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Original Research Article

Establishing pathology museum in a new medical college: Processes and challenges

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ABSTRACT

Background: A good pathology museum is intended to strengthen the intellectual material for the undergraduate students and visits to a pathology museum are an indispensable part of teaching pathology to medical students. The preservation of anatomy of pathological specimen is of utmost importance as the new successful current methods of therapy are changing the picture of diseases beyond recognition.
Objectives: We aim to elaborate the processes, difficulties and challenges faced in developing and setting up the pathology museum in a nascent medical college in a rural area.
Materials and Methods: The new museum was set up in accordance with the guidelines provided by the National Medical Commission in addition to the guidelines of the state university. Literature search and discussions with other medical colleges all over the country also played an important role in the setting up of the museum.
Conclusions: Our effort is to present our experience as hands on experience for setting up a pathology museum from a scratch for the pathologists, students and the technicians and also to increase the awareness to utilize the museum for innovative and interactive learning sessions for students by usage of QR coded specimens, museum catalogues, interactive E-kiosks and maintaining of log books.

1. Introduction

A museum is an institution where a collection of objects of artistic, cultural, historical or scientific importance are displayed and made available for public viewing.[1] The word "museum" is derived from theancient Greek word mouseion, which denotes a place or temple dedicated to the muses.[2] Anatomical museums like Frederick Ruysch in Amsterdam were first started in the sixteenth and seventeenth centuries.[3] Many general museums involving extension into natural history and physiology were developed by William Hunter, for use in the schools of anatomy in London.[4,5] Medical museums are significant medical tools, particularly in teaching institutions for both undergraduates and post graduates. A good pathology museum is a source of information on many diseases and visits to a pathology museum are a crucial part of teaching pathology to students in medicine.[6] The function of the museum is to deliver a graphic or visual recapitulation of the concepts already taught and to reinforce the subject literary content.[7] The preservation of anatomy of pathological specimen is of prime importance as the new successful currents methods of therapy are changing the picture of diseases beyond recognition. Pathological

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museums are partly historical, depicting the pioneer work of diagnosticians and in part they are becoming museums in the literal sense of the word, presenting records of past states which are not seen now or of conditions of great rarity.[8] For hundreds of years, educational and training programmes conceptualized in pathology museums have played an important role along the path to become a good physician.[9] The exhibitions and displays in the museum should serve pedagogical purpose as well as have an aesthetic appeal. The preparation of a good museum specimen s dependent upon many minor technical points. The role of different methods of collection, preservation and display of museum specimen together constituting 'museum technology' plays an important role.[10]

2. Objective

This article elaborates the difficulties and challenges faced in developing and setting up the pathology museum in a nascent medical college in a rural area and present our experience as hands on experience for setting up a pathology museum from a scratch for the pathologists, students and the technicians. This article also emphasizes that good pathology museum is intended to strengthen the academic resources for the undergraduate students by usage of innovative teaching learning aids like E-kiosks, Quick response (QR) coded specimens, museum catalogues and video library.

3. Materials and Methods

The pathology museum was designated a floor space on the same floor near to the Pathology department for ease of mobility and connect. A space/room of 90 square meters was assigned for the pathology museum in accordance to the National Medical Commission (NMC) guidelines keeping in mind the possibility of further need for expansion in view of additional student capacity and postgraduate students.[11] A room with minimal pillars to avoid interruptions and with good ventilation, light and adequate wall space for the purpose of poster display was selected. Electric sockets with raw power were fixed to the wall where we intended to keep the computers, digital display, microscopes and interactive kiosk, all of which would be used for students learning and assessing purpose. Flood lights were installed to the roof and background lights were installed on the wooden racks for better illumination of the collected specimens and the posters. Wooden racks with glass shelves and background illumination lights were procured to keep the specimen jars (Figure 1). The racks with jars were placed in a strategic way to ensure the optimum utilization of the area of the museum keeping in mind the ease of navigation for visitors. Side slabs were laid for placing microscopes and desktops in student's area with seating capacity of at least 40 students as per NMC guidelines 2020.[11] A table for organ dissection along with digital video camera to visualize the dissection, a projector and a screen along with seating area for students to visualize the projected images and videos/dissection was also arranged in a dedicated area. An ante room/curator room with adequate light and ventilation was designated behind the museum room. The ante room was equipped with a grossing table, area for storage of unmounted specimens, storage of museum related equipments, an exhaust fan and a sink with continuous water supply along with drain for the flow of water and chemicals.

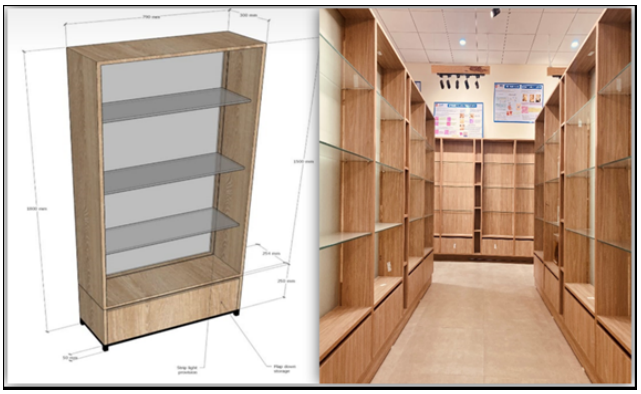

Figure 1: Image of wooden rack

3.1. Collection and preparation of specimens

Majority of preserved specimens were collected from teaching medical colleges and diagnostic centers in and around Bangalore and Ramanagara districts due to lack of adequate number of inhouse specimens in the initial phases of development. Relevant information like history, clinical details and final histopathological diagnosis were also collected from respective centers. Few mounted brain specimens were directly procured from National Institute of Mental Health and Neuro Sciences (NIMHANS) hospital, Bangalore. All the specimens were collected from the respective teaching medical colleges and diagnostic centers by following proper protocols and after signing of memorandum of understanding (MOU) between both the parties. Decent number of specimens were preserved for museum from our institution histopathology lab in the later phases of development. Specimens for mounting were selected and segregated based on how carefully the specimens were handled during grossing and minimally distorted specimens were selected. Universal precautions were taken as per occupational safety and health administration guidelines as all specimens were considered potentially unsafe. Suitable protective measures such as usage of gloves, facemasks and eye gear were undertaken. The contact with chemicals was kept to minimal and the protective gear was disposed of appropriately. All the specimens to be mounted were carefully examined and

system wise names, museum reference numbers and labels were given to those specimens so as to allay confusion. The commonest cause of specimen distortion is contact with tap water which causes hemolysis and drying of specimens which we circumvented by using normal saline to wash the specimens. Specimens were preserved in 10% formalin before mounting. 10% formalin was prepared by following standard protocols [mixing one part of commercially available formalin (40% formaldehyde) with 9 parts of water].[5] Due care was taken while using formalin as it is toxic and known carcinogenic. The International Agency for Research on Cancer (IARC) classifies formaldehyde as a human carcinogen. The sustained exposure to it can cause nasopharyngeal cancer and asthma while acute exposure causes various health-related issues such as irritation on various body parts like mucosal surfaces and skin.[12,13]

Procurement of specimens and transportation was a challenge as our institute was located in a rural area which was almost 30 kms away from the city center. Due to absence of a museum curator, the senior residents and assistant professors volunteered to do procedures like selection and segregation of specimens, preparation of 10% formalin, mounting of specimens using electrical drilling machine, preparation of preservatives (Kaiserling solutions) etc.

3.2. Storage of specimens

The specimens were stored in such a way that it was easy to identify each specimen at a later stage. A reference book along with a desktop museum file was maintained with all necessary details about the specimens like specimen label, clinical details, gross and microscopic description and final histopathological diagnosis. Photographs of fresh and fixed specimens were clicked to assist in documentation of different gross pathology. Specimens were wrapped in cotton and hanged down with thread in a large bucket containing 10% formalin along with specimen labels. The quantity of 10% formalin in the bucket was maintained according to standard protocol for fixation which is approximately 15 to 20 times the size of specimen.[5] Specimens were taken from this bucket as and when mounting was done. The instruments were cleaned post usage and hands were washed regularly to avoid spread of infection.

3.3. Mounting jars

Vendor selection for the museum jars was done after comparing the price, reliability, and quality of the jars. Different sized Perspex jars with lid and Perspex mounting plates were procured (Table 1, Figure 2A). Perspex jars were preferred over conventional and outdated glass jars as they offer many advantages like minimal ridges and distortions, better refractive index, improved transparency, better strength and ability to withhold cracking with temperature changes when sealed.[8,14] Procurement of ideal sized museum jars was often delayed due to covid waves interfering with the logistics for the same.

3.4. Equipment for mounting

Mounting was carried out in curator's room which was well equipped with all the materials required which is listed in Table 2.

The pathologists experienced difficulty in using drilling machines and it took some time for them to get accustomed to usage of drilling machines. There were occasional incidences of cuts and needle stick injuries which were treated immediately by following standard protocols. The possible risks including infections and exposure to flammable, toxic, allergenic or carcinogenic chemicals were curtailed by appropriate tissue fixation of the specimen before grossing.

3.5. Mounting technique

The specimens were inspected carefully after their retrieval from storage and any surface irregularity was recontoured. Specimen edges were trimmed to get proper shape. Specimens like intestine were cut through hollow viscous and cleaned thoroughly to visualize the inner surface. Specimens like cyst wall were cut open for better appreciation of pathology. Friable specimens were handled very carefully. Bile specimens were soaked in saturated solution of calcium chloride for 24 hours.[4] Pins were put on specimens to hold them in position, after which the specimens were placed on a flat bench and placed in anatomical position over appropriately sized Perspex plate. Perspex plate were selected based on specimen size and a minimum of 2 cm clearance was left on both the sides as well as the top and bottom. The bottom clearance was necessary to avoid obscuring part of the specimen while putting the labels. Approximately 5 mm was added for the center plate for the depth of the specimen and a suitable Perspex jar was then selected from stock and labelled. Appropriately sized multiple holes were made in the Perspex plate according to specimen size using Bosch GSB 500W electric drilling machine. The specimens were affixed on to the Perspex plate firmly using sewing needle and nylon thread and transferred to labelled jar of appropriate size subject to availability of jars (Figure 2B)

3.6. Mounting fluid

In 1897, Kaiserling developed widely used museum mounting fluid, which has 3 different solutions with different but specific functions as shown in Table 3. These fluids are widely known as Kaiserling's solution[5]

All the steps should be taken to reduce the danger of formalin to technicians and pathologists. Formalin

Table 1: Size and number of the museum jars procured

S.No.	Sizes of Jars	Quantity
1	20cmX12cmX10cm	80
2	15cmX10cmX5cm	40
3	20cmX15cmX10cm	60
4	10cmX5cmX6cm	20
5	15cmX10cmX10cm	25
6	40cmX20cmX16cm	30
7	30cmX20cmX20cm	30
8	50cmX20cmX15cm	20
9	30cmX20cmX15cm	35
10	30cmX15cmX12cm	35
11	25cmX20cmX15cm	25

Table 2: List of equipments for mounting

S.No.	Equipments	Uses
1	Perspex mounting plates	On which specimen is mounted
2	Electric drilling machine –Bosch GSB 500W 500 RE Corded-Electric Drill, Tool Set with drilling bits	To drill perspex plates, to mount the specimens
3	Long sized sewing needles and nylon thread	For tying specimen firmly to plate
4	Cutting board, various instruments like scissors, forceps, probe, scalpel handle, disposable blades, long-bladed sharp knife, rulers	For grossing of the specimens
5	Thermocol	To stabilize the tissue while cutting and drilling
6	Diamond Marker	For numbering over perspex plate and jars
7	Goggles, surgical masks and hand gloves	For safety measures
8	Kaiserling's fluid	For fixation

Table 3: Kaiserling solution, composition and it's function[5]

	Composition	Function
Kaiserling solution I	Formalin (40%) 400 ml.	Primary Fixation
	Pot. nitrate 30 g.	Preservative
	Pot. acetate 60 g.	Preservative
	Tap water 2,000 ml.	
Kaiserling solution II	Ethyl alcohol 80%	Color restoration of the specimens
	Glycerin 500 ml.	Refractive media
Kaiserling solution III	Arsenious acid 1% 200 ml.	Preservative
	Pot. acetate 250 g.	Preservative
	Thymol 2.5 g.	Inhibits molds (Preservative)
	Formalin 0.5%	Fixative

Figure 2: A: Image of empty museum jars; **B**: Mounted specimen.

used universally for fixation of specimens predisposes to dermatitis with serious effects on the nasal mucosa causing sinusitis.[15] Therefore, a museum mounting room must be thoroughly ventilated and an exhaust fan should be fitted for good air circulation. The protocol for mounting of specimens using Kaiserling solution is as follows: specimens to be mounted should be fixed in Kaiserling solution I for up to two weeks depending on their size, and larger specimens should be injected with formalin. The specimens should be transferred to Solution no. II (80% ethyl alcohol) for color restoration where they should be kept for a maximum of 1 hour with careful observation. Keeping for longer periods leads to the irreversible fading

of the color of the specimens. Finally the specimens should be transferred to jars with Solution no. III which is the mounting fluid. It contains arsenious acid and thymol to inhibit molds and glycerin (an expensive reagent,) for its effect on the refractive index. It is often difficult to get the arsenious acid into solution, but good results are obtained by making up 1% arsenic trioxide in water and steaming the solution for six hours in a steam sterilizer. The thymol is ground up and floated on the surface of the fluid.[5] This technique has been modified by Pulvertaft in 1936, a method of restoring color to tissues by the addition of reducing agent to the mounting medium. Reducing agent used was sodium hydrosulphite and the technique widely known as Pulvertaft-Kaiserling method.[8] Israel & Young (1978) used pure liquid paraffin as the third solution after color restoration with alcohol. This procedure reduces chances of discoloration of the mounting fluid by pigments in the specimen particularly bile-stained specimens.[16]

Getting expensive chemicals like glycerin, arsenious acid and sodium hydrosulphite was difficult for us, so we used limited chemicals temporarily with good results, as follows-

1. Solution 1: 10% Formalin for fixation
2. Solution 2: 80% Ethyl alcohol for restoration of color
3. Solution 3: 10% Formalin along with thymol for mounting

We plan to upgrade these solutions to standard Kaiserling solution once we receive the chemicals. Jars were sealed immediately after mounting and it was made sure that the lid was kept unperforated. Perforation of the lid was necessary with large glass jars to prevent cracking on cooling in winter but is a redundant practice with Perspex jars.

Subsequently, the mounted specimens were arranged as per organ system in an orderly pattern to facilitate visits from other specialties like Surgery, Oncology and Gynecology as well (Figure 3). Clinical histories and Pathology museum specimens are invaluable resources for getting an insight for scientific investigations.

Figure 3: Image of completed museum

3.7. Museum catalogue

A particularly designed museum catalogue for all museum specimen was made which had details of specimen label with final histopathological diagnosis, gross picture of the specimen, microphotographs. Gross and microscopic description was printed on it and laminated along with brief clinical details. 15 copies of this museum catalogue were made available for undergraduate students in accordance with the NMC guidelines.[11] This is useful for students and visitors to have a clear idea about the museum specimens. Subsequently, as an innovative method of teaching learning platform, quick response codes (QR codes) was generated linking to PDF documents of the museum catalogues with gross pathology, microscopy and clinical history concerning the specimens (Figure 4). This is to attract the medical students and fuel their interests towards the pathology museums. An E-kiosk at the museum was set up to guide and help the students. A video library was also set up, with short videos demonstrating important procedures such as frozen sections, grossing of radical specimens, etc. A few DOAP sessions related to museum were planned and the performance of these exercises were documented in practical record book and logbook. Kumar et al also concluded that innovations in Pathological museum are need of the hour for training undergraduate medical students to impart a structured module that enables successful self-guided learning of Pathology.[17]

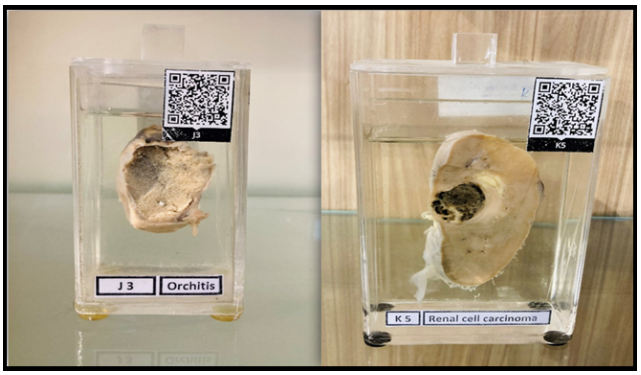

Figure 4: Specimens with QR code

4. Conclusion

The conservation of pathology specimen is of highest importance at present, as the classical picture of diseases is being changed with the application of newer and better methods of treatment. The histologist/pathologist must always keep in mind the need to prepare uncommon or important specimens for permanent preservation and display. Museums in medical colleges have been the cornerstone in imparting knowledge to the medical students since time immemorial, however in addition to the

longstanding time - tested honored method of museum visits by students; there is definite need to incorporate innovative technology-based methods of training involving the usage of museum to train the students and staff. The intent of this article is to provide a reference model to our peers on the overview of establishing a functional pathology museum from its stage of inception. As laboratory physicians involved mainly in academics and diagnostics, our experience in setting up the museum gave insights into various facets of infrastructure, equipment, levels of documentation and techniques required to set up the museum.

5. Conflict of Interest

None.

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