EMS Intubation Improves with King Vision Video Laryngoscopy

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Abstract

Introduction. Intubation success by paramedics has historically been variable. The lack of first-pass success (FPS) has been associated with increased adverse events. Various video laryngoscope (VL) devices have been investigated to improve success among paramedics. Conflicting research exists on VL vs. direct laryngoscopy (DL) by paramedics and on the effects of the specific King Vision device on FPS and overall success (OS) in an emergency medical services (EMS) system with low intubation frequency and historically low success rates. **Objectives**. To evaluate the effect of an ongoing training program using the King Vision VL on FPS, OS, and success per attempt when compared with DL in one suburban EMS system with low historical intubation success rates. **Methods**. We performed a retrospective analysis of electronic patient care reports in a suburban EMS system. We analyzed three metrics of intubation success before DL and after implementation of ongoing training with VL in both cardiac arrest and in all other indications: success per attempt, overall success, and first-pass success. We also performed an intention to treat analysis of these rates to account for protocol violations. **Results.** During the study period, intubation was attempted on 514 patients. There was no difference between the DL and VL groups in age, weight, gender, or percentage receiving paralytic medications. There was improvement over DL with VL in each of the outcome measures: overall success (64.9 vs. 91.5%, $p < 0.01$), first-pass success (43.8% vs. 74.2%, $p < 0.01$), and success per attempt (44.4 vs. 71.2%, $p < 0.01$). A subgroup analysis by indication for intubation also showed improvement in all metrics for all indications. There were several protocol violations: 11 of 376 attempts that should have used VL (2.9%) but were done with DL. An intention to treat analysis was therefore done. Again, we saw an improvement in all metrics for all indications. **Conclusion**. In this suburban EMS system with historically low intubation success rates and low frequency of intubation, paramedics were able to improve all measures of intubation success using the King Vision video laryngoscope and an ongoing training program when compared with direct laryngoscopy. **Key words:** intubation; airway management; emergency medical services; prehospital emergency care

PREHOSPITAL EMERGENCY CARE 2015;Early Online:1–8

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Introduction

Endotracheal intubation is a fundamental skill of paramedics, defined in the National EMS Scope of Practice Model[1] and required for national certification.[2] It is commonly included in the protocols of most U.S. emergency medical systems (EMS), despite variable reported overall success rates of between 48 and 99%.[3–7] Recently, there has been increased recognition of the importance of first-pass success.[8] First-pass success rates in EMS with direct laryngoscopy (DL) have also been variable between 57 and 77%.[6,9]

Video laryngoscopy (VL) with a variety of devices has been suggested as providing better intubating conditions and leading to better intubating success. The results of studies comparing DL and VL have been mixed,[10–13] although a systematic review of the literature does show an improvement in success rates with VL vs. DL in novice intubators.[14] Studies from systems with experienced paramedics and high baseline success rates have shown little to no benefit of VL vs. DL but this has not been evaluated in an EMS system with inexperienced (low annual intubation rates) and low baseline success rates.[12,15]

The King Vision VL (Ambu. Ballerup, Denmark) is a device utilizing a color display with an attached reusable blade. The blades come in two varieties, both with (Figure 1) and without a channel to hold and guide the ET tube. The "head" of the device is approximately $1,000, with the reusable blades costing ~$25. It has a hyperacute, angled blade, similar to the GlideScope (Verathon Medical, Bothell, WA)

Received July 25, 2014 from the Department of Emergency Medicine, Scott & White Healthcare/Texas A&M University College of Medicine, Temple, Texas (JLJ), Williamson County EMS, Georgetown, Texas (JLJ, SFM, DJ), and William Carey University College of Osteopathic Medicine, Hattiesburg, Mississippi (SFM). Revision received December 15, 2014; accepted for publication December 16, 2014.

There was no support, financial or in-kind, by the manufacturer of the King Vision device. All devices were purchased by the EMS system.

An abstract of this paper was presented in poster form at the Texas EMS Conference Fort Worth, November 2013, the TCEP Annual Conference, April 2014, and the SAEM Dallas, May 2014, and in oral form at SAEM Dallas, May 2014.

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The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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doi: 10.3109/10903127.2015.1005259

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FIGURE 1. King Vision video laryngoscope with channeled blade.

device, which uses an indirect, nondisplacing intubating technique. Recently, several studies have evaluated its use, compared both with DL and with other VL devices,[16–19] again with mixed results.

We identified poor intubation success using DL (64.9% overall success) during normal quality improvement efforts at a suburban EMS system. In an attempt to improve this, we implemented a program on continual training using video laryngoscopy instead of direct laryngoscopy.

This study aims to assess whether intubation success rates with DL can be improved with a program of ongoing training using VL with the King Vision device in this EMS system with a history of low intubation success rates and few annual intubations per paramedic.

METHODS

Population and Setting

The population of the study was all patients undergoing endotracheal intubation for any indication during the study period. The system is a county government, third service EMS system covering a mixed rural and suburban county of over 1,100 square miles and a population of 495,000 citizens. The system consists of 123 credentialed paramedics staffing 19 ambulances with two paramedic each in addition to three paramedic commanders in non-transport vehicles augmented by 16 fire department first-responder agencies (none of whom are credentialed or equipped to intubate).

All credentialed paramedics are authorized to perform endotracheal intubation utilizing sedation and paralytic medications. All were trained in documentation of intubation attempts using the documentation standards. They also participated in 100% peer–peer chart review to assure documentation compliance with, among other things, these definitions. The EMS medical director also reviews 100% of all charts with an intubation attempt and assures compliance with these definitions.

We selected the King Vision for our system after a brief cadaver workshop demonstrated better paramedic satisfaction where it was preferred for usability and glottic view over the AirTraq (Prodol Meditec, Bizkaia, Spain) and the VividTrak (FujiFilm SonoSite, Bothell, WA). Other devices, including the GlideScope and C-Mac (Karl Storz, Tuttlingen, Germany), were not considered because of budgetary restrictions.

Study Design

We performed a retrospective observational study of all records in our electronic patient care report (ePCR) system (emsCharts, Pittsburg, PA) between October 1, 2010 and November 14, 2013 using a "before and after" adoption of VL strategy. This date range was chosen because prior to October 1, 2010 we had not yet implemented a standard definition of an intubation. All intubation attempts between October 1, 2010 and June 19, 2012 were performed with DL. A phase-in period occurred from June 20, 2012 to September 30, 2012 during which the King Vision was available on only four ambulances. On October 1, 2012 the King Vision was distributed to all ambulances and all adult intubations were required by protocol to be performed using VL. Between October 1, 2012 and August 15, 2013, however, there were several protocol violations in which

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the patient should have been intubated using VL but had DL used instead. To prevent these protocol violations, all DL blades were removed from the ambulance inventory save a single direct blade used solely for use with foreign body removal. After August 16, 2013, providers no longer had a choice of DL or VL for intubation and used VL for all adult intubations. In the event of a device failure, the providers were instructed to proceed directly to a rescue airway and not make an attempt with DL.

Data elements analyzed were limited to those that had been historically collected in the ePCR. This prohibited analysis of variables such as body mass index, Mallampati scores, and duration of intubation attempts. Additionally, while data concerning oxygen saturation and end tidal CO_2 were transferred into the ePCR, the fashion in which it is done does not lend itself to aggregate analysis.

The lead author conducted multiple training sessions prior to full implementation. These included both didactic and psychomotor practice and were approximately 1 hour per session. While the system had conducted periodic training sessions with skills verification with DL, there was no ongoing training program in place with DL prior to the implementation of VL.

All medics practiced intubation with the device on manikins and were required to successfully demonstrate competence with the King Vision VL prior to implementation. We also provided ongoing training that included two mandatory video updates (~30 minutes each) focusing on lessons learned and reminders of initial techniques. Paramedic field commanders conducted ongoing manikin-based training with all paramedics on a monthly basis that included monthly skills verification for each medic. Finally, a field commander is simultaneously dispatched on all calls that are predicted to result in intubation based on emergency medical dispatch caller interrogation protocols. These field commanders received the same training as the other field paramedics in the use of the King Vision but also had additional training with the medical director on how to teach the procedure (tips/tricks, troubleshooting, etc.) and specific items to observe in the field, including confirming the number of attempts/successes documented in the ePCR. Their primary role regarding intubation is to support and assist the medic but, from time to time, they will perform the procedure. Intubation performance is reported monthly to the staff on a system (not by individual) basis.

Paramedic competence in intubation is confirmed at hiring and annually thereafter with manikin testing. After implementation of the King Vision, monthly manikin testing became mandatory for all medics. No operating room experience is available in the area and thus not mandated. Additionally, deployment requirements prohibit us from requiring a minimum number of intubations per year per medic. For 2013, the average intubations-per-medic was 2.9 (median 2, interquartile range 3 [1–4]); out of 131 credentialed paramedics there were 12 (9%) with no intubations and 30 (23%) with only 1 intubation. Some medics clearly have more intubations per year than others. This is largely a function of their station location. The system covers both suburban and rural areas with resulting higher and lower call volumes.

Pre-intubation oxygenation is required and includes high-flow oxygen by non-rebreather mask or BVM in conjunction with simultaneous low-flow oxygen by nasal cannula. This nasal oxygen is then increased to high flow as soon as the patient is able to tolerate it following sedation and is continued throughout the intubation attempt.

Any patient felt to need paralytic medication is given both succinylcholine and ketamine prior to the procedure. Roccuronium was used in place of succinylcholine for a brief period when succinylcholine was not available due to a drug shortage. Post intubation analgesia and sedation are mandatory and achieved with the combination of fentanyl and Versed unless the patient is hypotensive, in which case ketamine is used.

Protocol dictates that compressions not be interrupted for any period of time for intubation during cardiac arrest, therefore intubations were done with simultaneous compressions. Verification of this is obtained in an ongoing fashion during review of compression metrics obtained through our cardiac monitor CPR (cardiopulmonary resuscitation) feedback device (Phillips MRX and qCPR device, Andover, MA).

Outcome Measures

We analyzed three metrics of intubation success before (using DL) and after (using VL) implementation: first-pass success (FPS), success per attempt, and overall success. FPS rates are calculated as number of first-attempt successes/number of patients with an intubation attempt. An FPS was defined as an ET tube passing through the vocal cords on the first attempt and confirmed in the standard fashion described below. The success per attempt rate is defined as the number of successful intubations/number of intubation attempts. Overall success rate is the number of successful intubations/number of patients with an attempt. It is possible with these definitions to have more than one first-pass success per patient if the initial attempt was successful but the tube became dislodged after being secured and then the patient was again successfully intubated on the first subsequent attempt, i.e., without a prior unsuccessful attempt. Likewise, it is possible to have multiple successes per patient for similar reasons. Paramedics are limited by protocol to a maximum of two attempts per patient at intubation before

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using a blind insertion airway device. The system used the King LT during this study as its blind insertion rescue device.

The system has formal documentation standards, which define an intubation attempt as anytime the laryngoscope blade passes the teeth (or enters the mouth) regardless of whether ET tube placement was attempted. The attempt ends when the blade is removed past the teeth (or from the mouth). A successful intubation attempt is required to be confirmed with all of the following: direct visualization, waveform capnography, presence of breath sounds and chest rise, and the absence of gastric sounds. In cases using video laryngoscopy, two providers are required to confirm placement with direct visualization that is possible because of the wide viewing angle of the display.

Analytical Methods

All data were exported from our ePCR into MS Excel (Microsoft, Redmond, WA) for analysis. Statistical testing was performed using a free online calculator (www.graphpad.com/quickcalcs/). We used a two-tailed Fischer's exact test for categorical data and an unpaired *t*-test to compare continuous data. A *p*-value of <0.05 was considered significant.

Human Subjects Committee Review

This project was undertaken as a quality improvement initiative at Scott & White Hospital, and as such was not formally supervised by the Institutional Review Board, per their policies on quality improvement initiatives.

RESULTS

During the study period, intubation was attempted on 514 patients. Of these, the majority were with VL (329 or 64%) vs. DL (185 or 36%). There were 196 attempts with DL between October 1, 2010 and June 19, 2012. On June 20, 2012 the King Vision was introduced to four of our units. Between June 20, 2012 and September 30, 2012 there were 52 DL attempts and 21 VL attempts. The King Vision was placed in service on all units on October 1, 2012. From this date through August 15, 2013, there were 11 attempts made with DL in violation of protocol and 293 made with VL. From this point until the end of the study on November 14, 2013 there were 293 VL attempts with no protocol violations. Figure 2 summarizes the distribution and outcome of all patients in the study. There was no statistical difference between DL and VL groups in average age, weight, percentage of male patients, or percentage receiving paralytic medications (Table 1). There were 14 patients, representing 2.7% of the total intubations, for whom three attempts at intubation occurred prior to placement of a rescue device (7 DL versus 7 VL) and 1 patient (0.2% of total) who had four attempts. There were no patients with more than four intubation attempts with either DL or VL. Supervisors performed 13 intubations: 7 (3.8%) with DL and 5 (1.5%) with VL.

TABLE 1 All intubations, demographics and success rates

	DL	VL	*p*-value
Age, years	59.1	61	0.3
Weight, kg	82.9	87.9	0.07
Male, %	58.9	60.8	0.7
Paralytic use, %	34.1	33.4	0.9
Cardiac arrest, %	62.7	69.3	0.1

There was improvement in intubation success with VL over DL in each of the outcome measures (Table 2): overall success (DL 64.9 vs. VL 91.5%), first-pass success (DL 43.8 vs. VL 74.2%), and success per attempt (DL 44.4 vs. VL 71.2%). Of those patients in whom intubation was not successful, there was no difference in the success of rescue device placement between DL and VL groups respectively (93.8 and 89.3%, $p = 0.4$) (Table 3).

Cardiac arrest was the most common indication for intubation in both groups, with 116 (62.7%) in the DL group and 228 (69.3%) in the VL group. A subgroup analysis was done based on indication for intubation: cardiac arrest versus non-cardiac arrest (Table 3). There was no significant difference in the demographics to include age, percent male patients, and paralytic use (DL versus VL) in both subgroups by indication for intubation. In addition, the non-cardiac arrest indication subgroup had no significant difference in average weight in the DL versus VL groups. However, in the cardiac arrest subgroups, the DL group of patients was lighter when compared with the VL group (DL 75.7 kg vs. VL 88.9 kg, $p < 0.01$). Similar to the overall group, there was an improvement with VL compared with DL in all three outcome measures in both those undergoing intubation for cardiac arrest and non-cardiac arrest.

There were 11 protocol violations representing 2.9% of all intended VL attempts performed. All protocol violations involved using the DL instead of the VL according to protocol. Nine were for cardiac arrest and

TABLE 2. Success rates, DL versus VL for all patients

	DL	VL	*p*-value
Patients	185	329	
Successes	120	301	
First-pass successes	81	244	
Attempts	270	423	
Overall success rate, %	64.9	91.5	<0.01
First-pass success rate, %	43.8	74.2	<0. 01
Success per attempt rate, %	44.4	71.2	<0.01

Overall success, successes/patients; first-pass success, first-pass success/patients; success per attempt, success/attempts.

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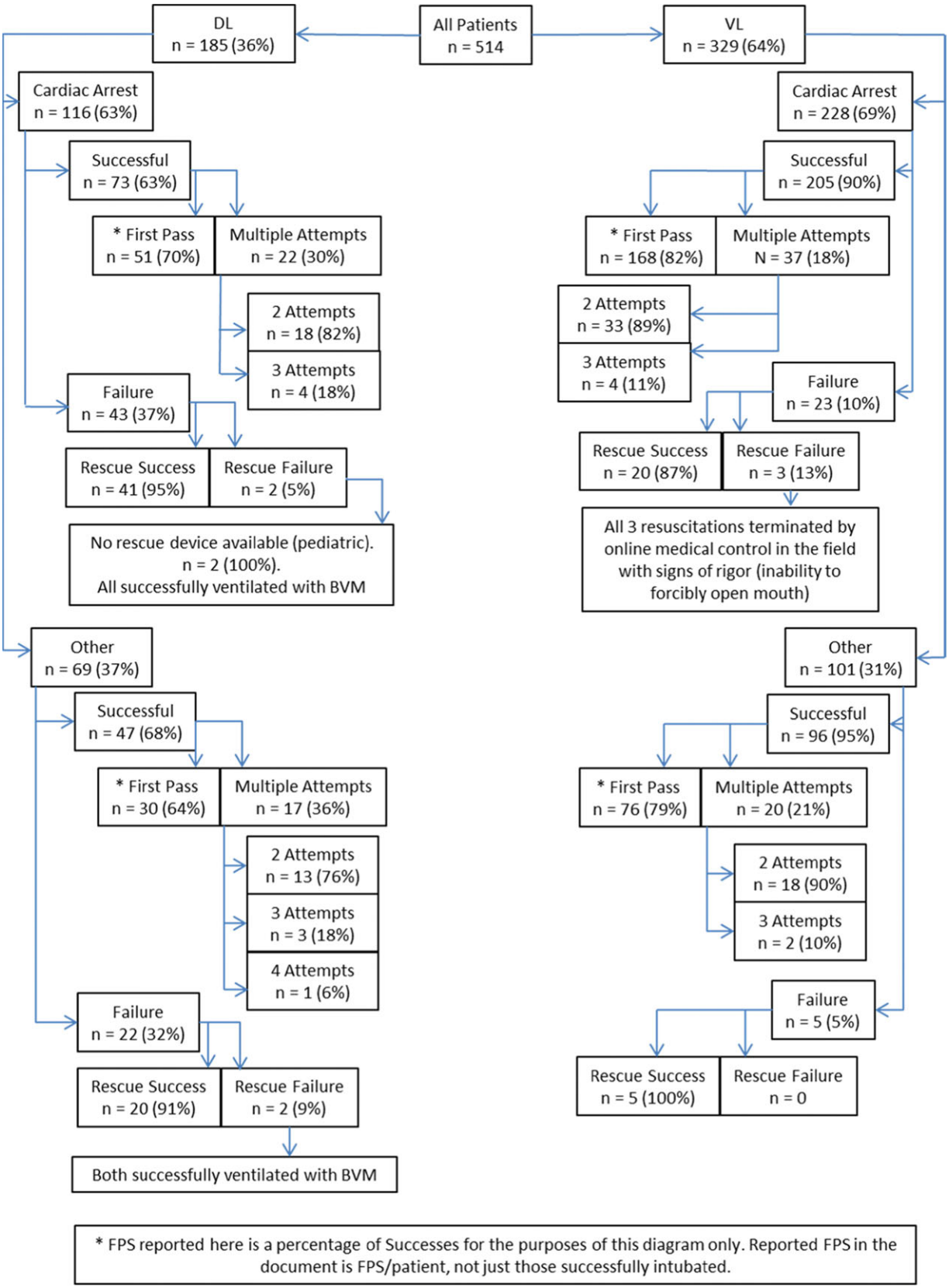

Figure 2. Distribution of patients and outcomes. DL, direct laryngoscopy; VL, video laryngoscopy; FPS, first-pass success; BVM, bag valve mask.

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TABLE 3. Subgroup analysis by indication for intubation

	DL	VL	*p*-value
Cardiac arrest patients			
Age, years	61	64.4	0.1
Weight, kg	75.7	88.9	<0.01
Male, %	61.2	63.6	0.7
Paralytic use, %	5.17	9.21	0.2
Patients	116	228	
Successes	73	205	
First-pass successes	51	168	
Attempts	167	296	
Overall success rate, %	62.9	89.9	<0.01
First-pass success rate, %	44.0	73.7	<0.01
Success per attempt rate, %	43.7	69.3	<0.01
Non-cardiac arrest patients (all other indications)			
Age, years	57.7	53.3	0.2
Weight, kg	88	85.8	0.6
Male, %	55.1	54.5	1
Paralytic use, %	82.6	88.1	0.4
Patients	69	101	
Successes	47	96	
First-pass successes	30	76	
Attempts	103	127	
Overall success rate, %	68.1	95.0	<0.01
First-pass success rate, %	43.5	75.2	<0.01
Success per attempt rate, %	45.6	75.6	<0.01

Overall success, successes/patients; first-pass success, first-pass success/patients; success per attempt, success/attempts.

two were for other indications. An intention to treat analysis was performed to account for these violations. In this analysis, there was also an improvement in all three outcome measures with VL over DL (Table 4) and in subgroup analysis by indication for both cardiac arrest and non-cardiac arrest (Table 5). Patients undergoing VL were heavier than those undergoing DL in both the overall group analysis and the subgroup by indication analysis for the cardiac arrest indication. All other demographics were not significantly different in the overall analysis or in the non-cardiac arrest indication subgroup analysis.

TABLE 4. Demographics and success rates for intention to treat

	DL	VL	*p*-value
Age, years	58.9	61	0.3
Weight, kg	82.3	88.1	0.04
Male, %	58.6	60.9	0.6
Paralytic use, %	35.6	32.6	0.6
Cardiac arrest, %	61.5	70.0	0.07
Patients	174	340	
Successes	112	309	
First-pass successes	73	252	
Attempts	258	435	
Overall success rate, %	64.4	90.9	<0.01
First-pass success rate, %	42.0	74.1	<0.01
Success per attempt rate, %	43.4	71.0	<0.01

Overall success, successes/patients; first-pass success, first-pass success/patients; success per attempt, success/attempts.

TABLE 5. Subgroup analysis by indication for intention to treat

	DL	VL	*p*-value
Cardiac arrest patients			
Age, years	60	64.4	0.08
Weight, kg	80.7	88.8	0.02
Male, %	60.7	63.7	0.6
Paralytic use, %	5.61	8.86	0.4
Patients	107	237	
Successes	67	211	
First-pass successes	45	174	
Attempts	157	306	
Overall success rate, %	62.6	89.0	<0.01
First-pass success rate, %	42.1	73.4	<0.01
Success per attempt rate, %	42.7	69.0	<0.01
Non-cardiac arrest patients (all other indications)			
Age, years	56.7	53.4	0.4
Weight, kg	85	86.3	0.8
Male, %	55.2	54.4	1
Paralytic use, %	83.6	87.4	0.5
Patients	67	103	
Successes	45	98	
First-pass successes	28	78	
Attempts	101	129	
Overall success rate, %	67.2	95.1	<0.01
First-pass success rate, %	41.8	75.7	<0.01
Success per attempt rate, %	44.6	76.0	<0.01

Overall success, successes/patients; first-pass success, first-pass success/patients; success per attempt, success/attempts.

DISCUSSION

We saw a significant increase in all measures of intubation success and across all indications for intubation with the King Vision VL compared with DL, but our baseline experience with DL intubations (64.9%) was worse than that previously reported for ground EMS systems, allowing much room for improvement. Wang et al. reported on a multicenter prospective study showing overall success rates of 86.8%,[3] and on a registry study of over 10,000 intubations 7 years later showing an overall success rate of 77%.[4] Diggs et al. repeated this registry study 4 years later, showing an 85% overall success rate,[5] and Prekker et al. showed an astounding 99% overall success rate.[6] Our FPS rates with DL were also worse than has been reported. Prekker et al.'s FPS in King County was 77%[6] and Wang et al. showed an FPS rate in cardiac arrest of 70% compared with our rate of 44%. They reported a 78% rate in non-cardiac arrest compared with our 44% in this group.[9]

We saw an improvement with VL compared with DL, which is consistent with that seen by Cinar et al. in manikins[10] (79% with DL vs. 92% with VL) and in a systematic review including novice operators (paramedics and non-anesthesia house staff) showing an improvement from 52% with DL to 94% with VL.[14] It is in contrast, however, with that seen by Wayne and McDonnell in a study comparing the GlideScope Ranger device that showed a 95% rate with DL vs. 97%

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with VL.[12] Unlike our system, the one described by Wayne had a high baseline intubation success rate with DL. Griesdale et al.'s systematic review also showed no significant improvement (83% with DL vs. 87% with VL) in experienced (anesthesiologist) intubators. It is likely that this difference between experienced and novice intubators with VL is reflective of a ceiling effect. If experienced operators are already highly successful, it will be difficult to show improvement, where novice operators with lower success rates with DL, such as those in our system, are likely to show more improvement with VL.

Finally, several studies using manikins have also failed to show a significant improvement with VL. Piepho et al. used manikins to compare the McGrath and GlideScope VL devices with a Macintosh DL blade and saw no significant improvement.[13] Similarly, a manikin study of nurses without any prior intubation experience compared DL using a Macintosh blade with the King Vision using both a channeled and nonchanneled blade.[18] No significant difference in success rates was found between the Mac (85%) and the King Vision channeled blade (86%). Interestingly, there was a significant decrease in success with the nonchanneled blade (42%) compared with both the channeled and Macintosh blade. It is possible that manikins, by nature of presenting a relatively easy intubation, may blunt any improvement seen with VL because it would be difficult to show an improvement if the rates with all methods are high.

During the early phases of implementing VL, we noted a high initial success followed by a rapid drop-off. This was similar to that reported by Burnett et al.[19] in their recent study comparing the C-MAC to the King Vision. After we implemented a program of ongoing training with required monthly manikin training for all medics, we noted a steady improvement in these rates, suggesting the existence of skill degradation without ongoing training. It is also possible that the marked drop-off in success with the King Vision seen by Burnett may be due to the differences in laryngoscope function and technique between devices. The C-MAC is used in a similar fashion to DL. Because provider's initial training was presumably done with DL, they were likely more familiar and experienced with this technique. This may explain why the degradation in success they saw with the King Vision was not seen with the C-MAC.

Video laryngoscopes can be divided into two categories based on their function: displacing and nondisplacing devices. Displacing devices operate like traditional direct laryngoscopy and "displace" the tissues of the oropharynx anteriorly so that the glottic opening may be directly visualized from outside the mouth. Nondisplacing devices do not lift these tissues, rather they curve around the tongue to visualize the glottic opening without requiring full alignment of airway axes. Displacing devices, such as the CMAC, have the advantage of being able to be used with the same technique as direct laryngoscopy and, therefore, may have a shorter learning curve for those with experience with directly laryngoscopy. The technique used with nondisplacing devices may be more foreign to experienced operators, require a different skill set, and contribute to the rapid drop-off seen in the Burnett et al. paper.[19]

Figure 3. Correct hand position.

We determined that we had to train our medics to consider intubating with the nondisplacing King Vision, to be a different skill than using DL. We instructed the paramedics to hold the device low down on the blade (Figure 3) rather than using the handle itself (Figure 4). This successfully addressed two issues: first, it prevented the device failures noted in the Burnett trial in which the screen would become dislodged from the blade, and, second, it minimized the likelihood of the medic inserting the blade too deeply into the oropharynx. The depth of insertion was very important. Inserting the blade under the epiglottis and lifting, in the fashion of a Miller blade, almost universally gave the medic a clear view of the glottic opening but the medics would be unable to manipulate the tube into the trachea. Inserting the tip of the blade into the vallecula, akin to the use of a Macintosh blade, would give a good view of the glottis opening and allow for easy intubation. We operationalized this concept by teaching each paramedic to look for "the view," which consisted of a clear and midline view of the epiglottis anterior to the glottic opening. The paramedics are instructed to not attempt to pass a tube without first obtaining "the view."

Finally, we identified an additional benefit of using a device with a channeled blade. A common reason given for a failed intubation attempt was the presence of blood or gastric contents requiring suctioning. Using the channeled video blade, it is possible to si-

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FIGURE 4. Incorrect hand position.

multaneously and continuously suction throughout an intubation attempt. This skill was incorporated into the monthly training sessions.

LIMITATIONS

There are several potential confounders that may limit generalization of the results seen in this study. Ongoing training with the device was implemented along with VL but not with DL. This training could be expected to improve rates regardless of device. We also began regular reporting of these three success rates as part of our quality improvement program. This reporting may have induced a Hawthorne effect. Finally, this study was not a prospective randomized, controlled trial. It was a retrospective chart review that presents inherent limitations to generalizability. While we attempted to control for other variables, a randomized, prospective trial that controls for all variables, including ongoing education, is needed to better answer this question.

CONCLUSIONS

In this suburban EMS system with historically low success with direct laryngoscopy and low frequency of paramedic intubation attempts, paramedics were able to improve all measures of intubation success using the King Vision video laryngoscope and an ongoing training program when compared with direct laryngoscopy.

References

1. The National EMS Scope of Practice Model. NHTSA, February 2007.
2. National Registry of EMTs. www.nremt.org. Accessed April 2014.
3. Wang HE, Kupas DF, Paris PM, Bates RR, Yealy, DM. Preliminary experience with a prospective, multi-centered evaluation of out-of-hospital endotracheal intubation. Resuscitation. 2004 Jul;58(1):49–58.
4. Wang HE, Mann NC, Mears G, Jacobson K, Yealy DM. Out-of-hospital airway management in the United States. Resuscitation. 2011 Apr;82(4):378–85.
5. Diggs LA, Yusuf JE, De Leo G. An update on out-of-hospital airway management practices in the United States. Resuscitation. 2014 Jul;85(7):885–92.
6. Prekker ME, Kwok H, Shin J, Carlbom D, Grabinsky A, Rea TD. The process of prehospital airway management: challenges and solutions during paramedic endotracheal intubation. Crit Care Med. 2014;42(6):1372–78.
7. Hubble MW, Brown L, Wilfong DA, Hertelendy A, Benner RW, Richards ME. A meta-analysis of prehospital airway control techniques, part I: orotracheal and nasotracheal intubation success rates. Prehosp Emerg Care. 2010;14:377–401.
8. Sakles JC, Chiu S, Mosier J, Walker C, Stolz U. The importance of first pass success when performing orotracheal intubation in the emergency department. Acad Emerg Med. 2013;20:71–8.
9. Wang HE, Yealy DM. How many attempts are required to accomplish out-of-hospital endotracheal intubation? Acad Emerg Med. 2006;13(4):372–77.
10. Cinar O, Cevik E, Yildirim AO, Yasar M, Kilic E, Comert B. Comparison of GlideScope video laryngoscope and intubating laryngeal mask airway with direct laryngosopy for endotracheal intubation. Eur J Emerg Med. 2011 Apr;18(2):117–20.
11. Kim YM, Kang HG, Kim JH, Chung HS, Yim HW, Joeng SH. Direct versus video laryngoscopic intubation by novice prehospital intubators with and without chest compressions: a pilot manikin study. Prehosp Emerg Care. 2011 Jan-Mar; 15(1):98–103.
12. Wayne MA, McDonnell M. Comparison of traditional versus video laryngoscopy in out-of-hospital tracheal intubation. Prehosp Emerg Care. 2010 Apr-Jun;14(2):278–82.
13. Piepho T, Weinert K, Heid FM, Werner C, Noppens RR. Comparison of the McGrath Series 5 and the GlideScope Ranger with the Macintosh laryngoscope by paramedics. Scan J Trauma Resusc Emerg Med. 2011 Jan 17;19(1):4.
14. Griesdale DE, Liu D, McKinney J, Choi PT. Glidescope videolaryngoscopy versus direct laryngoscopy for endotracheal intubation: a systematic review and meta-analysis. Can J Anaesth. 2012 Jan;59(1):41–52.
15. Guyette FX, Farrell K, Carlson JN, Callaway CW, Phrampus P. Comparison of video laryngoscopy and direct laryngoscopy in a critical care transport service. Prehosp Emerg Care. 2013;17:149–54.
16. Murphy LD, Kovacs GJ, Reardon PM, Law JA. Comparison of the King Vision video laryngoscope with the Macintosh laryngoscope. J Emerg Med. 2014 Aug;47(2):239–46.
17. Yun BJ, Brown CA 3rd, Grazioso CJ, Pozner CN, Raja AS. Comparison of video, optical, and directly laryngoscopy by experienced tactical paramedics. Prehosp Emerg Care. 2014 Jul-Sep;18(3):442–5.
18. Akishisa Y, Maruyama K, Koyama Y, Yamada R, Ogura A, Andoh T. Comparison of intubation performance between the King Vision and Macintosh laryngoscopes in novice personnel: a randomized, crossover manikin study. J Anesth. 2014 Feb;28(1):51–7.
19. Burnett AM, Frascone RJ, Wewerka SS, Kealey SE, Evens ZN, Griffith KR, Salzman JG. Comparison of success rates between two video laryngoscope systems used in a prehospital clinical trial. Prehosp Emerg Care. 2014;18:231–8.

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