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Original Article

Assessment of Some Public Hospitals in Turkey Regarding Anaesthetist, Anaesthesia and Intensive Care Equipment

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Abstract

Objective: Every year, 230 million patients undergo major general surgery with anaesthesia worldwide, and 7 million resulted with major complications. Monitorisation and equipment has a great role in increasing patient safety and safe surgery during anaesthesia.

Methods: Turkey is divided into 12 Eurostut-NUTS regions and 26 subregions statistically. Totally, 303 hospitals that are included in these regions were enrolled in this descriptive trial. The hospitals were contacted by telephone between October 2012 and August 2013. Data collecting forms were e-mailed to any of the anaesthetists or anaesthesia technicians of the hospital and they were requested to fill the forms and forward them to one of the investigators.

Results: Data were obtained from 221 of 303 hospitals (73%). Twenty-three hospitals were tertiary (university and education and research), 21 were city and 177 were county hospitals. No anaesthetist, operating rooms or intensive care units were available in 114 of the county hospitals. Anaesthetists were responsible for 61% of these active working theatres. Electrocardiogram, heart rate, non-invasive blood pressure and saturation could be monitored in 97% of them. End-tidal carbon dioxide could be monitored in 91% of at least one operating room in these hospitals. However, if the subject became to end-tidal carbon dioxide monitoring in every room, this ratio decreased to 63%. Defibrillators were absent in 6% of these rooms. Adult intensive care units were available in 33% of the hospitals and paediatric intensive care units were available in 32.4%; the responsibility of these intensive care units were carried out by anaesthetists at a 91.4% ratio. End-tidal carbon dioxide could be monitored in 54% of these units; invasive monitorisation could be applied in 68.4% if needed.

Conclusion: It was observed that hospitals have different standards according to their infrastructures of anaesthesia and intensive care unit equipment. We think that the elimination of these differences is an important step with respect to increasing patient safety and enhancement of the service quality in hospitals.

Keywords: Anaesthesia, intensive care unit, operating room, monitor, airway, equipment

Introduction

Every year, major surgical intervention under anaesthesia is performed on 230 million patients worldwide, with severe complications occurring in 7 million of them. The key medical associations of various countries representing the anaesthesiology medical came together on 13 June 2010 and signed the Helsinki Declaration to enhance patient safety (1). This suggested that monitoring standards for patient safety should be in accordance with the major anaesthesia monitoring standards determined by the American Anaesthetists Association (ASA) (2). As most anaesthesia-related deaths arise from problems with intubation or extubation (3), it was also the commonly held view that one or more anaesthesiologists should always be available, if possible, together with an anaesthesia team and also adult and paediatric compatible anaesthesia devices, monitors, an infusion pump, a defibrillator and difficult airway equipment and that it is also vital to provide good postoperative care [intensive care unit (ICU)] and pain treatment. To enhance patient safety, it is important to conduct an evaluation of the anaesthesia and intensive care infrastructure and to quickly eliminate any deficiencies detected. To safely take a patient into an operating room, at least saturation, end-tidal carbon dioxide (ET-CO2), electrocardiogram (ECG)

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and non-invasive blood pressure (NIBP) tests as well as temperature monitoring should be able to be performed. In addition to these and depending on the type of the surgery, it is necessary to be able to perform infusion pump procedures and invasive monitoring, as well as neuromuscular transmission (NMT) and bispectral index (BIS) monitoring. It is also vital to make preparations to handle both a paediatric and an adult laryngoscope and difficult airway patients (e.g. to have available a laryngeal mask set, laryngeal mask that provides intubation a paediatric and adult fibre-optic bronchoscope). Additionally, it is important to keep available at least one defibrillator in the operating room. Aside from non-invasive and invasive monitoring conditions, there should also be an infusion pump and haemofiltration device available. With regard to preventing the risk of hypoxic damage to patients, there should also be central oxygen system available in the hospital. It is also important to have sufficient anaesthesia devices suitable for paediatric patients and enhanced security alarm systems. There should also be a transport ventilator and an blood gas analyser at the hospital.

In our survey study, for providing information regarding patient safety, we aimed to determine the situation in Turkish hospitals with respect to these standards and compared the data based on the type of hospital.

Methods

This study is descriptive and covered 303 hospitals in 26 cities in 26 sub-regions of 12 Eurostat-NUTS regions in Turkey. After receiving approval from the Kocaeli University Clinical Research Ethics Committee, a data collection form was prepared to compare university and education and research hospitals (tertiary care), provincial hospitals and district state hospitals with regard to their anaesthesiologist, operating rooms and intensive care equipment.

The hospitals included in the study were contacted by phone between October 2012 and August 2013 and were asked whether there was an anaesthesiologist or technician employed there, and if so, information was given about the data collection form, and then their mail addresses were taken for sending the data collection form (App. 1). They were asked to return the filled-out data collection forms to the mail address of one of the researchers. The data collection form included questions on what type of hospital the establishment was (e.g. a university or education and research hospital, which are together considered as tertiary hospitals, a provincial hospital or a district state hospital); whether it had a central oxygen system or not; the number of anaesthesiologists working there; whether it had an operating room or not, and if so, which department was responsible for it, the number of operating rooms, the number of operations in a month, the number of anaesthesia devices and for how long the devices were used. These data were collected so that we could compare them according to the hospital type.

Additionally, the hospitals were asked whether saturation, NIBP, ECG, ET-CO_2 and temperature monitoring could be performed in every operating room; whether there was a defibrillator, infusion pump and portable pulse oxymeter in each operating room and whether NMT and BIS monitoring could be performed or not. Moreover, with regard to operating room equipment, it was investigated whether there were paediatric and adult normal airway intervention equipment (adult and paediatric AMBU, laryngoscope set, difficult airway equipment) in every operating room and whether there was a laryngeal mask set, a laryngeal mask set that provides intubation and an adult and paediatric fibre-optic bronchoscope. With regard to ICU, it was investigated whether there was an adult and paediatric ICU, as well as which department was responsible for ICUs. These were also compared according to the hospital type. The presence of ET-CO_2 monitoring, infusion pump, portable ventilator and X-ray device and blood gas device and whether non-invasive mechanic ventilation could be performed were also questioned. Finally, it was questioned whether paediatric patients were admitted or not. The intention was to compare the data obtained according to hospital type.

Statistical analysis

The analyses in this study were performed with the Statistics Package for Social Sciences (SPSS for Windows ver. 15.0, IBM, Chicago, IL, USA) package program. Appropriate statistical tests were conducted taking into consideration data type and normal distribution characteristics, as necessary. The chi-square test was used to calculate the p-values for the three hospital groups in the assessments of the categorised data. Moreover, Pearson correlation analysis and Bonferoni correction were applied when necessary. The Kruskal–Wallis test was used in multiple group comparisons. Significant data in the Kruskal–Wallis test were checked with the Mann–Whitney U test by paired comparisons. The significance level was taken as $p<0.05$ in the comparisons.

Results

Data were obtained for 221 hospitals (73%) out of the 303 hospitals called. Of these hospitals, 13 were university hospitals, 10 were education and research hospitals, 21 were provincial state hospitals and 177 were district state hospitals. There was no anaesthesiologist, operating room or ICU in 114 of the district state hospitals. Therefore the analyses were based on the data about the remaining 63 district hospitals that had these facilities/personnel. The hospital data in the tables only relate to hospitals with an operating room and for which data were received. However, not all the survey questions were answered by each respondent and this has resulted in some data variability.

The responsibility for the active operating rooms was mostly incumbent on anaesthesiologists, at a rate of 61% (p=0.004) (Table 1). The number of anaesthesiologists, anaesthesia de-

Table 1. Data on the presence of an operating room, operating room responsibility, number of anaesthesiologists, number of operations per anaesthesiologist, number of anaesthetic apparatus, presence of a central oxygen system, anaesthesiology outpatient clinic and number of operations in a month. The values are given as ± SD or number (n)

	University and Education and Research Hospital (n=23)	Provincial State Hospital (n=21)	District State Hospital (n=63)	p
Operating Room				
Yes/No	23/0	21/0	63/114	<0.001†
Operating room responsible Anaesthetist/surgeon/other	8/10/3	11/8/0	42/19/0	0.004*
Number of anaesthesiologists (n)	13.7±8.2	7.4±3.9	2.2±2.1	<0.001†
Number of operations per anaesthesiologist (n)	125.3±74.6	93.2±44.6	65.3±50.2	<0.001†
Number of anaesthetic apparatus (n)	21.8±11.3	8.6±6.2	3.3±2.6	<0.001†
Central oxygen system				
Yes/No	21/2	19/2	44/19	0.03*
Anaesthesiology outpatient clinic in the Hospital				
Yes/No	20/1	15/4	34/27	0.002*

*p<0.05, †p<0.001

vices and operations conducted per anaesthesiologists in a month were greatest in tertiary care hospitals (university and education and research hospitals) than in provincial state hospitals, and the least in district state hospitals, respectively, and the difference was statistically significant (p=0.001) (Table 1). There was a statistically significant correlation among the number of anaesthesiologists, operations and devices (r=0.73, p<0.001). Just 14% of the anaesthesia devices were older than 11 years. District state hospitals seem to be the weakest with regard to the presence of an oxygen system (91.3%, 90% and 71.4 % respectively; p=0.03) (Table 1). Anaesthesia outpatient clinics were at a low rate again in district state hospitals (p=0.005) (Table 1). Irrespective of the presence of an ICU, there was portable X-ray device in all the hospitals.

In 97% of the operating rooms, ECG, heart rate, NIBP and saturation monitoring could be performed. End-tidal CO_2 monitoring could be performed in 91% of the operating theatres, in at least one room; however, when there was ET-CO_2 available, this rate fell to 63%; furthermore, it could be performed at the lowest rate in district state hospitals (p=0.02) (Table 2). The facilities capable of carrying out body temperature monitoring, invasive monitoring, BIS and NMT monitoring and infusion pump procedures decreased from the tertiary care hospitals to district state hospitals (Table 2). In 6% of the operating rooms, there was no defibrillator. Although portable pulse oxymeters were found in 81% of the operating rooms, this number did not differ according to hospital type.

When airway equipment is considered, it was seen that there was a laryngoscope set in 99% of the operating rooms. There was at least one laryngeal mask set in 92.2% of the operating rooms, and a laryngeal mask set providing intubation was found in 51% of the operating rooms (Table 3). Adult fibre-optic bronchoscopy was found in 39% of operating rooms and paediatric fibre-optic bronchoscopy was found in 21% of them. With respect to these data, the district state hospitals seem weak.

Among the hospitals with active operating rooms, there was an ICU in 95.7% of the tertiary care hospitals, in 80% of the provincial state hospitals and in 20% of the district state hospitals, with the presence of an ICU decreasing statistically significant towards district state hospitals (p<0.001) (Table 4). An adult ICU was found in 33% of all hospitals and a paediatric ICU was found 32.4% of all hospitals. A paediatric ICU was found in 66.7% of tertiary care hospitals, 18.8% of provincial state hospitals and 17.6% of district state hospitals (Table 4). Anaesthesiologists are responsible for the ICUs in 91.4% of cases (Table 4). All the ICUs included a defibrillator and facilities for ECG, heart rate, saturation and NIBP monitoring. There was ET-CO_2 in 54.3% of hospitals, invasive monitoring in 68.4% and an infusion pump in 93%. The presence of a transport ventilator, blood gas and haemofiltration devices and facilities for non-invasive mechanical ventilation in ICUs is less as we go towards district state hospitals (Table 4). ICUs in university and in education and research hospitals and in provincial state hospitals provide the service as a tertiary or secondary service, while district state hospitals provide this service as first and secondary care.

Table 2. Anaesthesia equipment data in the operating room. The values are given as number (n).

	University and Education and Research Hospital (n=23)	Provincial State Hospital (n=21)	District State Hospital (n=63)	p
ET-CO_2 monitoring in the operating room				
Yes/No	21/0	17/1	53/9	0.1
ET-CO_2 monitoring in every room				
Yes/No	18/2	11/8	34/28	0.02*
Temperature Monitoring				
Yes/No	20/0	12/7	36/25	0.003*
Invasive Monitoring				
Yes/No	21/0	16/3	23/38	<0.001†
BIS monitoring				
Yes/No	21/2	7/12	6/57	<0.001†
NMT monitoring				
Yes/No	17/4	3/16	6/52	<0.001†
Portable pulse oxymeter				
Yes/No	18/3	16/3	47/13	0.7

*p<0.05, †p<0.001

Discussion

The main conclusions to be drawn from this study are:

1. Anaesthesiologists are responsible for operating rooms in 61% of cases and for ICUs in 91.4% of cases.
2. There were saturation, NIBP, ECG and heart rate monitoring in every operating room in almost all (97%) the hospitals.
3. Although there were paediatric and adult normal airway equipment in almost all the hospitals, it is remarkable that most of them did not have sufficient difficult airway equipment. The deficiency with respect to the availability of an infusion pump and temperature and invasive monitoring equipment, which are key areas to be monitored in the ASA guidelines, is also remarkable.
4. Although university and education and research hospitals were generally sufficient, the deficiencies in the district state hospitals are noteworthy.
5. The number of ICUs should be increased.

The World Health Organization (WHO) launched a project called 'no operating room without saturation probe' in October 2008 and issued a 'surgical safety checklist' in 2009. In this checklist, the surgery to be performed, the place of incision and whether difficult intubation is expected or not are questioned, and the operation requires the signatures of the anaesthesiologist and the surgeon before it can proceed (4, 5). A determination of the risks to the patients by being examined by the anaesthesiologist and being fully prepared will reduce potential complications. Although an anaesthesia outpatient clinic is a routine application in tertiary care hospitals, it could not occur in all provincial and district state hospitals.

It was noticed that respiration-related deaths decreased at a rate of 50% since 1986 when ET-CO_2 and saturation began to be monitored; however, there was no decrease in cardiovascular deaths (6). Improvement of these data is necessary for Turkey.

BIS monitoring can be performed in patients with cardiovascular dysfunction and in surgeries where the patient needs to be stable (7). According to ASA, NMT monitoring can be used in patients with neuromuscular dysfunction and spinal surgery (8, 9). It was reported that if NMT monitoring could be performed in every operating room, residual block could be prevented (10).

Taking into consideration that most anaesthesia-related deaths develop during intubation or extubation, ASA and the difficult airway society separately issued intubation guidelines (11, 12). According to these guidelines, both adult and paediatric normal airway equipment have to be available and made ready in every operating room (13). Moreover, difficult airway equipment must be kept available together and in a difficult airway trolley. ASA also included video laryngoscopes to this guideline in 2013. We did not ask questions about the video laryngoscope and cricothyroidotomy set in our data collection form. It seems that the laryngoscope set and other

Table 3. Airway equipment data in the operating room. The values are given as number (n)

	University and Education and Research Hospital (n=23)	Provincial State Hospital (n=21)	District State Hospital (n=63)	p
Laryngeal mask set				
Yes/No	20/0	18/2	57/6	0.4
Laryngeal mask set providing intubation				
Yes/No	21/2	9/9	23/40	<0.001†
Adult fibre-optic bronchoscopy				
Yes/No	20/2	12/7	8/53	<0.001†
Paediatric fibre-optic bronchoscopy				
Yes/No	12/9	4/15	5/56	<0.001†

†p<0.001

Table 4. ICU equipment data. The values are given as number (n)

	University and Education and Research Hospital (n=23)	Provincial State Hospital (n=21)	District State Hospital (n=63)	p
Adult ICU				
Yes/No	22/1	16/4	34/29	<0.001†
Paediatric ICU				
Yes/No	14/7	3/13	6/28	<0.001†
ICU responsibility				
Anaesthetist/surgeon/other	23/0/0	14/1/0	27/0/5	0.04*
ICU ET-CO2 monitoring				
Yes/No	18/2	6/10	14/20	0.001†
ICU invasive monitoring				
Yes/No	20/0	15/1	19/14	<0.001†
ICU blood gas device				
Yes/No	21/2	14/5	22/39	<0.001†
ICU haemofiltration device				
Yes/No	16/5	7/8	9/26	0.001†
Non-invasive mechanic ventilation				
Performed/Not performed	20/1	15/1	21/13	0.003*
Paediatric patient admission				
Yes/No	18/3	6/10	12/22	0.001†
Transport ventilator at ICU				
Yes/No	19/3	15/4	34/27	0.02*
ICU stage				
I/II/III	0/2/20	1/7/8	18/15/2	<0.001†

*p<0.05, †p<0.001

equipment necessary for intubation are found in all operating rooms these days, that at least one laryngeal mask set is found in 90% of them and that a mask set providing intubation is found in 51% of them. There is, however, a deficit of fibre-optic bronchoscopy in hospitals.

According to the study by Kuş et al. (14), which investigated the availability of difficult airway equipment and the knowledge of the emergency ambulance staff in Kocaeli province, ambulances do not have sufficient difficult airway equipment or informed staff.

In a study conducted in 14 emergency helicopters found in European countries, it was found that anaesthesiologists most often accompany the patients (68%–85%), and all but one had a laryngeal mask set; furthermore ET-CO2 monitoring could be performed in all of them, all of them had an automatic ventilator, some of them enabled NIMV and all of them had cricothyroidotomy. It was concluded that they had sufficient equipment to a large extent with regard to modern difficult airway equipment.

In a study in which anaesthesia monitoring equipment in various hospital groups in China was investigated, it was reported that there was insufficient anaesthesia application and monitoring equipment in hospitals located in small and economically underdeveloped regions (16).

District state hospitals were also weak with regard to ICUs. It was found that there were insufficient mechanical ventilators, invasive monitoring and infusion pump equipment in hospitals with ICUs. ICUs were also not sufficient with regard to ET-CO_2, blood gas device and haemofiltration devices. European and American ICU associations and some studies have explained ET-CO_2 as a major monitoring necessity.

Conclusion

The present study aimed to evaluate anaesthesia and the intensive care infrastructures of state hospitals in Turkey according to the answers given in a survey. The analyses of the results suggest that there are differences among hospitals with regard to infrastructure. We are of the opinion that eliminating these differences would be an important step in improving service quality. In particular, it is necessary to begin projects such as ' an anaesthesiologist in every operating room', 'an ET-CO_2 monitor in every operating room' and 'ICU in every hospital' in Turkey, and every hospital should be separately handled to help it reach the necessary standards by eliminating any deficiencies.

Ethics Committee Approval: Ethics committee approval was received for this study from the Kocaeli University Clinical Research Ethics Committee.

Peer-review: Externally peer-reviewed.

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Appendix 1. Data collection form sample

Dear colleague,

Our aim behind conducting this survey is the **EVALUATION OF ANAESTHESIA AND INTENSIVE CARE EQUIPMENT IN THE HOSPITALS OF THE MINISTRY OF HEALTH AND IN UNIVERSITY HOSPITALS IN TURKEY.** We would be glad if you can resend a mail after filling out the survey. We thank you in advance for your time.

Best regards….

1) University Hospital / Education and Research Hospital / Provincial State Hospital / District State Hospital

2) Province/district the state hospital is in:

3) Central system is used at the hospital: Yes/No

4) Number of anaesthesiologists at the hospital:

5) Number of operating rooms:

6) The operating rooms are active: Yes/No

7) How many operations are performed per month?

8) Number of anaesthetic apparatus:

9) Number of years the anaesthesia device was used: 1-2 / 3–5 / 6–8 / 9–11 / >11

10) In the operation room;

Number of infusion pump: Number of defibrillators:

Number of monitors:

Saturation can be monitored in every room: Yes / No

Number of laryngeal mask (set): Number of Fastrach (ILMA) (set):

Number of patient-controlled analgesia devices:

Number of stimulators for peripheral block:

11) Anaesthesiology outpatient clinic: yes / none

Number of ultrasound devices for peripheral block:

End-tidal carbon dioxide monitoring: Yes / No

End-tidal carbon dioxide can be monitored in every room: Yes/No

Invasive monitoring: Yes/No

The number of monitors at which BIS/ENTHROPY can be conducted:

The number of monitors at which NMT monitoring can be conducted: Yes/No

Temperature monitoring can be conducted: Yes/No

1 Set of laryngoscopes in every room: Yes/No

Necessary equipments for paediatric patients in every room: Yes/No

11) In the hospital; Number of adult fibre-optic : Number of paediatric fibre-optic:

Number of portable saturation devices: Number of transport ventilators:

Responsible for the operating room: Surgeon / Anaesthetist / Other

12) In the Emergency Care Unit; Which department is responsible :

Which stage : Number of mechanical ventilators:

Number of defibrillators: Portable X-ray: Yes / No

Number of haemofiltration devices: Blood gas device: Yes/No

End-tidal carbon dioxide can be monitored: Yes/No

Invasive monitoring: Yes/None

Infusion pump/ number of perfusors: Number of paediatric compatible ventilators:

Paediatric intensive care: Yes/ None

Paediatric patients are admitted: Yes/No

THANK YOU FOR YOUR TIME.