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A Randomized Controlled Trial Comparing the Cuffed Oropharyngeal Airway and the Laryngeal Mask Airway in Spontaneously Breathing Anesthetized Adults

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Background: **The cuffed oropharyngeal airway (COPA), a modified Guedel airway, was compared with the laryngeal mask airway (LMA) during spontaneous breathing anesthesia. Specifically examined were ease of use, physiologic tolerance, and the frequency of problems.**

Methods: **Adult patients consented to random (2:1) assignment to either COPA (n = 302) or LMA (n = 151) for airway management during anesthesia with propofol, nitrous oxide, and oxygen.**

Results: **Ease of insertion was similar, but the first-time successful insertion rate was higher with the LMA (COPA, 81% compared with LMA, 89%; $P = 0.05$). More brief manipulations (head tilt, chin lift, jaw thrust) were reported in the COPA group (average total number of manipulations: COPA, 1.1 ± 1.6 compared with LMA, 0.1 ± 0.2; $P < 0.001$). Continuous airway support was used more frequently in the COPA group (COPA, 30% compared with LMA, 0%; $P < 0.0005$). The incidences of aspiration, regurgitation, laryngospasm, wheezing, succinylcholine administration, oxygen saturation (Sp_{O_2})<92%, failed use, and minor intraoperative problems were similar. When the airways were removed, blood was detected on the COPA less frequently than on the LMA (COPA, 5.8% compared with LMA, 15.3%; $P = 0.001$). The incidence of early and late sore throat was greater with the LMA (early: COPA, 4.7% compared with LMA, 21.9% [$P = 0.001$]; late: COPA, 8.4% compared with LMA, 16.1%; $P = 0.01$). The LMA did better than the COPA when anesthetists analyzed the technical aspects of the two devices.**

Conclusions: **Although the COPA and LMA are equivalent devices in terms of physiologic alterations and overall clinical problems associated with their use, the LMA was associated with a higher first-time insertion rate and fewer manipulations, suggesting that it is easier to use. The COPA was associated with less blood on the device and fewer sore throats, suggesting it may cause less pharyngeal trauma. Ultimately, both devices were similar in establishing a safe and effective airway for spontaneously breathing anesthetized adults. (Key words: General anesthesia; airway devices; airway management; complications; sore throat.)**

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** Greenberg RS, Toung T: The cuffed oro-pharyngeal airway—a pilot study. ANESTHESIOLOGY 1992; 77:A558.

THE cuffed oropharyngeal airway (COPA; Mallinckrodt Medical, Athlone, Ireland) was first described by Greenberg and Toung** in 1992 as a potential airway during anesthesia in spontaneously breathing patients. The device is a modified Guedel airway with an inflatable distal cuff and proximal 15-mm connector for attachment to the anesthetic breathing system (fig. 1). The cuff was designed such that when inflated it would,

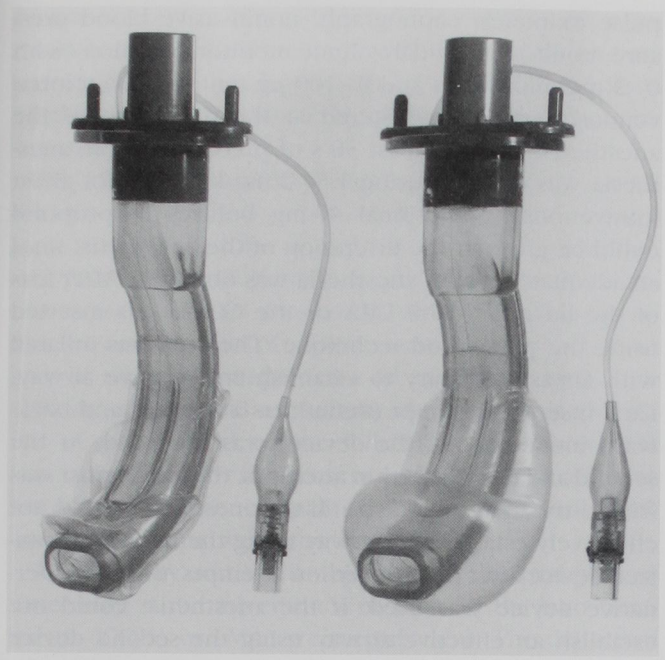

Fig. 1. The cuffed oropharyngeal airway with the cuff inflated and deflated.

ideally, displace the base of the patient's tongue; form a gentle, airtight seal with the pharynx; and elevate the epiglottis from the posterior pharyngeal wall to provide a clear airway (fig. 2). It is inflated through a one-way valve and pilot balloon that emerges from the COPA tube at the flange. The flange at the proximal end is fitted with two posts for a securing strap to stabilize the COPA at the mouth against the upper teeth or gums. The COPA is available in four sizes: 80, 90, 100, and 110, which refer to the distance measured in millimeters between the flange and distal tip. The COPA is made from polyvinyl chloride and is disposable.

Clinical experience with the COPA is limited: In the first study, investigators found that the device had a feasible design in supporting the airway of patients emerging from a short general anesthetic.** In a clinical appraisal of 100 spontaneously breathing anesthetized patients, Brimacombe and Berry[1] showed that the COPA provided a clear airway in 98% of patients and had a low complication rate, but most patients required one or more minor airway manipulations and chin support was required for 20% of the anesthesia time. The aim of the present study was to compare the COPA and LMA with respect to ease of use, physiologic tolerance, and frequency of clinical problems in adult patients undergoing spontaneously breathing intravenous general anesthesia. We hypothesized that the devices were substantially equivalent in these three areas.

Methods

Four hundred fifty-three consenting adult patients undergoing general anesthesia for routine procedures at three institutions were randomly assigned using a 2:1 allocation to have either the COPA (n = 302) or LMA (n = 151) used for airway management (table 1). The study sites—Johns Hopkins Medical Institution (JHMI; Baltimore, Maryland), Cairns Base Hospital (CBH; Cairns, Australia), and Nambour General Hospital (NGH; Nambour, Australia)—were chosen to provide anesthetists of varying seniority and with a broad spectrum of clinical experience and expectation of the investigational devices. Clinical investigation committee approval was obtained from all three study sites. Patients were excluded from the trial if they were younger than 18 yr, were pregnant, had a history of gastroesophageal reflux, a known or predicted difficult airway (*e.g.*, Mallampati classification 4), or were considered unsuitable for a face mask or LMA. All participating anesthetists viewed an instructional video produced by the research team that informed them of the study protocol and prescribed technique for use and placement of both devices. Patients were assessed by trained data collectors (different from the anesthetist) regarding tolerance

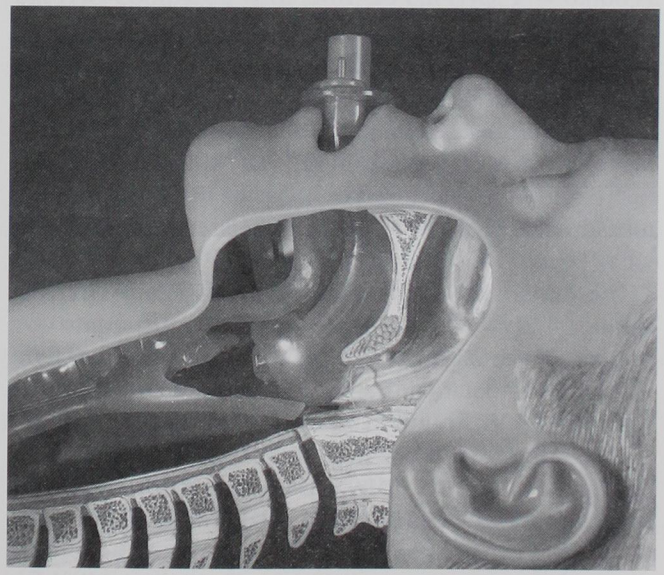

Fig. 2. The cuffed oropharyngeal airway in position with the cuff inflated.

Table 1. Selected Demographic, Surgical, Anesthetist, and Anesthetic Details

	COPA	LMA
Total randomized	302	151
Site		
JHMI	85	43
CBH	150	75
NGH	67	33
Gender (M)	160 (53%)	82 (54%)
Smoker (yes)	113 (37%)	63 (42%)
Height (cm) (mean ± SD)	170.3 ± 9.7	171.5 ± 9.3
Weight (kg) (mean ± SD)	73.3 ± 14.1	74.6 ± 15.4
Age (yr) (mean ± SD)	41.4 ± 14.7	40.7 ± 14.4
Mallampati score		
1	140 (46%)	67 (44%)
2	131 (43%)	73 (48%)
3	31 (10%)	11 (7%)
Surgical procedure		
General	54 (18%)	23 (15%)
Genitourinary	29 (10%)	18 (12%)
Gynecological	54 (18%)	31 (21%)
Orthopedic	105 (35%)	46 (30%)
Plastic	28 (9%)	18 (12%)
Other	32 (11%)	15 (10%)
Anesthesia details		
Anesthesia time (min)	45.7 ± 38.2	52.1 ± 47.3
Propofol induction ($mg \cdot kg^{-1}$)	2.3 ± 0.7	2.4 ± 0.8
Total fentanyl (μg)	115 ± 55	130 ± 65
Propofol maintenance ($\mu g \cdot kg^{-1}\ min^{-1}$)	83 ± 123	105 ± 173

COPA = cuffed oropharyngeal airway; LMA = laryngeal mask airway; JHMI = Johns Hopkins Medical Institutions; CBH = Cairns Base Hospital; NGH = Nambour General Hospital.

of the devices under anesthesia (heart rate [based on electrocardiogram], blood pressure [sphygmomanometer or automated blood pressure manometer], oxygen saturation [pulse oximetry], tidal volume [in-line spirometer of anesthesia machine], end-tidal carbon dioxide [circuit end-tidal monitor]), use of airway supportive measures, and clinical events associated with each device.

The initial size of the COPA was chosen by placing the distal tip of the device at the angle of the jaw of a patient in the supine position with the COPA straight up, perpendicular to the floor. When viewed from the side, the tooth/lip guard of the COPA would be about 1 cm ventral to the lip in a device of the proper size. The initial size of the LMA was chosen according to the manufacturer's weight-related recommendations.[2]

Anesthetic management was standardized according to the following protocol: Monitoring was applied before induction and included an electrocardiograph, pulse oximeter, capnograph, noninvasive blood pressure monitor, and tidal volume monitor. Sedation (with 0–2 mg midazolam and 0–100 μg fentanyl given intravenously) was administered at the discretion of the anesthetist. After at least 30 s of preoxygenation, anesthesia was induced using 1.5–2 mg/kg propofol given intravenously. Additional 40-mg boluses of propofol could be given at the discretion of the anesthetist until an adequate level of anesthesia was obtained. After loss of the lid reflex, the LMA or the COPA was inserted using the prescribed technique. The cuff was inflated with air as necessary to establish an effective airway. Each insertion attempt (defined as a forward and backward movement of the device) was recorded. At the second and third insertion attempts, the anesthetist was free to try an alternate size. If the anesthetist could not effectively establish an airway using the initial randomized device after three insertion attempts, then the alternative device was used. If the anesthetist could not establish an effective airway using the second device within three attempts at insertion, the patient was managed as clinically indicated.

Anesthesia was maintained with a propofol infusion (50–200 $\mu g \cdot kg^{-1} \cdot min^{-1}$) and nitrous oxide (up to 70%) as clinically indicated. Cuff volumes, resultant pressures (blinded to the anesthetist), and airway leak pressures were measured when the anesthetist obtained an acceptable airway immediately after placement of the device and recorded. Leak pressure was determined by closing the expiratory valve of the circuit and noting the airway pressure (measured in the anesthesia circuit) at which oropharyngeal gas leak occurred into the mouth.

Airway manipulations (head tilt, chin lift, jaw thrust, continuous positive airway pressure) were used as necessary and recorded. The time required to achieve a clinically adequate airway not requiring manual support and the time of resumption of spontaneous ventilation was recorded. If problems occurred, they were noted, timed, and an explanation given. Adverse events were classified into major (aspiration, regurgitation, laryngospasm, wheezing, failure of device after three attempts, use of succinylcholine, use of any alternative device for airway rescue, oxygen saturation <92%), minor intraoperative (coughing, gagging, hiccup, patient movement, stridor, blood detected on device, need for continuous airway support, nasogastric tube insertion to decompress air in the stomach), and immediate and next-day postoperative (shivering, sore throat, lip trauma, hearing changes, ear pain, jaw–neck–mouth ache, postop-

erative vomiting). Vital signs were recorded before induction, at 5-min intervals for the first 15 min or until surgical incision, 5 min after surgical incision, and every 15 min until the device was removed, and once after removal.

Subjective assessment of various aspects of using the devices were solicited from the anesthetists using a scale that included the parameters excellent, good, fair, and poor. This included the quality of the patient's airway before the commencement of surgery, ease of device insertion, ease of airway management, effectiveness of sizing technique, ease of hands-free anesthesia delivery, and overall usefulness of the device used. Before discharge and on the following day, the patient was questioned for the presence of sore throat, hearing changes, vomiting, ear pain, or lip swelling. Any additional comments were also recorded.

The primary statistical objective of the trial was to determine if the adverse event rates in the two treatments (COPA or LMA) were equivalent. The definition of equivalence was ±10% with a background rate of 15%. The sample size was chosen to yield 90% power to detect nonequivalent event rates. Randomization, stratified by institution, using permuted blocks (blinded to anesthetists) was used to assign individual patients to treatment groups in a ratio of 2:1 (COPA:LMA). The randomization was unbalanced to yield more clinical exposure with the COPA because this was the newer device. Group comparisons and all other analyses were made based on randomized treatment assignment (intention to treat). The association between categorical variables was tested using the chi-squared test. The magnitude of differences in categorical variable groups between groups was estimated using the odds ratio and 95% confidence limits. Differences between the treatment groups with respect to continuously varying measures were tested using a random effects linear model. For non-normally distributed measures, comparisons were based on logarithmically transformed values or nonparametric tests were performed. Unless otherwise noted, data are presented as means ± SD. Probability values <0.05 were considered significant.

Results

Table 1 shows demographic, surgical, and anesthetist details. Randomization was successful in balancing the treatment groups with respect to study site, sex, history of smoking, height, weight, age, Mallampati score, American Society of Anesthesiologists physical status, type or duration of surgical procedure, training level of the anesthetist placing the device, or induction or maintenance anesthetic management. There were no significant differences between groups with respect to the randomized airway device and the final airway device used (table 2). Cardiorespiratory data (table 3) revealed no significant differences between the two groups.

Sixty-two anesthetists participated in the trial, reflecting a wide range of clinical experience (range, 1–30 yr). Protocol deviations were most common at JHMI (19 of 20) and occurred more frequently ($P < 0.02$) in patients assigned to the COPA group (18 of 302) than in those in the LMA group (2 of 151). Protocol deviations were included in the analysis.

Insertion was evaluated as easy for both devices. First-time successful insertion rates, taken alone, were 81% for the COPA and 89% for the LMA ($P = 0.05$). Success on the second and third attempts was similar, as was the percentage of insertion attempts for each device as the second, crossover device (table 2). Groups were not different when comparing all insertion attempts ($P = 0.26$). Failure of a randomized device to be effective for airway management was similar in both groups (COPA, 5.4%; LMA, 3.4%; $P = 0.31$).

The COPA group had a higher cuff volume (COPA, 34 compared with LMA, 25 ml; $P = 0.0001$) but a lower cuff pressure (COPA, 93 cm H_2O compared with LMA, 129 cm H_2O; $P = 0.0001$) and leak pressure (COPA, 17 cm H_2O compared with LMA, 20 cm H_2O; $P = 0.0003$). There were significantly more airway manipulations with the COPA: head tilt (COPA, 54.2% compared with LMA, 3.3%; $P < 0.001$), chin lift (COPA, 42.8% compared with LMA, 1.3%; $P < 0.001$) and jaw thrust (COPA, 4.7% compared with LMA, 0.7%; $P = 0.025$). One or two airway manipulations were required in 35% of patients with a COPA compared with only 4% for the LMA, and 36% of patients with the COPA required more than two brief airway manipulations compared with none for patients in whom the LMA was used ($P = 0.001$; table 4). Similarly, continuous chin support was used in nearly 30% of patients with the COPA, whereas this was used in no patients with the LMA ($P < 0.0005$; table 4). Although airway quality after device placement was most commonly considered excellent with the LMA (76.7%), there was a broader range of performance when using the COPA (fair, 22.6%; good, 45.1%; excellent, 25.6%).

The median time to achieve an effective airway was

Table 2. Randomized Airway Device and Final Airway Device Utilized

Randomized Device	Final Device								
	LMA Size			COPA Size				Alternative Devices	
	3	4	5	80	90	10	11	ETT	FM
COPA (n = 302)	3	3	2	2	74	153	57	5	3
LMA (n = 151)	41	83	23	0	0	3	0	1	0
Total	44	86	25	2	74	156	57	6	3

COPA = cuffed oropharyngeal airway; LMA = laryngeal mask airway; ETT = endotracheal tube; FM = face mask/oral airway.

longer with the COPA than with the LMA (COPA, 150 s compared with LMA, 106 s; $P = 0.004$). Manual support was required to establish an effective airway in 29 of 302 (9.6%) patients with the COPA, in contrast to only 1 of 150 (0.66%) patients with the LMA ($P < 0.001$). Time to spontaneous breathing was similar for the COPA and LMA (COPA, 7.3 compared with LMA, 6.7 min; $P = 0.44$). During the apneic period it was possible to ventilate all patients until spontaneous breathing resumed. Although no patient suffered any adverse clinical consequence from participating in this study, at least one potentially serious event occurred in 43 of 302 (14.2%) patients in the COPA group and in 18 of 151 (11.9%) patients in the LMA group; this was not different between the groups ($P = 0.50$; table 5). This includes one patient, managed with a COPA, who, during repositioning from the supine to the lateral position, coughed and probably aspirated bile-stained fluid. Regurgitation occurred in one additional patient in the COPA group and in another in the LMA group. Each case was probably related to inadequate depth of anesthesia. Forty-four patients (COPA, 30; LMA, 14; $P = 0.823$) were noted to have hemoglobin desaturation (Sa_{O_2} <92%).

The overall number of patients with minor intraoperative problems was similar (COPA, 24.2% compared with LMA, 30.5%; $P = 0.15$; table 5a), but hiccup occurred more frequently with the LMA (COPA, 1.7% compared with LMA, 5.3%; $P = 0.03$; table 6). When the devices were removed, blood was detected on the LMA more frequently than on the COPA (LMA, 15.3% compared with COPA, 5.8%; $P < 0.001$; odds ratio [95% confidence limits], 3.01 [1.56-5.83]). Overall, the number of patients with immediate ($P < 0.0001$) and next-day ($P = 0.02$) postoperative problems was greater in the LMA group (table 5). Specifically, sore throat was significantly more frequent with the LMA than with the COPA, both in the immediate postoperative period (COPA, 4.7% compared with LMA, 21.9%; $P < 0.0001$; odds ratio, 5.75 [2.97-11.1]) and at the next day followup (COPA, 8.4% compared with LMA, 16.1%; $P < 0.01$; odds ratio, 2.09 [1.15-3.81]). Although reports

Table 3. Cardiorespiratory Data

	Baseline		After Device Placement		Incision	
	COPA	LMA	COPA	LMA	COPA	LMA
HR (min^{-1})	75 ± 15	75 ± 15	75 ± 16	73 ± 11	73 ± 14	73 ± 14
SBP (mmHg)	139 ± 21	137 ± 22	109 ± 17	107 ± 17	110 ± 18	108 ± 16
DBP (mmHg)	81 ± 12	81 ± 13	63 ± 12	62 ± 12	64 ± 12	63 ± 12
Sa_{O_2} (%)	98 ± 1	98 ± 1	98 ± 1	98 ± 2	98 ± 2	98 ± 2
FI_{O_2} (%)	—	—			39 ± 13	40 ± 10
ET_{CO_2} (mmHg)	—	—			48 ± 10	46 ± 10
RR (min^{-1})	—	—			15 ± 6	15 ± 6
Vt (L)	—	—			0.244 ± 0.13	0.265 ± 0.14

HR = heart rate; SBP = systolic blood pressure; DBP = diastolic blood pressure; Sa_{O_2} = pulse oximetry oxygen saturation; FI_{O_2} = fraction of inspired oxygen; ET_{CO_2} = end-tidal carbon dioxide; RR = respiratory rate; Vt = tidal volume.
Values are mean ± SD.

Table 4. Airway Manipulations (Head Tilt, Chin Lift, Jaw Thrust, CPAP, Continuous Support) Postincision to Propofol Off

Airway Manipulations	COPA (n = 287)	LMA (n = 150)
0	143 (49.8)	144 (96)
1	62 (21.6)	5 (3.3)
2	37 (12.9)	1 (0.7)
3	17 (5.9)	0 (0.0)
4	17 (5.9)	0 (0.0)
5	7 (2.4)	0 (0.0)
6	2 (0.7)	0 (0.0)
8	1 (0.4)	0 (0.0)
13	1 (0.4)	0 (0.0)
No. of manipulations (mean ± SD)	1.12 ± 1.6	0.05 ± 0.2
Continuous support	90 (29.8)	0 (0.0)

CPAP = continuous positive airway pressure.

Values are no. (%) of patients.

of jaw, neck, and mouth ache were not significant between groups (COPA, 10 compared with LMA, 1; $P = 0.08$), they were associated with >2 or continuous airway manipulation ($P = 0.0002$). When postoperative ache (jaw, neck, chin), associated with continuous chin lift in the COPA group, is included with all other after effects, late postoperative pain and discomfort becomes similar in both groups (COPA, 11.2% compared with LMA, 15.9%; $P = 0.24$). Overall, the total number of patients with any problem (major intraoperative, minor intraoperative, immediate or next-day postoperative) was higher in the LMA group than the COPA group (LMA, 56.3% compared with COPA, 40.7%; $P < 0.002$; table 5). Table 7 shows a summary of problems by study site.

Ease of insertion was evaluated by the anesthetists as similar between the two devices ($P = 0.26$), but airway quality ($P < 0.001$), sizing technique ($P < 0.001$), ease of attachment of the airway device ($P < 0.001$), and overall usefulness ($P < 0.001$) were determined to be better with the LMA than with the COPA.

Table 6. Incidence of Adverse Events by Patient Event

	COPA (n = 302)	LMA (n = 151)	*P* Value
Major			
Probable aspiration	1 (0.3)	0 (0)	0.479
Regurgitation	2 (0.7)	1 (0.7)	1.000
Laryngospasm	6 (2)	2 (1.3)	0.614
Succinylcholine given	5 (1.7)	0 (0)	0.112
Wheeze	1 (0.3)	0 (0)	0.479
Hypoxia (Sa_{O_2} < 92%)	29 (9.6)	11 (7.2)	0.822
Failed use	14 (4.6)	4 (2.6)	0.291
Minor intraoperative			
Hiccupping	5 (1.7)	8 (5.3)	0.029
Gagging	4 (1.3)	4 (2.7)	0.313
Coughing	28 (9.3)	11 (7.3)	0.477
Stridor	9 (3.0)	3 (2.0)	0.535
Nasogastric tube insertion	0 (0)	1 (0.7)	0.157
Blood detected	17 (5.8)	23 (15.3)	0.001
Movement	15 (5.0)	9 (6.0)	0.656
Postoperative—immediate			
Shivering	4 (1.3)	0 (0)	0.155
Sore throat	14 (4.7)	33 (21.9)	0.001
Vomiting	0 (0)	0 (0)	—
Lip swelling	3 (1)	2 (1.3)	0.750
Hearing changes	1 (0.3)	0 (0)	0.479
Ear pain	3 (1)	1 (0.7)	0.722
Postoperative—next day			
Sore throat	25 (8.4)	24 (16.1)	0.01
Vomiting	16 (5.4)	12 (8.1)	0.266
Lip swelling	3 (1)	2 (1.3)	0.748
Hearing changes	7 (2.3)	4 (2.7)	0.825
Ear pain	5 (1.7)	2 (1.3)	0.791

Values are no. (%) of patients.

Discussion

This study demonstrates some similarities between the COPA and LMA that are relevant to anesthetic

Table 5. Incidence of Adverse Events by Number of Patients

	COPA (n = 302)	LMA (n = 151)	LMA:COPA Odds Ratio	95% Confidence Interval	*P* Value
Major intraoperative	43 (14.2)	18 (11.9)	0.82	0.45–1.47	0.50
Minor intraoperative	73 (24.2)	46 (30.5)	1.37	0.89–2.12	0.15
Immediate postoperative	25 (8.3)	36 (23.8)	3.47	1.99–6.04	0.0001
Next-day postoperative	46 (15.2)	36 (23.8)	1.74	1.07–2.84	0.03
Any problem	123 (40.7)	85 (56.3)	1.87	1.26–2.78	0.002

Values are no. (%) of patients.

Table 7. Incidence of Adverse Events by Number of Patients According to Study Site

	JHMI (n = 128)		CBH (n = 225)		NGH (n = 100)	
	LMA	COPA	LMA	COPA	LMA	COPA
Major intraoperative	10 (23)	23 (27)	6 (8)	11 (7)	2 (6)	9 (13)
Minor intraoperative	17 (40)	27 (32)	23 (31)	28 (19)	6 (18)	18 (27)
Immediate postoperative	19 (44)	17 (20)	10 (13)	7 (5)	7 (21)	1 (1)
Next-day postoperative	18 (42)	25 (29)	12 (16)	16 (11)	6 (18)	5 (7)
Any event	35 (81)	52 (61)	36 (48)	45 (30)	14 (42)	26 (39)

JHMI = Johns Hopkins Medical Institutions; CBH = Cairns Base Hospital; NGH = Nambour General Hospital.
Values are no. (%) of patients.

practice. In general, both devices were effective in establishing an airway for spontaneously breathing adults under general anesthesia. Both devices were easy to insert, tolerated well by patients under general anesthesia, and not associated with a high frequency or level of major clinical problems. On this basis the devices are equivalent, but this study also revealed some important differences between the devices that are clinically significant for both the patient and anesthetist.

The frequency of events that could lead to significant complications was higher in this study than in previous trials investigating both the LMA[3–5] and the COPA.[1] The incidence of hypoxia (Sa_{O_2} <90%) with the LMA is generally less than 1.5%,[3,5,6] compared with 7.2% (Sa_{O_2} <92%) in the current study. In a previous study of 100 patients, the incidence of hypoxia (Sa_{O_2} <90%) with the COPA was 6% compared with 9.6% (Sa_{O_2} <92%) for the current study. The factors producing a higher event rate may include different thresholds (<90% *vs.* <92%) for identifying clinical events, use of intravenous rather than volatile anesthesia, interanesthetist variability in experience with each device, and strict adherence to an intention-to-treat analysis (*e.g.*, inclusion of hypoxic events before placement of any device). In addition, calculation and comparison of event rates with the number of patients with problems between the groups must be made cautiously because several events (*e.g.*, laryngospasm, hypoxemia, use of succinylcholine, and failed use) may, in fact, be linked.

Only 2 of the 62 participating anesthetists had ever used the COPA before. Although all of the anesthetists had previously been exposed to the LMA, their clinical experience with the device varied, but was higher in the Australian sites than the U.S. site. Lopez-Gil *et al.*[5] showed that there is a short-term learning curve with LMA use in at least pediatric anesthetic practice and that the average problem rate per patient could be reduced from 62% to 2% within 75 uses. It is not yet clear whether such a learning curve exists for the COPA, but a previous study investigating the first 50 uses by each of two experienced anesthetists showed evidence of differences in performance between the first and last 25 uses of the device.[1] The results seen with the COPA in this study thus may parallel initial work on the LMA where, for example, a clear airway was obtained in 95%[7,8] compared with >99%[3,4] for more recent studies. Performance and anesthetist opinion of the COPA should be expected to improve with increasing individual experience, understanding, and application of the anatomic issues involved.

The variations in performance between the two devices studied here may reflect their different designs, ultimate anatomic positions in the pharynx, and methods of placement. For example, the cuff of the LMA occupies the narrow distal end of the conical laryngopharynx, whereas the cuff of the COPA occupies the wider proximal end of the hypopharynx. The need for airway manipulations with the COPA is probably related to the variable gap between the distal end of the device and the laryngeal inlet. This highlights the importance of selecting the proper size for the given patient, which may, in fact, not always have been the case in this early evaluation of the COPA. A large interlumen gap can become obstructed by the base of the tongue due to the action of gravity[9] combined with reduced tone in the anesthetized pharyngeal muscles.[10] Simple adjustments in head and neck position probably improve airway quality by stretching anterior neck and pharyngeal structures, thus compensating for reduced tone. These maneu-

vers also elevate the epiglottis, as shown by Morikawa *et al.*[11] and Boidin,[12] thus improving gas exchange. The interlumen gap with the LMA is negligible, and as long as the epiglottis is not overfolded and entrapped, airway supportive measures are not required. Differences seen in leak pressure and cuff volume between the devices are reasoned by the fact that the LMA cuff occupies the narrower distal end and is more tightly applied to the glottis, whereas the COPA seals the tissues in the more compliant hypopharynx. Although the lower pressure seen with the COPA may limit the frequency and type of pharyngeal complications when compared with the LMA, it may limit its performance in positive-pressure ventilation. This requires further study.

The LMA is inserted more deeply into the pharynx than is the COPA; the former requires positioning of the mask behind the laryngeal opening at the level of C2-3 and the latter requires positioning of the cuff at the base of the tongue at C1-2. This may have led to the greater frequency of blood on the LMA and more frequent sore throat immediately and 1 day after the procedure than with the COPA. A factor that has been shown to reduce the incidence of sore throat with the LMA is cuff pressure control,[13] yet this was not attempted with either device in the present study. Multiple attempts at insertion probably increase the incidence of sore throat with the LMA[14] and was suggested as one of the reasons for sore throat in a previous study with the COPA,[1] although it was not seen in this trial.

We conclude that with respect to physiologic alterations using the devices and overall clinical problems, the COPA and LMA are equivalent. The LMA was associated with a higher first-time placement rate and fewer manipulations during use, suggesting that it is easier to use. The COPA was associated with less blood on the device and sore throat, suggesting that it may cause less pharyngeal trauma. Ultimately, both devices can be used to establish a safe and effective airway for spontaneously breathing anesthetized adults.

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