mounted with a cover slip and then examined under X5, 10, 20 and 40 objectives of an Olympus CX21light microscope provided by the hospital and routinely used for examination of blood and microbiology slides.
To one of the eyepieces of the microscope eye pieces we attached a 1.3 mega pixel Moticam 1000 digital microscopy camera connected to a Toshiba satellite laptop computer with a 40 GB hard drive, Pentium 4 processor (2GHz) and 512 RAM. The camera run on computer installed soft ware provided by the manufacturer (MOTIC USA) [11]. The images were captured by the camera form the microscope eye piece and viewed on the laptop screen. Static images of the imprint smears were captured as jpeg images and the most representative images then saved onto a SD memory card.
The images were then sent as email attachments to a waiting pathologist, 600km in Kampala using the hospitals dial up telephone connection (1-2 Kilo bytes per sec average upload connection speed) using an American based Yahoo server. The time intervals between sending the images and receiving an email response were noted.
The laboratory staffs were also taken through the hands on practicalities of making the imprint and the staining procedures as well as the image capturing process

III RESULTS

The average connection speed at the time was 1-2 Kilobytes per second though the system was reportedly set for 246 Kilo bytes per second. Several attempts were required to attach the images which were over 1 Mega byte in size. Once attached it was possible to obtain an opinion from a pathologist in the city within 45 minutes. Overall, the time taken from specimen imprint to pathologists' response was an hour ten minutes
In the pathologists' opinion, the images in the one specimen had cellular features suggestive of chronic inflammation {Case 1: See Image A (X100) and Image B (X 400)} and another of a lymphoblastic cellular proliferative process {Case 2: See Image C (X100) and Image D (X 400)}. The pathologist commented that there was a large amount of red hue in the images sent which was compromising the quality of the images, in contrast to the image quality from our location. In spite of efforts to adjust the hue settings, it was not possible to rectify this on site. The diagnosis of chronic inflammation and a lymphoblastic



proliferating process of burkits lymphoma were confirmed on viewing slides obtained from sectioning and staining of the specimens in paraffin wax 10 days later by two other senior pathologists.
The resident health professionals felt that this was a more convenient and faster method than the previously used means of sending specimen by courier service. They were also pleased with the fact that their patients would be able to receive a diagnosis within a shorter period without necessarily having to wait weeks or months. Both cadres of staff, that is, the medical doctors and laboratory staff felt they could confidently use the technique if given the necessary guidance and equipment.

IV DISCUSION

This study demonstrates that static telepathology can reduce the biopsy results waiting time from several days to minutes for physicians in a rural and remote African setting. There are still challenges related to the quality of the images in addition to a possible bias from poor sampling. In this pilot, the sampling error was reduced by having the images taken by a final year of pathology postgraduate in training. This was effective as evidenced by the similarity between the results from the touch imprint smears and the paraffin wax blocks. A similar arrangement was used in a larger study in a different setting yielding similar findings of reduced bias if trained individuals sample the images [7].
There were other challenges with the use of digital imagery in static telepathology in a remote rural African setting. Some of these challenges include the slow connection speed, related low bandwidth, lack of standards and appropriate technology to mention but a few [2]. These challenges have led to some authors suggesting the impossibility of using telepathology in its current state in low resource settings [1]. This is related to the additional challenges of acceptance of the tools and the opportunities telepathology has to offer [5].
In our setting, we observe that the resident health professional workers at the selected hospital quickly accepted the use of the tool. One explanation for this rapid acceptance is the greater access to important information for

decision making and patient management. This is especially important in the selected disease condition, burkits lymphoma [12], where one alternative to waiting is to subject the patient to a trial of treatment based on clinical judgement. In the case of the individual with chronic inflammation, this would have been fatal as other disease conditions like tuberculosis would have progressed rapidly and fatally in the immune compromised states associated with the use of anti cancer drugs. This makes the observed distinction between the two conditions in this pilot especially important for ethical patient management. Having quick access to this information improves the quality of patient care. In Africa, most patients with cancer present late for treatment. More often than not coming to the health facility is seen as a last resort in a long journey in search of a cure [12]. By which time the patients' arrive to the health facility, their financial resources are close to exhaustion. Thus, the long wait for the results presents an additional ethical dilemma for the rural practicing health professionals. In such situations access to some form of information is better than no information at all [3], [4]. In combination with other tools telepathology has the potential to further reduce the cost of healthcare in the already poor African communities by providing faster access to critical diagnostic information [13].

The use of routine stains like the haematoxylin and eosin stains and simple but accurate touch imprint cytology [14]-[16] made this method even easier to accept. Other cadres of healthcare professionals can diagnose disease processes if trained. In an article by Chen et al, they found that with the necessary guidance physicians could identify different skin lesions almost as well as dermatologists could [17]. Performance was dependent on the quality of training the physicians received prior to completion of their undergraduate degree. Also those physicians who participated in or had received training in how to make skin biopsies performed better than those that had no such experience. The creation of a locally appropriate digital archive is one of the items needed to make telepathology part of an active continuing medical education program [1], [5], [18]. In this pilot, the resident health professionals were able to produce high quality stained touch imprints, with a bit of guidance.

IV CONCLUSION

These results demonstrate that telepathoogy can be used in a remote and rural African location. While there is a need to directly address the challenges that were identified, more effort will have to be applied to explore the different ways in which these simple technologies can aid patient care in remote and rural African settings. Future potential developments include the creation and validation of a digital image archive and use of clear, simple basic guide lines for appropriate tissue handling.

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