ORIGINAL RESEARCH PAPER

Medical Science

A STUDY OF DESIGN AND LAYOUT OF A TERTIARY CARE APEX GOVERNMENT REFERRAL HOSPITAL

KEY WORDS: Layout, Design, Operation Theatre, Scale of Accommodation , Armed Forces

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ABSTRACT

Background: The operative unit provides a controlled climatic environment for the operative and peri-operative care of patients undergoing diagnostic and surgical procedures under anaesthesia. The introduction of safer practices in anaesthesia, surgical advances, integration of computerization system including robotic surgery has necessitated the modernization of operation theatres. There is a need to improve the layout and design of operation theatres of the armed forces hospitals.
Methods:A direct observational study of Operation Theatre complex of a twenty year old tertiary referral hospital of Govt of India in Delhi built as per Govt approved scales for construction was carried out.
Results: The present lay out is grossly different from the original drawing and lay out is more akin to a single corridor system even though it was meant to be a double corridor system. However the traffic of staff, patient and supplies is not unidirectional. The spaces for some of the areas are very small.
Conclusion: The design constraints which were not visualised at the time of construction, virtually leave no scope of expansion of OT to accommodate new spaces to keep pace with scientific advancements.

Introduction

An operation theatre (OT) is a specialised facility of the hospital where life-saving or life improving procedures are carried out on human body by invasive methods under strict aseptic conditions in a controlled environment by specially trained personnel to promote healing and cure with maximum safety, comfort and economy. Optimal functioning of OT requires an ideal design, layout and efficient engineering services.

The present study was undertaken to study the design and layout of the OT complex of Govt hospital at National Capital and evaluate its status vis-ŕ-vis existing standards especially Govt approved scales for construction.

Materials and Methods

The study was conducted as direct observational study by the author. The venue of the study was the OT of Govt hospital at New Delhi. It was conducted in form of qualitative evaluation of infrastructure and flow of patients, staff and supplies. This was achieved by informal interactions with doctors in charge of OT, Matron in charge of OT and administrative paramedical staff of OT. Discussions were held with engineering services branch and their representatives in the OT. During the study, references were made to Govt approved scales for construction and other existing standards such as HBN 26, Australian standards and JCAHO guidelines related to the topic.

Observation

The OT complex of the hospital is part of the hospital building which was commissioned in the year 1998. There are specialized surgical suites super-specialist surgeries. The other features are as under.

Location: - The OT complex of the hospital is located on the second floor in the A wing. It is a complex consisting of 11 operating rooms. The offices of the anaesthesia department are also located at the same level.

Relationship: - The OT complex is in immediate vicinity of 16 bedded intensive care unit located on the same level. However, laboratory, blood bank are situated a floor below. The radiology department is on the ground floor and CSSD is situated at a floor above. However all these departments are on the same wing of the hospital building and are easily accessible by stairs as well as earmarked lifts.

Types of accommodation, number and size: -Even though OT was originally built on a double corridor model, this seems to have transformed into a single corridor system because of subsequent modifications in OTs. All 11 operating rooms are of different sizes. Six of the OTs have been converted into modular OTs. Each of them have been provided with their own instrument room, store room and scrub room. There was no provision of dirty utility room or exit bay. None of the OTs had any access to natural light. There is no separate casualty or emergency theatre nor is there any septic OT.

Operating Suites: - In the original plan, there were nine major OTs, one minor OT and one casualty OT. While the casualty OT had its own scrub room and instrument room, the rest of the theatres were laid out in the pattern of twin operating suites.. In addition, each OT had its own hatch and dirty wash area merging with disposal lobby. However, over a period of time, all the OTs have been converted into standalone theatres with each having its own instrument room, store room and scrub room. The anaesthetic rooms have been amalgamated with the OTs. More importantly, the dirty wash area has been completely walled off and hatches have been closed. This has made disposal lobby redundant. The minor OT has now been converted into Bionic OT.
Zoning and traffic: - The complex has now turned into a single corridor system, traffic of patients, staff and supplies takes place through the same passage.

Recovery Room:-There is one recovery room with enough space for four trolleys and provision of monitoring stands and pipeline gas outlets. There is no separate communication base, storage space, clean or dirty utility room.

Supporting facilities: - In absence of adequate storage space, the corridor of OT is full of equipments either in use or in a state of maintenance. This led to cramming and posed difficulty in movement of staff and trolleys.

Staff accommodation: - There are separate rooms for various categories of staff.

Dirty utility Room and disposal hold: - This room is located at the entrance just after the preoperative area. This leads to crossing of path of dirty supplies returning from OTs and patients.

Discussion

Possibilities for new surgical treatments and interventions continue to increase as knowledge and technology advance, for example by digitally-based image enhancement, laser technology,

alternative diathermy and argon beamers. There is an increase in the use of intra-operative ultrasound or echocardiography. The size of anaesthetic machines has also increased due to the number and complexity of the integral patient monitoring systems, safety features and record-keeping technology. As well as the need for greater space, flexibility is the key to accommodating this new technology.

There are a number of documents available on the subject, which serve as a valuable resource on OT planning and layout, including Govt approved scales. Being a Govt hospital, it is expected that OT complex of would be designed on the basis of Govt approved scales. However, there appears to be a large gap between the existing standards and the actual OT complex of the hospital.

It is pertinent to mention here that the original drawing of the OT showed 11 OTs and the pattern was that of a double corridor system. However, over the years, various modifications have been undertaken in various OTs in an attempt to convert some of the OTs into modular one. This has totally eliminated the double corridor pattern of the complex affecting traffic significantly and against the norms of acceptable traffic in any OT. This has resulted because several of disposal windows, communication doors etc have been closed by walling them off. The disposal lobby is not being used at all and all the traffic was noted to take place through the pathway used for patients coming for surgery.

The hospital has an authorized bed strength of 950 and is therefore authorized a minimum of 19 OTs. Thus there is a significant shortage of surgical facility and this fact was amply highlighted by the stake-holders since there is pressure on utilization of OTs. In terms of location and relationship, the OT complex is appropriately placed. There was no reception area at the main entrance and the patients were received directly into the preoperative rooms.

As guided by scales of accommodation, floor area authorized per general OT is 42 m2 and that for a super-specialty OT is 56 m2. The OTs were of right size according to current standards. The modular OTs were larger than that recommended by SOA. This was consistent with current approach towards sizes of a theatre. On account of , developments in various types of surgical techniques, a need is being felt for larger operating rooms which previously were around 45-50 m2 and are now more commonly 50-55 m2. The incorporation of real time imaging provided by MRI or CT-scanning during neurosurgical, cardiovascular or orthopaedic surgery has resulted in larger operating rooms in the order of 65 m2 to 75 m2. In many tertiary hospitals specialised operating rooms of 80m2 have been constructed. Imaging equipment which is capable of performing 3D rotational angiography, CT scanning and intravascular ultrasound enable open surgery and endovascular techniques to be employed simultaneously.

The provision of large multipurpose operating rooms is desirable to give flexibility in booking cases to any operating room and this generally means operating rooms of around 65 m2 to cater for the imaging equipment that now accompanies many procedures. Specialised operating rooms are very expensive to build and the debate that follows is the recurrent costs in maintaining these specialised theatre rooms and ensuring the throughputs justify the means. The equipment that is installed in the specialised or hybrid theatres should not impede their use in more standard cases. Whilst the hybrid operating room is yet to be adopted in universally in developing world, it has been implemented in many facilities abroad.

An important aspect of any OT complex is whether it can be expanded in future depending upon emerging needs and changing trends. In the current location, there is no scope of adding rooms which are not existent. Also any expansion is ruled out. In the present OT complex, there were neither anaesthetic rooms nor dirty utility rooms. The provision of anaesthetic rooms immediately adjacent to the operating room has also become a source of controversy.

The recovery room of the present OT complex was extremely small and also had limited holding capacity even though scales provides for sufficient space for recovery room in terms of beds. The other key relationship to anaesthetic rooms and operating rooms is the distance to the recovery area. Currently in Australia there has been an approach amongst Health Planning Architects to have a maximum distance of 65m from the operating theatres to a stage 1 recovery bay.

There is complete violation of the principles of zoning because of the building modifications. The existing layout also does not allow itself for a proper flow of staff, patient and supplies. The OT has two accesses, one through the central gallery of the hospital leading through the anaesthesia department and the other one from the front of ICU. While the former is entry is restricted to consultants, the latter is used for all other purposes. This often leads to overcrowding at the entrance. More significantly, dirty supplies from all the OTs have to be brought out through the same corridor, though there is a separate exit for the same to sluice room. The common passage which led to the main operating room complex was 2.3 metres wide.

The idea of clean and dirty lines or corridors is now replaced by the notion of zones requiring varying levels of cleanliness. Whilst this gives more planning flexibility, it can cause confusion if there is no clear understanding operationally of how functions will be grouped and accessed and by whom during the 24 hour cycle of a typical operating day. The removal of the clean and dirty corridor concept has opened up theatre design to more flexible arrangements of like activities. Needless to say this flexibility requires stringent operational work practices to maintain clean to dirty flows which were previously set up through rigid planning. The flexibility of theatre design enables natural light into the operating room by the removal of the dirty corridor which previously ran around the perimeter.

As per all standards, support rooms are equally important in deciding operating room efficiency. Storage areas are of prime importance especially in view of acquisition of newer, heavier and bulky equipment. There appeared to be gross deficiency of such space in the present OT complex. Most of the equipments were lying in the central corridor which often obstructed movement of men and material.

Layout and design should be such that it allows itself for prompt and complete evacuation in case of any fire hazard or natural calamity. However single entry and exit is likely to make it very difficult in case of any eventuality. There was no proper place for fire extinguishers and hydrants in the lay out plan.

The patient experience is a crucial consideration when designing and building a new operating department. In a study which related to the patient experience and the built environment, patients were asked about their journey to the operating theatre, their reception, experience in the anaesthetic room, in the operating theatre (if conscious) and finally in the recovery unit. Some of the questions were related to the built environment. Majority of the patients viewed as very important being able to maintain their privacy, dignity and confidentiality, being warm and comfortable, and experiencing minimum noise levels in all areas of the department. In similar manner staffs of an OT were asked to identify the factors that influence their morale and performance. Poor working conditions were cited frequently as a cause for dissatisfaction and it was suggested to have better catering facilities on a 24-hour basis, better changing rooms with storage area, more office space, dedicated "smoking" area and more natural daylight.

Summary and Conclusions

Theatre complex design is undergoing change brought on by changes in technology, higher acuity of patients and the change to a more patient focussed delivery of care. The study of the layout and design of OT brings out salient points which are summarised below:-

1. The OT complex shows several deviations from current standards in vogue, even though it was made according to guidelines contained in SOA-2003.
2. Operating suites are adequate in size and some of them are bigger than that authorised in SOA – 2003.
3. There has been complete transformation of pattern of operating suites because of construction of several theatres into modular ones.
4. The number of operating suites is lesser than that calculated by SOA-2003.
5. Each operating suite has been turned into single unit comprising of instrument room, store room without any dirty utility room and exit bay.
6. There is inadequate storage space for medical stores, bulky equipment and there is no clear cut zoning pattern.
7. Recovery Room is very small and is in need of more space as recommended by HBN 26 and SOA 2003.
8. Some of the rooms as authorized in SOA 2003 are non-existent.
9. There is no space for any further expansion to add new facilities such as "admission lounges", "interview room", "endoscope cleaning room" etc.

The design of an operating theatre offers a challenge to the planning team to optimize efficiency by creating conducive environment conditions, realistic functional traffic flow, and flexibility for future expansion. The OT complex of the Govt hospital though built 20 years ago can still absorb new surgical techniques as some of the theatres are large enough to accommodate new technology. There is an urgent need of more number of operating suites; however the flexibility for future expansion is limited because of structural constraints.

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