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COST SAVING WITH ULTRASONOGRAPHY IN A DEVELOPING COUNTRY DISTRICT HOSPITAL

Q. M. Ali, Professor, Dean of the Faculty of Medicine and Health Sciences, University of Omdurman, Sudan, J. Roth, Medical Student, Department of Paediatrics, Medizinische Hochschule Hannover, Germany, I.M. Abdel-Rahim, Professor in Internal Medicine, The Health Centers Directorate, Ministry of Health, Riyadh, Saudi Arabia, D. Franke, MD in Internal Medicine, Kinderklinik Charite, Berlin, Germany, R. Kardorff, Paediatrician, Department of Paediatrics, Medizinische Hochschule Hannover, Germany, H. Schweisfurth, Professor in Internal Medicine, Medical Director of Thien Kliniken, Cottbus, Germany and E. Doehring, Professor in Paediatrics, Interdisziplinäres Therapiezentrum, Feldberg, Germany.

Request for reprints to: Prof. Ekkehard Doehring, Interdisziplinäres Therapiezentrum, Passhöhe 5, 79 868 Feldberg, Germany

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Q.M. ALI, J. ROTH, I.M. ABDEL-RAHIM, D. FRANKE, R. KARDORFF,
H. SCHWEISFURTH and E. DOEHRING

ABSTRACT

Objective: To estimate the potential monetary reduction induced by the introduction of an ultrasound unit in a major district hospital in a developing country.

Design: Propective study.

Subjects: Patients referred with abdominal diseases and pregnancy.

Setting: Wad Medani Teaching Hospital, Central Sudan.

Results: Local specialists referring the patients stated that an estimated 792 radiologic procedures would have been carried out to obtain the same amount of information as achieved by ultrasound. Such procedures budgeted approximately 8100 US dollars, in terms of equipment, material and personnel by 1987 rates. Such savings have benefited all departments of the hospital.

Conclusion: The authors consider this as evidence for the fact that despite its initial high investment (15000 US dollars), availability of ultrasound virtually reduced expenditure on other radiological diagnostic procedures. This is of special benefit for the limited budgets of hospitals in non-industrialised countries.

INTRODUCTION

Increases in the costs of health care have become an issue in the current era of shrinking budgets(1,2). Much has been written about the high costs of radiological procedures in both industrialised and non-industrialised countries. A number of approaches have been suggested to control costs of both the conventional radiological procedures and the proliferating diagnostic modalities(3-5).

Ultrasonography has advanced to replace many conventional and interventional procedures. The aim of the present study was to estimate the potential monetary reduction induced by the introduction of an ultrasound unit in a major district hospital in a developing country.

MATERIALS AND METHODS

The investigations were performed at Wad Medani Teaching Hospital in Central Sudan. It is the largest hospital available for the training of medical students in the University of Gezira and serves population of three million people. During the study period, there were three conventional x-ray machines in the Radiology Department with one dedicated for fluoroscopy without image intensifier or monitor. All were

out of function at the time of the present investigation. Lower Saxony Government of Germany donated an ultrasound machine (Sonoline I300) to the University of Gezira and this was placed in the Radiology Department in October 1986. Details of the ultrasound service in operation since then have been published previously(6).

Eight hundred and sixty three patients from the surrounding rural area of Wad Medani Teaching Hospital underwent ultrasonographic examination between October 1986 and March 1987. Those patients were mostly peasants and had only limited income, even though the area cannot be described as extremely poor in comparison to the rest of Sudan, which is one of the poorest countries in Africa. Frequent indications for referring the 863 patients for ultrasound were hepatosplenomegaly and biliary tract diseases in internal medicine; complications and abnormal clinical findings during pregnancy; palpable abdominal masses and suspected calculi in the renal or biliary system. The gynaecological service asked for diagnostic contribution for uterine masses and suspected ovarian diseases, whereas assessment of hydrocephalus was an important paediatric indication. The referring physicians were interviewed for the alternative procedures for diagnostic work-up of each particular patient in case ultrasound had not been available.

The potential costs of radiologic procedures that were saved, were calculated and averaged from two government hospitals (Wad Medani Teaching Hospital and Soba University

Hospital in Khartoum, Sudan) and a private clinic. The time taken by each technician during the procedure was estimated and expenses were calculated on the basis of the monthly salaries. The costs of radiologists were excluded as they were involved in the sonographic examinations. Conversion to US dollars was carried out according to the official rate of the Sudanese Pound in 1987, at the time when the ultrasound examinations were performed.

As radiological procedures were only done in very few patients (mostly not within the Faculty of Medicine) a direct comparison between the results of ultrasound and x-ray could not be done. Due to lack of other confirmatory tests and laboratory investigations, as well as post-mortem results, a 'final diagnosis' could not be given with certainty. Thus the ultrasound diagnosis, that was arrived at, had to be taken as the reference diagnosis.

RESULTS

Seven hundred and ninety two radiological examinations would potentially have been performed on the 863 patients to achieve the results obtained by ultrasonography (Table 1). A patient might have needed two or three radiological procedures in order to diagnose the underlying health problem. The procedures included plain abdominal x-rays, cholecystogram, intravenous urogram, hysterosalpingogram, barium swallow, barium meal, cystogram, intravenous cholangiogram, percutaneous transhepatic cholangiogram, splenoportogram and plain skull x-rays.

Table 1

Estimated amount of radiological procedures and the respective costs (in US Dollars) saved by introduction of ultrasound to the Wad Medani Teaching Hospital in Central Sudan over a half year period

Radiological procedure	Cost per procedure	No.	Total cost
Plain abdomen	1.34	219	293
Oral cholecystogram	9.76	113	1103
Intravenous urogram	21.22	128	2716
Barium swallow	9.15	50	457
Barium meal	15.24	54	823
Cystogram	20.24	12	243
Intravenous cholangiogram	9.76	42	410
Percutaneous transhepatic cholangiogram	10.24	26	266
Splenoportogram	15.37	84	1291
Plain skull	1.71	5	9
Grand Total		792	8143

The number of procedures saved in five months on 863 patients who were examined and their total calculated costs approximated 8100 US dollars. The most expensive procedures were oral cholecystograms, intravenous urograms and splenoportograms covering around 63% of the total costs on 41% of the patients

investigated. Departmental savings related to 44.7% in Internal Medicine, 33.5% in Obstetrics and Gynaecology, 12.5% in Surgery and 9.3% in Paediatrics and Paediatric Surgery. The patients from Internal Medicine, Obstetrics and Gynaecology constituted over three quarters of the total requests and also those examinations which saved at least one radiological procedure.

One hundred and two patients were diagnosed to have hepatosplenic schistosomiasis. On the basis of sonographical findings concerning periportal fibrosis two separate groups could be discerned. Fifty patients had no clinical symptoms suggestive of the infection and no signs of portal hypertension were found; fifty two patients presented with signs of portal hypertension, mainly haematemesis, and the specific request for sonographical evaluation of portal hypertension was made.

DISCUSSION

According to our results, ultrasonography seemed particularly suited to the compromised budgets of rural and district hospitals of non-industrialised countries. The total potential savings of 8143 US dollars achieved in five months, in the present study, is more than half the costs of the particular machine used (15000 US dollars). Maintenance of the ultrasound machine is inexpensive, referred to in another context(7). Training of personnel is time-consuming and needs a lot of supervision.

Chest and skeleton evaluation are not particularly suitable for ultrasound and were omitted from this study. According to a report of a WHO scientific group(8), approximately 80% of radiological imaging encompassed these examinations on the level of secondary and tertiary health care in non-industrialised countries.

For industrialised countries Margulis(1) pointed out that the utilisation of new technology requires a new approach to radiological examinations by choosing an alternative set of 'algorithms' (specified order of investigations suitable for a particular problem). He found out that before the new advances the radiological work-up of a liver mass would require eight examinations costing 3000 dollars. With new technology it required three examinations, including ultrasound guided biopsy, costing only 850 dollars. Virtama and Dean(9) maintain that the new technology leads to a more dependable diagnosis in a shorter time, reducing the costs of hospitalisation.

In the present study, because other imaging methods were lacking, the presented data fall short of providing information on the real saving of resources when the diagnostic imaging procedures are chosen in accordance with clinical indications centered around the most rational way in order to achieve optimal diagnostic results.

Non-industrialised countries can only afford a limited pursuit of high technology medical care which

must be realistically calculated. Compared to other imaging techniques, ultrasound is inexpensive and when added to an existing basic x-ray unit adds relatively small cost after the initial high investment. This, however, should not detract from the fact that conventional radiology should be used, when ultrasound is not available.

In industrialised countries ultrasound is frequently used as a 'first-line' diagnostic step which induces further more sophisticated diagnostic workup. In non-industrialised countries the same value could be attributed to ultrasound within the spectrum of diagnostic facilities as far as the more sophisticated methods are available. Should this not be the case - like in the scope of the present study - at least as much diagnostic information can be gained as ultrasound provides.

For example, most of the plain abdomen x-ray examinations rendered unnecessary, were obstetrical or gynaecological, being one of the disciplines of maximum utilisation of ultrasonography. The demand for hysterosalpingography declined. The primary importance of ultrasonography has been pointed out during pregnancy as the risk of irradiation to the foetus is eliminated.

Some local problems of the Wad Medani Teaching Hospital included liver and biliary diseases (n=331), schistosomiasis (n=102), monitoring of pregnancy (n=214), renal and urinary disorders (n=159) and abdominal masses (n=69). This can be regarded as a typical spectrum of diseases presented in a rural hospital in a developing country. Ultrasonography of the gallbladder is non-invasive, requires minimum preparation, takes limited time(10) and provides 91% sensitivity and 99% specificity in cholelithiasis(11). Ultrasound has reduced the need for oral cholecystography in gallbladder disease(5).

In the region surrounding the hospital where this study was carried out, the prevalence of schistosomiasis reaches up to 80% in some communities(12). Ultrasonography proved helpful in the demonstration of hepatosplenic abnormalities particularly periportal fibrosis, enlarged spleen, and congested splenic and portal veins.

The results of this study should not be misinterpreted in such a way that the use of ultrasound actually saved the estimated 8100 US dollars, but would rather suggest, that imaging services were potentially improved by a value approximating this amount in terms of conventional radiology. This improvement in diagnostic imaging would be passed on to rural populations in non-industrialised countries to provide more efficient and rational patient care.

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