The Turkish Journal of Pediatrics 36: 11-19, 1994

EPIDEMIOLOGY IN PEDIATRIC ANESTHESIA
A Computerized Survey of 10,000 Anesthetics*

*Zeynep Esener MD***, Emre Üstün MD****

SUMMARY: Esener Z, Üstün E. (Department of Anesthesiology, Ondokuz Mayıs University Faculty of Medicine, Samsun, Turkey). Epidemiology in pediatric anesthesia. Turk J Pediatr 1994; 36: 11-19.

The practice of anesthesia in 10,000 children was analysed and evaluated with the aid of Epi-Info, Version 5. There were 545 newborns, 1573 infants, 3147 children between the ages of 1 and 5 years, and 4735 children between the ages of 6 and 15 years. Female: male ratio was 1:1.9. In 92% anesthesia was provided for surgical and in 8% for diagnostic procedures. The most common sites of surgery were head and neck (19%), eye (12%), genitalia (9%) and inguinal region (8%). The type of admission was elective in 76%, emergency in 16% and outpatient in 8% of patients. The distribution within the ASA classes was 92% in I, 4% in II, 2.7% in III and 1.1% in IV + V. Premedication was given to 66% of cases. 98.5% had a general anesthetic and the remaining were given regional blocks. Induction was carried out with intravenous agents in 59% and maintenance with inhalational agents in 92%. The use of muscle relaxants was 82%, mainly succinylcholine followed by vecuronium. Endotracheal intubation was done in 86% of cases, with serious difficulties in 1.3%. 91% of the newborn babies were intubated, 2.8% with difficulty. 9.2% had blood transfusions. There were serious complications in 4.4% and 28 cardiac arrests, of which 20 were successfully resuscitated. Epi-Info, Version 5 was found satisfactory for epidemiological analysis and evaluation in anesthesia, and the information obtained with its aid was discussed in light of published data. *Key words: pediatric anesthesia, epidemiology, computer programs, Epi-Info.*

The practice of pediatric anesthesia and its autcome in 10,000 children were evaluated with the aid of Epi-Info, Version 5, a general-purpose computer program designed to facilitate the management and analysis of epidemiological data[1,2]. Various computer-based schemes especially for record-keeping as well as retrieval and analysis of information from large and multi-centre series have been used[3-7]. Epi-Info, the program utilized in this study, contains modules for: defining data entry screens; setting data entry validation checks; performing data entry and update; and producing summary analyses. There are five versions in this family, of which Version 5 was used in this survey.

* From the Department of Anesthesiology, Ondokuz Mayıs University Faculty of Medicine, Samsun.

** Professor of Anesthesiology, Ondokuz Mayıs University Faculty of Medicine.

*** Associate Professor of Anesthesiology, Ondokuz Mayıs University Faculty of Medicine.

Material and Methods

A set-up based on Epi-Info, Version 5 was prepared for obtaining a suitable set of statements to describe the patient's history and anesthetic management. Forty-three parameters (Table I) obtained from the anesthetic records of 10,000 children betwen the ages of 0 and 15 years, given anesthetic over a 10 year period (1981-1991), were fed into 11 entry screens and analysed. Entry of each record took three minutes. Results of the analysis and evaluation of information so obtained were presented and discussed in light of published data.

Table I: Parameters Arranged in 11 Entry Screens and Fed Into Epi-Info for Each Patient

1. Date
2. Name
3. Surname
4. Protocol no
5. Sex
6. Weight
7. Diagnosis
8. Surgical Department
9. Type of surgery
10. Site of surgery
11. Type of admission (E, EM, OP)
12. ASA classification
13. Presence of CED
14. Type of CED
15. Blood group
16. Premedication
17. Anesthetic technique
18. Gas conduit (tube, mask, tracheostomy)
19. Type of intubation
20. No of endotracheal tube
21. Difficulty in intubating
22. Cause of difficulty
23. Type of induction
24. MR at induction
25. MR for maintenance
26. Inhalational agent
27. iv anesth for maintenance
28. iv analgesics for maintenance
29. Type of regional block
30. Local anesthetic used
31. iv fluids
32. Amount of blood transfused
33. Methods of monitorization
34. Type of CVS complication
35. Type of R complication
36. Other complications
37. Complication at recovery
38. Duration of anesthesia
39. Surgical position
40. Anesthetist (supervising)
41. Anesthetist (junior)
42. Notes

E : Co-existing disease.
EM : Elective.
OP : Emergency.
CED : Outpatient
MR : Muscle relaxant.
CVS : Cardiovascular.
R : Respiratory.

Results

The annual number of operations increased as the provision of surgical and anesthetic services increased in our hospital. The overall percentage of children in the total number of patients given anesthesia was 30.6.

Distribution of Age and Sex : There were 545 (5.5%) newborns, 1573 (15.7%) infants, 3147 (31.5%) children between the ages of 1 and 5 years, and 4735 (47.3%) children between the ages of 6 and 15 years. The overall female to male ratio was 1:1.9 (3469 vs 6531).

Types and Sites of Procedures : In 92% of the children, anesthesia was provided for surgical interventions, and in 8% for diagnostic procedures such as examinations, radiological or endoscopic investigations. The common sites of surgery are shown in Fig. 1. The majority of the operations were carried out by the Pediatric Surgery, Ear, Nose and Throat, Ophthalmology and Orthopedics Departments. The distribution of elective, emergency and outpatient cases was 76%, 16% and 8%, respectively.

Preoperative Clinical Status : Patients were classified according to their general conditions based on the classification of the American Society of Anesthesiologists (ASA)[8] as follows; (I) A normal healthy patient; (II) A patient with a mild systemic disease; (III) A patient with a severe systemic disease that limits activity but is not incapacitating; (IV) A patient with an incapacitating disease that is a

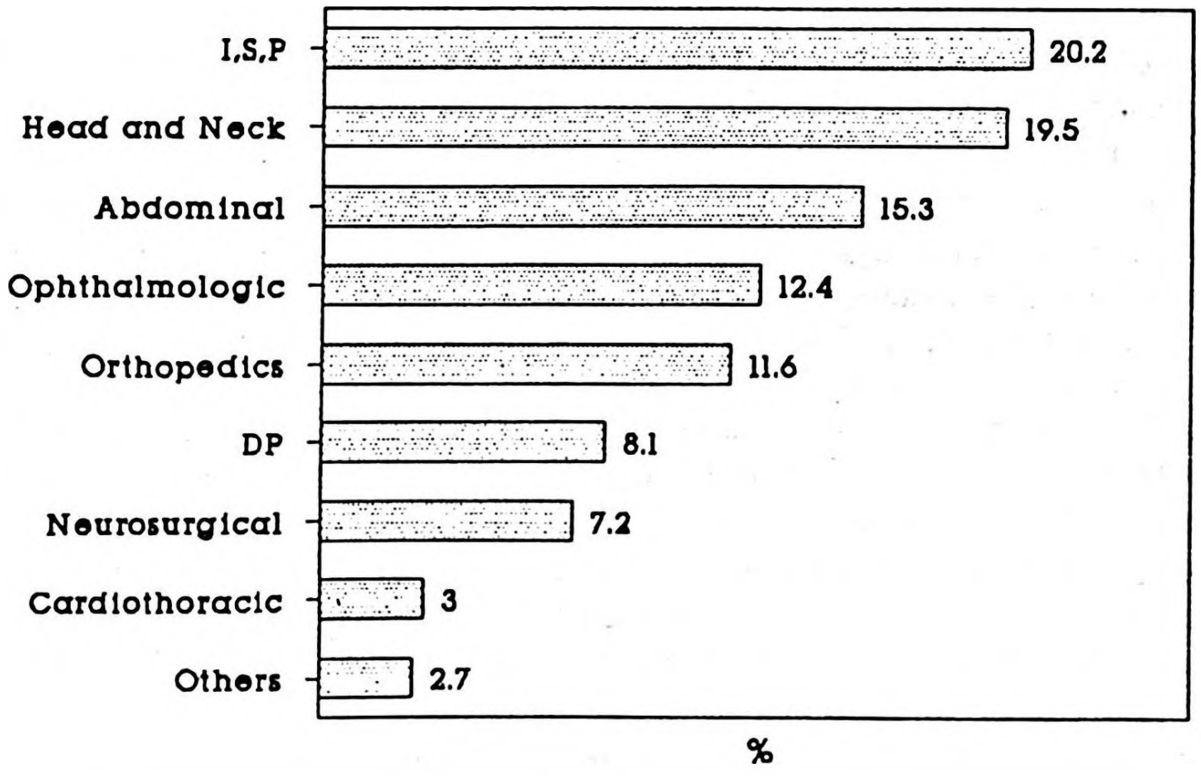

Fig. 1: Sites of surgery (I,S,P inguinal, scrotal and perineal, DP diagnostic procedure).

constant threat to life; and (V) A moribund patient not expected to survive 24 hours with or without an operation. ASA classes were recorded in 9418 patients. The distribution of these patients to the ASA classes were 92% in I, 4% in II, 2.7% in III and 1.1% in IV + V. Table II shows the distribution of ASA classes by age. In 7% of the children, co-existing diseases involving major systems were present.

Table II: Distribution (%) of ASA Classes by Age (ASA Class was Recorded on The Anesthetic Chart in 9418 Patients Out of 10,000)

ASA Class	Newborn	Infant	1-5 Yr	6-15 Yr	Total	
I	89.7	92.0	92.0	92.2	92.1	(8671)
II	6.2	4.3	4.2	3.7	4.1	(386)
III	2.9	1.8	2.5	3.0	2.7	(252)
IV-V	1.2	1.0	1.3	1.1	1.1	(109)

Premedication : 66% of the children were premedicated with various agents. In these children, overall use of atropine was 67%, decreasing to 33% in 1991, and there has been a substantial increase in the use of sedative and anxiolytic drugs over the years.

Type of Anesthetic : 98.5% of the patients had general anesthetic only. The remaining had regional blocks, mainly caudal combined with general anesthesia or sedation. Mean duration of anesthesia was 80 ± 62 minutes.

Induction and Maintenance of Anesthesia : Induction was carried out with various intravenous agents in the majority of children (59%), mainly with thiopental (50%) followed by ketamine (7%). Use of inhalational anesthetics, mainly halothane (40%), for induction decreased with age, whereas maintenance was carried out mainly with inhalational agents (92%). Overall distribution of the use of halothane, isoflurane and enflurane for maintenance were 90.7%, 5.1% and 2.8%, respectively. Unless a contraindication was present, nitrous oxide was used routinely in these patients.

Muscle Relaxants : The overall use of muscle relaxants was 82%, mainly succinylcholine followed by vecuronium. Succinylcholine was used in 94% (n = 7607) of these children to aid endotracheal intubation and in 35% (n = 3392) during maintenance.

Endotracheal Intubation : was done in 86% of children, orally in 99.6% of cases. In the remaining patients, gas conduit was provided by a mask, a tracheostomy

tube or a bronchoscope. Forty of the 545 (7.3%) newborns were intubated awake. In 108 (1.3%) children, serious difficulties were encountered during laryngoscopy and intubation. Ninetyone percent of the newborn babies were intubated, 2.8% with difficulty. Causes of difficulty and their distribution by age are shown in Fig. 2. Four major causes of difficulty in order of appearance were epiglot obtructing the view (25%), soft tissue tumors or injuries (13.4%), restricted movement of jaw and neck (9%) and short, thick neck (5.4%).

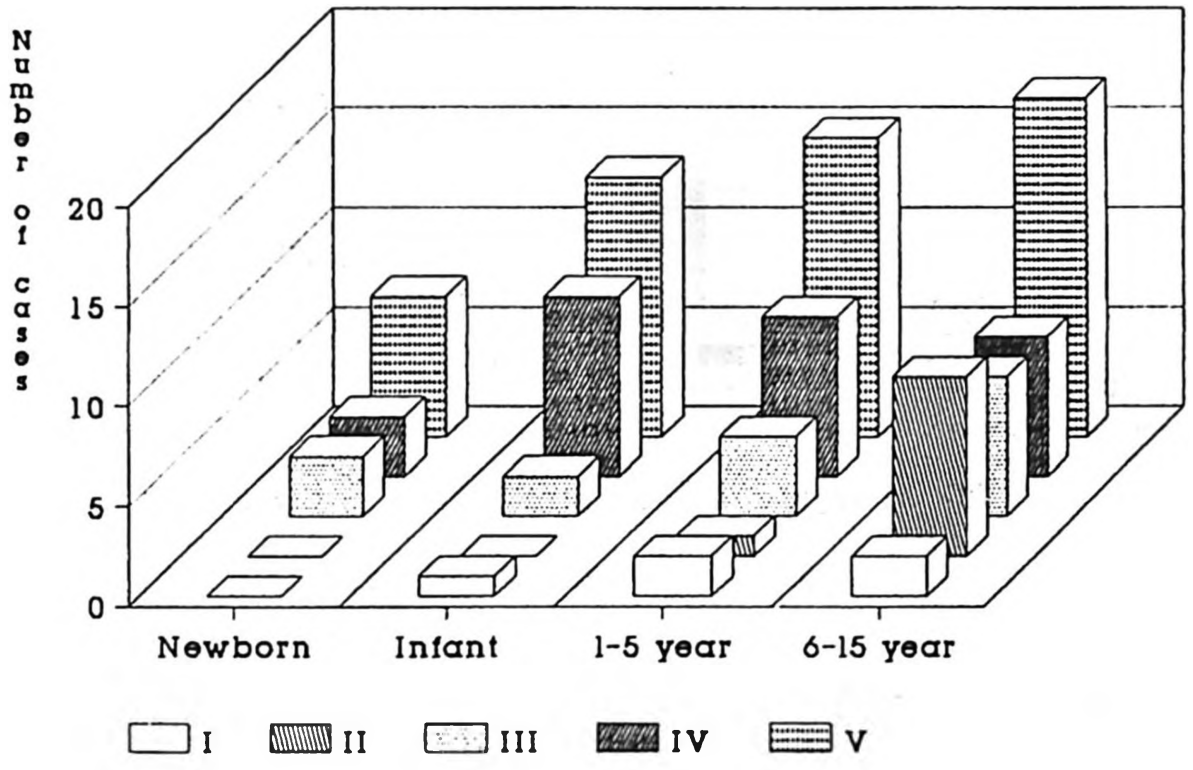

Fig. 2: Distribution of the causes of difficulty in intubating. I. Short, thick neck, II. Soft tissue tumors or injuries, III. restricted movement of jaw and neck, IV. problems arising from epiglot, V. others or unspecified.

Intravenous Fluids and Blood Transfusion : All the patients had an IV drip either before or after induction of anesthesia, and 9.2% of the patients had an intra-operative blood transfusion.

Complications and Mortality During Anesthesia : In 4.4% of the cases there were serious complications, mainly circulatory (66%) followed by respiratory problems (14%). In 7% (n = 32) of these children, anaphylactoid or allergic reactions were observed (Fig. 3). During anesthesia there were 28 cardiac arrests, of which 20 were successfully resuscitated. All of the 8 peri-operative deaths (two newborns, one infant, and five in the 1-5 year age-group) occurred in ASA class III or higher, and operations performed on these patients were major (intracranial in four,

abdominal in one and cardiac in three). The incidence of perioperative mortality and complications in our series was also higher among emergency procedures (0.184%) compared to elective and outpatient cases (0,066%) (Fig. 4).

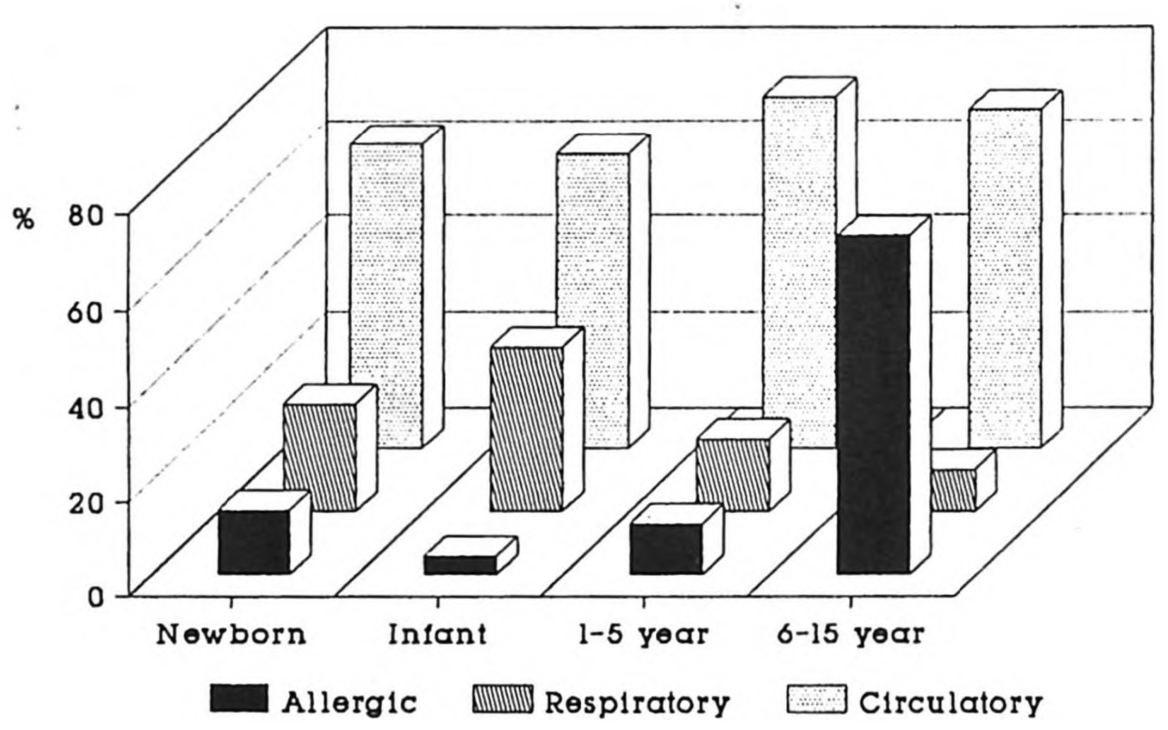

Fig. 3: Distribution of complications by age.

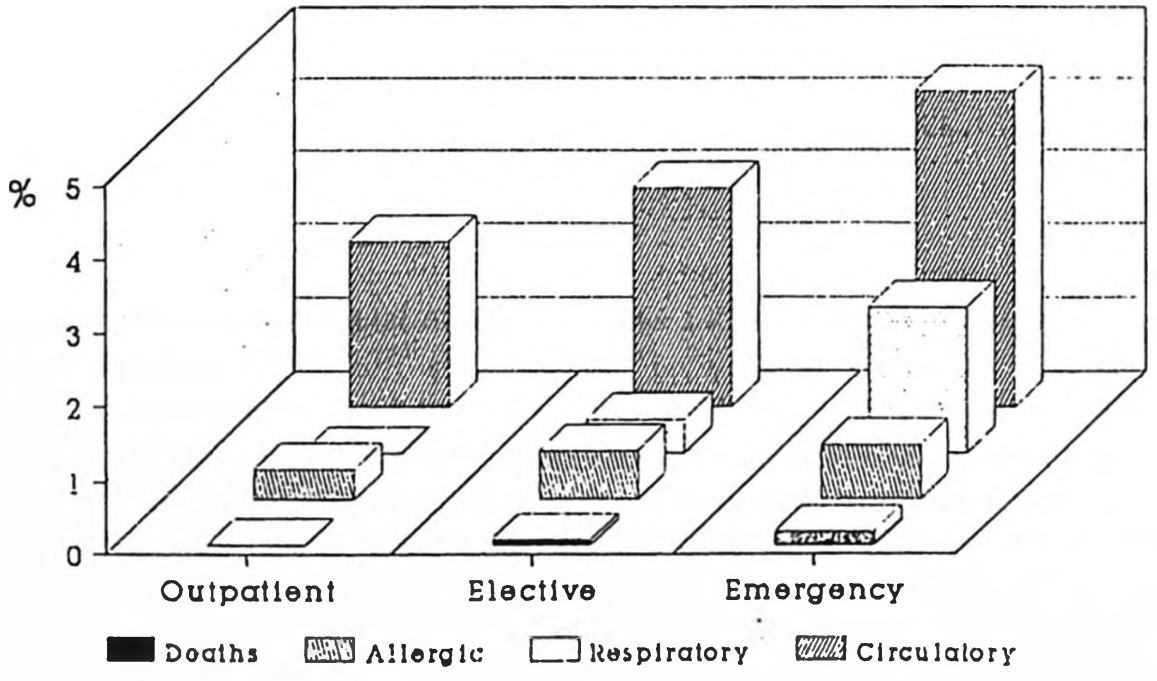

Fig. 4: Distribution of deaths and complications by the type of admission.

Discussion

Although various computer-based schemes for record keeping as well as retrieval and analysis of information from large and multi-centre series have been used, Epi-Info program, set up to meet our record-keeping standards was found to be easy, fast and satisfactory for data retrieval and analysis. Apart from containing modules for defining data entry screens, performing validation checks, facilitating data entry and update, and producing summary analyses, Epi-Info can also convert its files to other data file formats including dBase III, Lotus 1-2-3, Statistical Analysis System, and Statistical Package for Social Sciences PC formats or vice versa. There are five versions in this family, and the programs are in the public domain and may be copied freely. In order for any decision-making process to be computer-assisted, it is necessary for the information to be encodable in some way so that the computer can manipulate the data using logical operations. In this study, the information used to generate an anesthetic regimen included 43 parameters arranged in 11 entry screens for obtaining a suitable set of statements to describe the patient's history and anesthetic management. This set-up can be arranged to suit the needs and the protocol of any anesthetic department.

In our series, children comprised more than 30% of the patients. This may be due to the early establishment of the Pediatric Surgical Department in our newly founded Medical School.

The practice of premedication has changed over the years. Routine use of atropine, seen in 67% of cases in the total sample, was reduced to 33% of the children during the last year. There was a substantial increase in the use of sedatives and anxiolytics such as the butyrophenone and benzodiazepine drugs.

The choice of anesthetic technique was general anesthesia in the majority of patients. But the use of regional blocks combined with sedation or light general anesthesia is increasing. In our series, regional block was utilized in 1.5% of the children. Tiret et al[9] also reported 0.5% regional anesthesia in this age-group. The majority of the children had an intravenous agent for induction and an inhalational agent for maintenance. Although the use of halothane for maintenance was still approximately 90%, this percentage has decreased with the availability enflurane and isoflurane. Overall use of muscle relaxants was 82%, mainly succinylcholine followed by vecuronium. Succinylcholine was used in 94% of these children to aid endotracheal intubation and in 35% during maintenance. Due to concerns about its side effects and the availability of newer, fast-acting, medium-duration, non-depolarizing agents, use of succinylcholine has decreased considerably during recent years. The endotracheal intubation rate was higher in the newborn group (91% compared to 86% in the total pediatric population) and was associated with a higher incidence of difficulty (1.3% vs 2.8%). Unfortunately in nearly half of the cases, the cause of the difficulty was not noted. Although 7.3%

of the newborn babies were intubated awake, during recent years this practice has been limited to babies in very poor condition or to times when the anesthetist is not confident that intubation can be achieved without hypoxia.

Accidents were traditionally considered more common in children than in adults, but anesthetic morbidity and mortality in children have been lowered dramatically in recent decades. However, it is difficult to make comparisons between the series due to the differences in definitions, especially of "anesthetic death". The rate of anesthetic mortality in children has been reported to be 0.2 in 10,000[10], 0.7-1.3 in 10,000[11], and 1 in 40,000[9]. But the patients in these series were predominantly ASA class I and II. Other studies have reported overall anesthetic death rates in children as 12.8 per 10,000 operations, and one for every 300 children in ASA class III-V[12], whereas Hickey et al[13] report no anesthetic-related deaths in 500 children, the majority of whom were in ASA III-V. In our series the frequency of complications and deaths was closely related to the ASA grades and co-existing diseases. All of the perioperative deaths occurred in children with ASA class III or higher undergoing major surgery. The incidences of perioperative mortality and morbidity in our series were also higher in emergency procedures compared to elective cases.

Conclusion : The records and computer programs used in this study were found satisfactory for epidemiological research and capable of many more applications, and the data so obtained were found to be in accordance with current literature in pediatric anesthesia.

REFERENCES

1. Burton AH, Dean JA, Dean AG. Software for data management and analysis in epidemiology. World Health Forum 1980; 11: 75-7.
2. Dean Ag, Dean JA, Burton AH, Dicker RC. Revised Manual. Epi-Info, Version 5: a word processing, database, and statistics program for epidemiology on microcomputers. USD, Incorporated, Stone Mountain, Georgia, 1990.
3. Bender HJ, Osswald PM, Hartung HJ, et al. Use of computer technology in training assistants in the anaesthesia department. Anaesthetist 1985; 34: 516-21.
4. Harrison MJ, Johnson F. Codifications of anaesthetic information for computer processing. J Biomed Eng, 1981; 3: 196-9.
5. Hartung HJ, Osswald PM, Lutz H. Computerized evaluation of intraoperative complications during intubation anaesthesia, spinal-and peridural analgesia. Anaesthetist 1982; 31: 6-9.
6. Olsson GL, Hallen B, Hambraeus-Jonzon K. Aspiration during anaesthesia: a computer-aided study of 185, 358 anaesthetics. Acta Anaesthesiol Scand 1986; 30: 84-92.
7. Waldron HA, Cookson RF. Use of a viewdata system to collect data from a multicentre clinical trial in anaesthesia. Br Med J 1984; 289: 1059-61.
8. American Society of Anesthesiologists. New classification of physical status. Anesthesiology 1963; 24: 111.

9. Tiret L, Nivoche Y, Hatton F, et al. Complications related to anaesthesia in infants and children. Br J Anaesth 1988; 61: 263-9.
10. Downes JJ, Raphaely RC. Anesthesia and intensive care. In: Ravitch MM, Weleh KJ, Benson CD, et al (eds). Pediatric Surgery (3rd ed) Vol: 1. Chicago: Year Book Medical Publishers; 1979: 1-12.
11. Smith RM. Anesthesia for Infants and Children (4th ed), St Louis: CV Mosby Co; 1980: 657-9.
12. Wilson RD, Traber DL, Priano LL, et al. Anesthetic management of the poor risk pediatric patient. Southern Med J 1969; 62: 767-72.
13. Hickey PR, Hansen DD, Norwood WI, et al. Anesthetic complications in surgery for congenital heart disease. Anesth Analg 1984; 63: 657-64.