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The use of theatre time for paediatric dentistry under general anaesthesia

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Objective. The aim of this paper was to determine the use of theatre time for all procedures performed under general anaesthetic on a paediatric dental list.
Methods. A prospective study of paediatric dental general anaesthetic procedures was undertaken at Ninewells Hospital and Medical School, NHS Tayside, Dundee, UK. Data were collected prospectively for 71 operating lists over a 3-year period from April 2003 to March 2006. Both operator status and the procedure being undertaken were recorded. In addition, pre-anaesthetic, anaesthetic, operating and disconnection times were recorded.
Results. Of the 71 lists examined, 61 either finished early or on time, with a median unused time of 32.50 min (interquartile range = 19.50, 50.00 min), whilst 10 lists finished late with a median overrun time of 30.50 min (interquartile range = 9.25, 45.50 min). Comparing lists which finished late with those which were completed within time, the median pre-anaesthetic time was significantly longer (Mann–Whitney *U*-test, $W = 20.05$, $P = 0.048$). Overall, the theatre was in use for 78.22% of time combining pre-anaesthetic, anaesthetic, operating and disconnection times; hence, there was poor time utilization of theatre for 21.78% of the total theatre time.
Conclusions. Overall, 85.9% of theatre sessions for dental procedures under general anaesthetic in children finished early or on time. Where lists finished late, the duration of the pre-anaesthetic time appeared to be the significant factor.

Introduction

Surgical theatres consume a substantial proportion of hospital resource in terms of capital, equipment, drugs and staffing. Whilst there is variation between hospitals as a result of speciality, case-mix and internal financial arrangements, recent figures demonstrate that £1.1 million is required to run an operating theatre for 27 h week. In contrast, the cost to the National Health Service (NHS) of a day-case surgical procedure is £552 per patient[1]. Previous reports have identified that theatres only function for 70% of a normal working week; furthermore, only 70% of scheduled time is actually used[2,3]. Ideally, hospitals should aim to use 90% of planned theatre time[3]. Assessment measures for theatre sessions usage include determining both the number of sessions held and cancelled, as well as the utilization of both available and potential theatre time. Regarding the use of theatre time, two further key aspects of session utilization are planned/actual start and finish times, as well the proportion of cases that are cancelled[4]. Areas where there appear to have been no previous study in paediatric dentistry are the concept of 'lost' operating time during dental general anaesthetic (DGA) procedures, and also, the effect of grade of operator on the duration of the procedure. As such, the aim of this study was to evaluate both the use of theatre time during day-case DGA and the influence of operator status on the utilization of theatre sessions.

Materials and methods

Data were recorded prospectively for 71 operating lists at Ninewells Hospital and Medical School, NHS Tayside, Dundee, UK. These were for a range of dental procedures being undertaken on all patients presenting for dental treatment under general anaesthetic over a 3-year period from April 2003 to March 2006. Data for four operators were collected, including one consultant and three specialist registrars (all in the

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Box 1. Times during theatre.

- *pre-anaesthetic time*: the time between the official start of the operating list or the time that the previous patient was sent to recovery;
- *anaesthetic time*: the time from the start of either intubation or gaseous induction, including connection to the anaesthetic machine and the monitoring devices;
- *operating time*: the time taken to perform the dental procedure;
- *disconnection time*: the time between the end of the operation, and the patient leaving the operating room and entering the recovery room; and
- *total case time*: the sum of all other time periods.

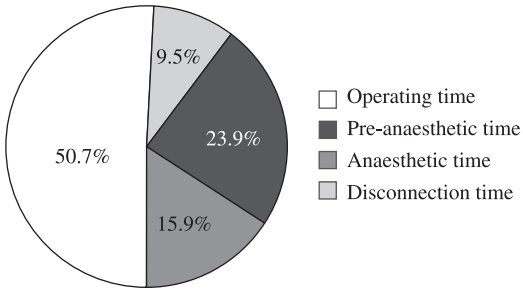

Fig. 1. Operating theatre times recorded and calculated (to mean scale).

first 3 years of Higher Specialist training) in Paediatric Dentistry. Both operator status and the procedure being undertaken were recorded. Procedures were assigned to restorative/extraction, extraction (including, where necessary, suture insertion) and minor oral surgery cases. In addition, the following times were recorded, see Box 1.

Data analysis

All of the above recorded times were rejected as being normally distributed (Kolmogorov–Smirnov test), and hence, median values were calculated and analysed with Mann–Whitney *U*-tests (MINITAB™ Statistical Software, Release 13.31, State College, PA, USA).

Results

Over the time periods examined, 76 lists were allocated, and 71 of these were utilized; five were cancelled because of a shortage of an anaesthetist or anaesthetic nursing staff cover. All theatre lists were scheduled to run for 210 min. Of the lists examined, 61 finished either early or on time, with a median unused time of 32.50 min (interquartile range = 19.50, 50.00 min). In total, 43 lists finished either on time or within 10 min of the end of the scheduled theatre time. In addition, 10 lists finished late, with a median overrun time of 30.50 min (interquartile range = 9.25, 45.50 min). One hundred and ninety-three patients were appointed, and 171 of these presented for general anaesthetic [males = 83, females = 88; median age range = 11.8 years (9.20, 13.90 years)]; 12 patients were cancelled by the parent/guardian, four by the anaesthetist, two by the dental team and one by the medical team, whilst three patients failed to attend for treatment. All lists comprised between one and four patients as follows: one patient = 6, two = 32, three = 31 and four patients = 2. The treatments comprised restorative/extraction (52 cases), extraction (17 cases) and minor oral surgery (102 cases). Examining all of the theatre lists, 50.7% was taken up with operating time, with 23.9% of the overall time comprising pre-anaesthetic time (Fig. 1). Overall, the theatre was in use for 78.22% of the time combining pre-anaesthetic, anaesthetic, operating and disconnection times; hence, there was poor time utilization of theatre for 21.78% of the total theatre time.

Analysis of a 'case' as a unit

When examining the median duration for each of the treatment groups, the operating time component accounted for the greatest proportion of the total time; there were statistically significant differences between the various case types, with times for restorative/extraction being greater than those for minor oral surgery and times for minor oral surgery being greater than those for extraction (Table 1). When comparing the overall treatment time, there was a statistically significant difference between the mixed restorative/extraction cases, and both the extraction and minor oral surgery cases (Mann–Whitney *U*-test, $W = 1740.0$, $P = 0.0013$ and $W = 4032.0$, $P = 0.0004$, respectively). There was, however, no statistically significant difference between extraction and minor oral surgery cases (Mann–Whitney *U*-test, $W = 762.0$, $P = 0.185$).

Table 1. Use of theatre time for paediatric dentistry: median values are given with the 25% and 75% quartiles in parentheses. A comparison of operating times between groups revealed statistically significant differences, as indicated by the superscript letters.

	Time (min)		
Stage	**Restorative/extraction**	**Extraction**	**Minor oral surgery**
Pre-anaesthetic	12.0 (5.0, 23.0)	18.0 (7.5, 25.0)	15.0 (7.8, 25.0)
Anaesthetic	10.0 (7.0, 15.0)	10.0 (5.0, 10.0)	10.0 (5.0, 15.0)
Operating	44.0 (30.0, 60.0)[a]	15.0 (5.0, 32.5)[b]	30.0 (18.5, 40.0)[c]
Disconnection	5.0 (5.0, 10.0)	5.0 (3.5, 5.0)	5.0 (3.0, 6.5)
Total	80.0 (60.0, 95.0)[a]	50.0 (37.5, 67.5)[b]	60.0 (45.0, 80.0)[b]

[a]Restorative/extraction versus extraction ($W = 1803.5$, $P = 0.0001$). [b]Restorative/extraction versus minor oral surgery ($W = 4062.0$, $P = 0.0001$). [c]Extraction versus minor oral surgery ($W = 596.0$, $P = 0.0081$).

Table 2. Use of theatre time for paediatric dentistry: median values are given with the 25% and 75% quartiles in parentheses.

	Time (min)			
Operator	**All treatments**	**Restoration/extraction**	**Extraction**	**Minor oral surgery**
Specialist registrar	35.0 (21.3, 55.0)	45.0 (30.0, 55.0)	27.5 (20.0, 82.5)*	32.5 (21.3, 53.8)
Consultant	30.0 (16.0, 45.0)	44.0 (30.0, 60.0)	15.0 (5.0, 25.0)	30.0 (16.0, 40.0)

*$W = 54.0$, $P = 0.048$.

Analysis of an operating list according to treating personnel

Comparing operators, there were no statistically significant differences for either mixed/restorative or minor oral surgery cases. The median consultant operating time for extraction cases, however, was 15.00 min (5.00, 25.00 min), whilst the median time for the specialist registrar grade was 27.50 min (20.00, 82.50 min). This difference did attain statistical significance (Mann–Whitney *U*-test, $W = 54.0$, $P = 0.048$) (Table 2).

Analysis of an operating list as a unit

Comparing those lists that either finished on time or early ('early lists') with those that overran ('late lists'), two further points emerged. First, the pre-anaesthetic time component of the 'late lists' [20.00 min (10.00, 30.00 min)] was significantly greater than that associated with the 'early lists', which was 15.00 min (5.00, 20.50 min) (Mann–Whitney *U*-test, $W = 2050.0$, $P = 0.048$). Secondly, the median total time of 'late lists' [85.00 min (60.50, 110.25 min)] was also significantly greater than the median total time of the 'early lists' of 60.00 min (50.00, 81.50 min) (Mann–Whitney *U*-test, $W = 2385.0$, $P = 0.006$). There were no statistically significant differences between any other time periods when comparing those lists that finished early with those that overran (Table 3).

Table 3. Use of theatre time for paediatric dentistry, comparing 'late' and 'early' lists: median values are given with the 25% and 75% quartiles in parentheses.

	Time (min)	
Stage	**Early list**	**Late list**
Pre-anaesthetic	15.0 (5.0, 22.8)	20.0 (10.0, 30.0)*
Anaesthetic	10.0 (5.0, 15.0)	10.0 (7.8, 14.3)
Operating	30.0 (20.0, 45.0)	35.0 (15.8, 67.5)
Disconnection	5.0 (5.0, 5.0)	5.0 (1.3, 10.0)
Total	60.0 (50.0, 81.5)	85.0 (60.5, 110.3)**

*$P < 0.01$; **$P < 0.001$.

Discussion

The aim of this study was to determine the utilization of theatre time over a 3-year period, with data available for all lists that were

appointed. Of these lists, 88.6% of patients scheduled for theatre underwent DGA, with data loss being caused by a combination of cancellations both by parents/guardians, as well as various members of the anaesthetic and medical/surgical teams. One previous study examining the extent of oral and maxillofacial surgery cancellations over a 12-month period determined that 31% of planned operations were cancelled[5]. With the exception of public holidays and theatre maintenance days, the commonest reasons for cancellation within this discipline included financial cut-backs, nursing staff shortages and failure of patients to attend[6].

Clearly, where case cancellation is identified as a problem, actions need to be taken, and it has been suggested by the Accounts Commission for Scotland that consideration should be given to the introduction of pre-admission clinics, maintaining a list of patients who can attend at short notice and requesting that patients confirm their intention to attend for their procedures[4]. Indeed, evidence suggests that the use of pre-admission clinics, in one study at least, increased attendance for surgery to 87%. Furthermore, nearly three-quarters of pre-admission clinic nonattenders were removed from the waiting list[7].

Analysis of a 'case' as a unit

Comparing case types, the operating time component accounted for the greatest proportion of the total time/patient experience. The order of operating time for the different case types was as follows: restorative/extraction was greater than minor oral surgery, which was, in turn, greater than extraction cases. Given the time constraints of a theatre list, knowledge of the expected length of procedure types for individual cases should, in theory, allow the optimal utilization of each session. Previous authors have demonstrated that both a pre-admission clinic, and also, the use of a grading system to estimate the anticipated duration of operating time, increased theatre utilization from 70% to 98%, in addition to increasing the number of day-case patients seen on a theatre list[8]. Regarding the current study, for children for whom adequate dental assessment pre-operatively is difficult, the exact treatment needs and associated duration can only be estimated. If patients, however, can be categorized pre-operatively (e.g. extraction or restorative case), this should aid theatre planning. Further factors to be taken into account when planning sessions are both the duration and variability of the pre-anaesthetic time. Concerning the variable pre-anaesthetic time seen amongst and between lists in this study, delays were noted in patients being transported from the ward to theatre following premedication. In addition, a significant pool of anaesthetic nurses staffed the dental list, and it is possible that unfamiliarity of these staff with both the layout and procedures involved in day-case/inpatient paediatric DGA may have increased the pre-anaesthetic time. Such difficulties could be overcome by relocation of the sessions to the main theatre suite, adjacent to the paediatric wards. In addition, a dedicated core 'team' of anaesthetic nurses trained specifically for DGA lists could alleviate unfamiliarity with both surroundings and techniques.

Analysis of an operating list according to treating personnel

Comparing operators, there were no statistically significant differences for either mixed/restorative or minor oral surgery cases, although the median consultant operating time for extraction cases was lower than that of the specialist registrars. The reasons for this are unclear, although difficulties with haemostasis and suture placement could have been contributory factors. There are no similar, comparative studies, although other authors have determined that the grade of anaesthetist impacted on the length of a case[5].

Analysis of an operating list as a unit

Overall, 86% of lists finished either on time, or early, whilst the remainder overran. Those lists which finished early included those where patients had either cancelled or failed to attend for DGA. Regarding those lists that finished late, a previous study identified the late running of lists when dentoalveolar procedures were undertaken with general anaesthetic, with lists overrunning in 27% of cases. In this

case, the authors suggested that one method of reducing late running lists would be to limit the list to four cases (for surgical dentistry procedures)[5]. Previous authors, however, have determined that difficulties arise with theatre time utilization when clerical staff select and appoint patients based on a fixed number of cases on each session[8]. As such, it has been suggested that improved use may be made of theatre time by appropriate case selection; for example, using a grading system which estimates the anticipated duration of operation time[8]. In the present study, the principal factor responsible for lists overrunning was the pre-anaesthetic time. This is an area where efficiency could be improved; for example, by sending for patients sooner, increasing the number of porters and the establishment of a 'core' team of staff for theatre sessions. Recording actual start and finish times of individual sessions that can be compared and analysed with planned timings would identify where sessions under- or over-run regularly. Where problems are identified, then the reallocation of theatre sessions should be considered, in conjunction with the theatre users' committee[4].

In conclusion, the majority of lists in the present study finished either early or on time. Routinely, the total operating time accounted for just over 50% of the overall time available, with nearly one-quarter of the time being taken up by pre-anaesthetic time. These results provide a baseline for comparison with other centres. Given that health boards incur costs regardless of whether theatre time is used, the avoidance of wasted time and maximization of operating time should help to reduce the pressure on waiting lists. Studies such as this may help to identify areas in which time may be more efficiently used and may confirm best practice.

What this paper adds
- Data of theatre usage time for paediatric dentistry under general anaesthesia.
- Confirmation that the operating time accounted for the greatest proportion of total theatre time.

Why this paper is important to paediatric dentists
- Data for use of theatre time allows comparison with other Units.
- Knowledge of theatre time usage should allow optimal utilisation of operating time.

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