

TRANSCONTINENTAL ANESTHESIA

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Introduction: Tele-medicine has been used in different fields of medicine to overcome the lack of specialist and improve health care. The aim of the study is to determine how anesthesia delivery can be achieved remotely.

Methods: After ethics approval in the remote (Montreal General Hospital, Canada) and local centre (University of Pisa, Italy), 20 patients undergoing thyroid surgery in Pisa were enrolled. The remote and local set-up were composed of a *master*-computer (Montreal – ‘*anesthesia cockpit*’), a *audio-video*-purpose computer (both sites) and a *slave*-computer (Pisa), respectively. Standard internet connection and remote desktop control software were used in both centres. The AV-computer system was used to collect images from distant monitoring of the patient, video-laryngoscopic intubation guidance, vital signs, ventilator parameters, view of the surgery field throughout the surgery, using HD webcams. [Fig 1]. Pre-operative assessment was performed by anaesthesiologists in both centres using standard protocols. Standard TIVA (propofol, remifentanyl, rocuronium) was automatically delivered using a closed-loop system (1) and controlled by the remote centre. The performance of the hypnosis was defined as excellent, good, poor or inadequate, when the BIS was respectively within 10%, between 10 and 20%, between 20 and 30% or outside 30% of the target BIS of 45. Pain was assessed using Analgoscoring with a score ranging from -9 to 9, with ± 3 representing excellent pain control, -3 to -6 and 3 to 6 good pain control, and -6 to -9 and 6 to 9 inadequate pain control. (2) Data are presented as mean (SD) or value, comparison of the pre-op assessment were done by Cohen’s Kappa test, SPSS.

Results: The remotely-controlled closed loop system maintained anesthesia for all patients (4 men, 16 women; age: 44 (13) yrs; weight: 66 (14) kg) throughout surgery without any interruption of the internet connection, providing teleanesthetic drug infusion during 100% of the time. Out of the 8 parameters of comparison of preoperative assessment, 4 showed perfect, 2 good and 2 moderate agreement, respectively [Table 1]. The mean propofol dose was 118 (32) $\mu\text{g}/\text{kg}/\text{min}$, the mean remifentanyl dose 0.28 (0.07) $\mu\text{g}/\text{kg}/\text{min}$, the total rocuronium dose 0.63 (0.11) mg/kg; time to extubation was 9.8 (4.0) min. The system showed 57 (20) modifications of propofol doses/h and 36 (9) modifications of remifentanyl doses per hour. The clinical performance was very good and is showed in table 2.

Conclusions: Tele-anesthesia is feasible using remote control of an automated anesthesia delivery system; inadequate control of hypnosis was influenced by electrocautery (marked as artifact) causing unreliable BIS values. Preoperative assessment using AV-communication showed overall good agreement with standard assessment.

References:

1. CAS meeting 2010, Montreal, Abstract ID: 803213
2. Journal of Computers 2009; 4: 311-318.

	Remote Group (N=20)	Local Group (N=20)	Kappa
ASA (1 / 2 / 3)	11 / 8 / 1	12 / 7 / 1	0.77
Allergies (0 / 1 / 2)	17 / 2 / 1	17 / 2 / 1	1.00
Medical History (0 / 1 / 2 / 3)	10 / 8 / 1 / 1	8 / 9 / 2 / 1	0.56
Airway Assessment			
Mouth Opening (1 / 2 / 3)	17 / 3 / 0	18 / 2 / 0	0.61
Mallampati Classification (1 / 2 / 3)	14 / 6 / 0	9 / 9 / 2	0.55
Thyromental Distance (1 / 2)	20 / 0	20 / 0	1.00
Neck Mobility (1 / 2)	20 / 0	20 / 0	1.00
Larynx Mobility (0 / 1)	20 / 0	20 / 0	1.00

Kappa \leq 0.2: poor agreement; 0.2 $<$ Kappa \leq 0.4: fair agreement; 0.4 $<$ Kappa \leq 0.6: moderate agreement; 0.6 $<$ Kappa \leq 0.8: good agreement; 0.8 $<$ Kappa $<$ 1: very good agreement; Kappa = 1: perfect agreement.

Table 1: Comparison of pre-operative assessment



Figure 1: Video-stream in Montreal from monitoring in Pisa

BIS	Excellent (%)	36.6 \pm 15.1	Analgoscoring	Excellent (%)	68.0 \pm 21.9
	Good (%)	32.8 \pm 6.4		Good (%)	24.2 \pm 18.4
	Poor (%)	13.3 \pm 5.6		Insufficient (%)	5.9 \pm 10.5
	Inadequate (%)	12.7 \pm 10.3		Artifact (%)	1.8 \pm 3.2
	Artifact (%)	4.6 \pm 3.6			

Table 2: Clinical Performance