Abstract for submission to Vanderbilt Global Health Symposium (figures and tables attached at end of document)

Title:

Impact of the COVID-19 Pandemic on Surgical Care and Outcomes at Two Tertiary Hospitals in Ethiopia

Authors:
Amany K Alshibli, BS [1]
Masresha G Teklehaimanot, BSc [2]
Rahel Seyoum, MSc [3]
Gebrehiwot A Tegu, MSc [3]
Haftom B Desta, MSc [2]
Gosa Tesfaye, MD [3]
Agenchew N Tsegaw, MSc [3]
Abraha Y Abay, BSc [2]
Naod B Etanaa, MSc [2]
Mulat Mossie, MSc [3]
Kore M Binwe, MSc [2]
Fantahun Tarekegn, MSc [3]
Hagos G Gebremedhin, MSc [2]
Mark Newton, MD [1]
Bantayehu Sileshi, MD [1]

Institutions:
[1] Vanderbilt University Medical Center, Nashville, TN
[2] Mekelle University, Mekelle, Ethiopia
[3] Bahir Dar University, Bahir Dar, Ethiopia

Introduction:
Disruption to healthcare services during the COVID-19 pandemic has been multi-faceted, with an estimated 72% cancellation rate of non-urgent surgeries worldwide.[1] Experts fear the "collateral damage" resulting from delaying care for unrelated conditions.[2–4] There is little known about how the pandemic has and will continue to affect the provision of surgical care in a low-resource setting. We set out to determine the impact of the COVID-19 pandemic on surgical care and outcomes at two tertiary hospitals in Ethiopia.
Methods:
We conducted a retrospective cohort study comparing surgeries performed during the pandemic to a year prior at Ayder Comprehensive Specialized Hospital in Mekelle (ACSH) and Tibebe Ghion Specialized Hospital in Bahir Dar (TGSH). The exposure is the COVID-19 pandemic, defined as: "Phase 0" prior to the pandemic, "Phase 1" when elective surgeries were cancelled, and "Phase 2" when elective surgeries resumed. Outcomes include 28-day perioperative mortality, case volume and referral patterns. Perioperative data was collected via

a REDCap form.[5] Statistical analysis was performed using R software. Impact of the exposure on 28-day mortality was determined using a logistic regression controlling for age, ASA status, urgency, procedure type, surgery length, and anesthesia type.

Results:
Data from 3449 surgeries were captured (Table 1). We observed a reduction in estimated case volume at TGSH (14 vs. 5 vs. 10 daily cases in phase 0, 1, and 2 respectively; $p<0.001$) and at ACSH (18 vs. 6 vs. 8 daily cases during phase 0, 1, and 2; $p<0.001$) (Figure 1). At ACSH there was an increase in proportion of patients from outside Mekelle during phase 1 and 2 compared to phase 0 ($p<0.001$ and $p=0.001$ respectively). Contrarily, at TGSH there was a decrease in proportion of patients from outside the district during phase 2 compared to phase 0 ($p=0.01$) (Table 2). 28-day mortality did not differ significantly between phases 0, 1, and 2 (2.1% vs. 3.0% vs. 2.8% respectively, $p=0.265$). Odds ratios of 28-day mortality were not significantly increased for cases performed during phase 1 (OR 1.19 [95% CI 0.57-2.43]) and phase 2 (1.33 [95% CI 0.77-2.35]) compared to phase 0 when accounting for confounders. ASA status 3 or more, emergency status, surgery length, and subspecialty surgeries were associated with increased mortality, consistent with previous literature[5–7] (Figure 2).

Conclusions:
Daily surgical case volume was significantly reduced during and after lockdown. The proportion of patients from outside the district undergoing surgery differed during the pandemic for each hospital, suggesting a shift in provision of surgical care at surrounding hospitals. These findings suggest that during the pandemic patients may experience delays in seeking or obtaining surgical care. However for patients who underwent surgery, perioperative mortality did not differ between pre-and post-pandemic care when accounting for confounders. Differences between phase 0 and 2 suggest that surgical care was affected even after restrictive policies were lifted. Our results describe the impact of the pandemic and lockdown on surgical care and outcomes at two low-resource referral hospitals which may assist in the development of surgical plans during future public health crises.

References:

1. COVIDSurg Collaborative. Elective surgery cancellations due to the COVID-19 pandemic: global predictive modelling to inform surgical recovery plans. *British Journal of Surgery*. Published online June 13, 2020. doi:10.1002/bjs.11746
2. Sud A, Jones ME, Broggio J, et al. Collateral damage: the impact on outcomes from cancer surgery of the COVID-19 pandemic. *Annals of Oncology*. 2020;31(8):1065-1074. doi:10.1016/j.annonc.2020.05.009
3. Sud A, Torr B, Jones ME, et al. Effect of delays in the 2-week-wait cancer referral pathway during the COVID-19 pandemic on cancer survival in the UK: a modelling study. *The Lancet Oncology*. 2020;21(8):1035-1044. doi:10.1016/S1470-2045(20)30392-2
4. Mazingi D, Navarro S, Bobel MC, Dube A, Mbanje C, Lavy C. Exploring the Impact of COVID-19 on Progress Towards Achieving Global Surgery Goals. *World Journal of Surgery*. 2020;44(8):2451-2457. doi:10.1007/s00268-020-05627-7

5. Sileshi B, Newton MW, Kiptanui J, et al. Monitoring Anesthesia Care Delivery and Perioperative Mortality in Kenya Utilizing a Provider-driven Novel Data Collection Tool. *Anesthesiology*. 2017;127(2):250-271. doi:10.1097/ALN.0000000000001713
6. Newton MW, Hurt SE, McEvoy MD, et al. Pediatric Perioperative Mortality in Kenya. *Anesthesiology*. 2020;132(3):452-460. doi:10.1097/ALN.0000000000003070
7. Biccard BM, Madiba TE, Kluyts H-L, et al. Perioperative patient outcomes in the African Surgical Outcomes Study: a 7-day prospective observational cohort study. *The Lancet*. 2018;391(10130). doi:10.1016/S0140-6736(18)30001-1

		Phase 0	Phase 1	Phase 2	P-value
Number of cases (N)		1402	558	1489	
Age		30.14 (19.55)	31.04 (17.87)	31.84 (19.05)	0.057
Gender					0.512
	Female	619 (46.5)	262 (49.4)	704 (47.4)	
	Male	713 (53.5)	268 (50.6)	781 (52.6)	
Urgency					<0.001
	Elective	739 (54.3)	126 (22.7)	690 (46.7)	
	Emergency	621 (45.7)	429 (77.3)	786 (53.3)	
Trauma		290 (21.4)	154 (27.8)	342 (23.1)	0.011
ASA Status					<0.001
	ASA1	805 (58.3)	125 (22.6)	756 (50.9)	
	ASA2	478 (34.6)	364 (65.8)	640 (43.1)	
	ASA3+	98 (7.1)	64 (11.6)	88 (5.9)	
Comorbidity					0.002
	Anemia	33 (2.4)	10 (1.8)	40 (2.7)	
	Diabetes	19 (1.4)	6 (1.1)	13 (0.9)	
	HIV	29 (2.1)	4 (0.7)	15 (1.0)	
	Hypertension	48 (3.5)	24 (4.3)	95 (6.4)	
	Other	99 (7.1)	16 (2.9)	175 (11.8)	
	None	1160 (83.6)	497 (89.2)	1144 (77.2)	
Time of surgery					0.042
	Daytime	940 (69.3)	379 (69.0)	1074 (72.8)	
	Nighttime	371 (27.4)	155 (28.2)	375 (25.4)	
	Weekend	45 (3.3)	15 (2.7)	26 (1.8)	
Procedure group					<0.001
	C-Section	184 (13.4)	106 (19.0)	238 (16.0)	
	General Surgery	289 (21.0)	114 (20.5)	414 (27.9)	
	Orthopedic	357 (25.9)	125 (22.4)	334 (22.5)	
	Other*	548 (39.8)	212 (38.1)	498 (33.6)	
Surgery length in minutes		85.10 (61.70)	82.78 (47.81)	90.59 (66.97)	0.013
Anesthesia type					0.006
	General	694 (50.7)	285 (51.4)	778 (52.6)	
	Regional	620 (45.3)	262 (47.3)	634 (42.8)	
	Other	56 (4.1)	7 (1.3)	68 (4.6)	
Safe surgery checklist used?					<0.001
	Yes	1295 (94.3)	535 (96.1)	1480 (99.7)	
	No	78 (5.7)	22 (3.9)	4 (0.3)	

Table 1. Demographics of patients undergoing surgery during three phases. Data are presented as absolute counts (%) for categorical and mean (SD) for continuous variables age and surgery length. P value was calculated using Fisher's Exact test for comorbidity and safe surgery checklist, Pearson's chi-square test for remaining categorical variables, and one-way analysis of variance for age and surgery length.
Phase 0 = unexposed, Phase 1 = lockdown, Phase 2 = post-lockdown.
* "Other" procedure group includes subspecialty surgeries: ENT, neurosurgery, cardiothoracic, urology, ophthalmology.

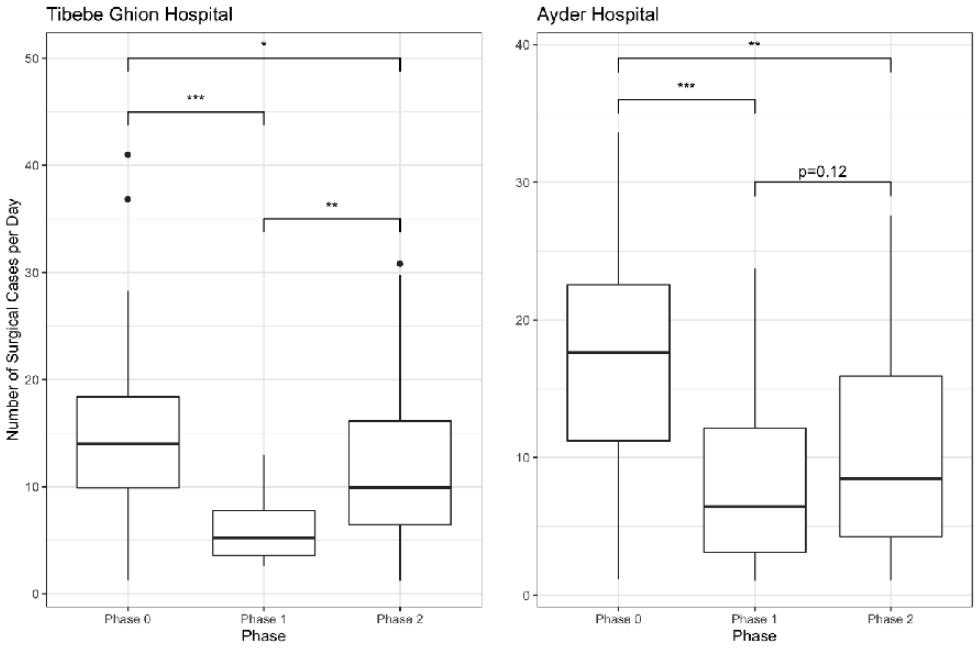

Figure 1. Estimated daily case volume. Estimates were obtained by adjusting the daily case totals in the REDCap database by the monthly proportion of logbook cases recorded in the database. Difference in medians was evaluated with Kruskal-Wallis test. P-value ***<0.001, **<0.01, *< 0.05

** p=0.001

*** p<0.001

	Patient origin	Phase 0	Phase 1	Phase 2	P-value
Ayder Hospital	N	727	508	211	
	Mekelle (local zone of hospital)	356 (50.2)	257 (50.9)	94 (45.0)	<0.001
	Outside zone within Tigray region	277 (39.1)	237 (46.9)	106 (50.7)	
	Outside region	76 (10.7)	11 (2.2)	9 (4.3)	
Tibebe Ghion Hospital	N	675	50	1278	
	West Gojjam (local zone of hospital)	411 (61.5)	39 (78.0)	865 (67.7)	0.02
	Outside zone within Amhara region	243 (36.4)	11 (22.0)	396 (31.0)	
	Outside region	14 (2.1)	0 (0.0)	16 (1.3)	

* p = 0.01

Table 2. Region or district of origin of patient undergoing surgery at each hospital, presented as absolute count (%). ACSH is located in Mekelle in the Tigray region, and TGSH is located in Bahir Dar in the West Gojjam zone of the Amhara region. P value calculated using Pearson's Chi-squared for ACSH and Fisher's exact test for comparisons involving phase 1 at TGSH. Pairwise P values are only displayed if significant at p<0.05.
P value * < 0.05, ** < 0.01, *** < 0.001

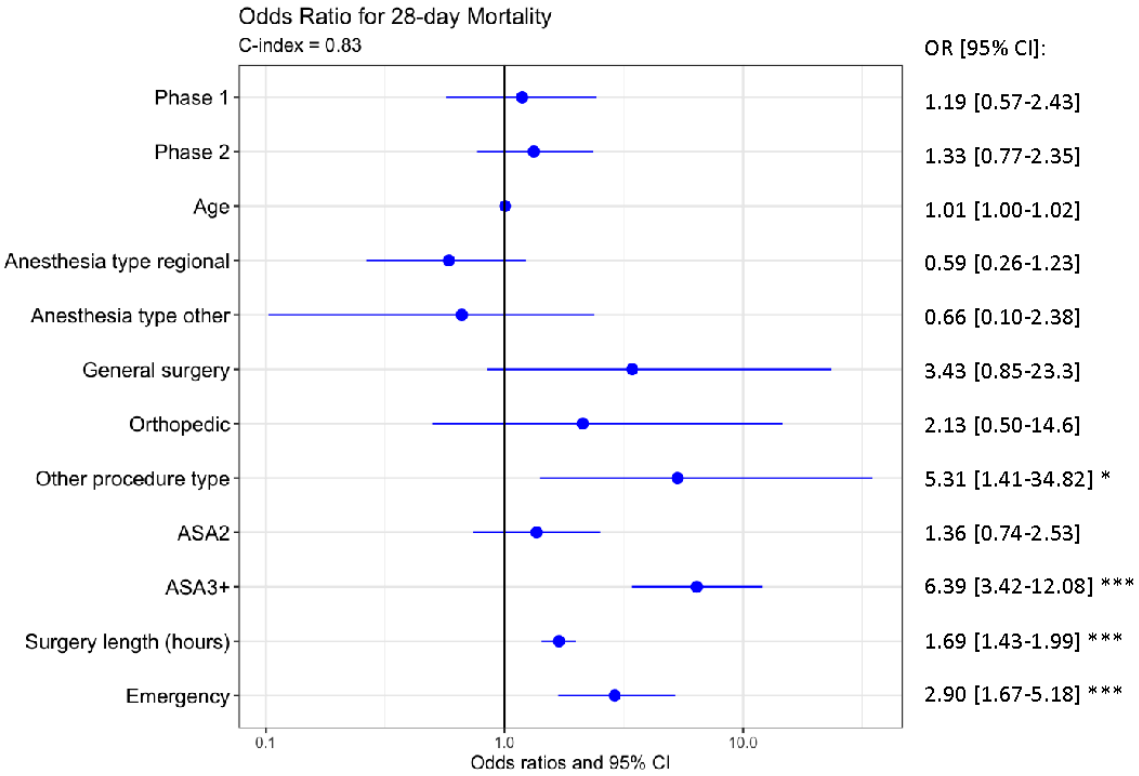

Figure 2. Multivariable logistic regression of 28-day perioperative mortality outcome adjusting for potential confounders. Phase 1 and Phase 2 surgeries were not significantly associated with increased mortality when controlling for confounders. Variables associated with mortality include ASA status 3 or more, emergency status, subspecialty surgery, and surgery length. 'Other procedure type' includes subspecialty surgeries: ENT, neurosurgery, cardiothoracic, urology, ophthalmology.
P-value ***<0.001, **<0.01, *< 0.05