COVID

MDPI

Article

Vascular Care Delivery during the COVID-19 Pandemic: Impact of Office-Based Laboratory and Ambulatory Surgery Center †

Scott S. Berman [1,2,*], Daniel Nguyen [1], Megon L. Berman [1], Joshua A. Balderman [1], Jennifer Clark [1], Luis R. Leon [1,2], Bernardo Mendoza [1], Joseph E. Sabat [1,2] and John P. Pacanowski [1,2]

[1] Department of Vascular and Endovascular Surgery, University of Arizona, 1625 N Campbell Ave, Tucson, AZ 85719, USA
[2] Southern Arizona Vascular Institute, Tucson, AZ 85704, USA
* Correspondence: bermanaz@gmail.com; Tel.: +1-520-360-1146; Fax: +1-520-628-4863
† Presented in part at the poster session of the Western Vascular Society 35th Annual Meeting, Santa Monica, CA, USA, 26–29 September 2020.

Abstract: Objective: To evaluate how access to an office-based laboratory (OBL) and ambulatory surgery center (ASC) impacted vascular care during the Coronavirus Disease 2019 (COVID-19) pandemic. Methods: Vascular procedures performed by our group during the 6-week period before COVID-19 restrictions (group 1) and in the first 6-week period during the COVID-19 restrictions (group 2) were reviewed. The number of procedures performed was categorized as hospital inpatient (HIP), hospital outpatient (HOP), OBL, ASC, and vein center (VC). The procedures were also grouped by type: aneurysm (AAA), carotid (CAR), peripheral arterial disease (PAD), amputation/wound care (AMP), vascular access (VA), deep vein thrombosis (DVT), and venous reflux (CVI). The number of healthcare provider contact points for each patient undergoing care at the HOP, OBL, and ASC were also collected and compared between groups 1 and 2. Differences between groups were determined using the two-way ANOVA. Results: There were no statistically significant differences between groups 1 and 2 for procedure location or type of procedure ($p > 0.05$). Patient contact with healthcare providers decreased between groups 1 and 2 for ambulatory care. However, projecting the number of contacts for patients in group 2 if they had to have ambulatory care in the HOP setting (913) compared to contacts in the OBL and ASC setting (588) was statistically significant ($p < 0.05$). No patient or staff member at the OBL or ASC developed COVID-19 infection because of the care received at these venues. Conclusions: The ability to provide essential care for patients in an ambulatory environment was enhanced using our OBL and ASC without compromising safety, efficacy, or transmission of the virus to patients or staff during the height of the COVID-19 pandemic and limited their contact with healthcare workers and therefore reduced the consumption of personal protective equipment by healthcare personnel.

Keywords: COVID-19; vascular care; office-based lab; ambulatory surgery center

Citation: Berman, S.S.; Nguyen, D.; Berman, M.L.; Balderman, J.A.; Clark, J.; Leon, L.R.; Mendoza, B.; Sabat, J.E.; Pacanowski, J.P. Vascular Care Delivery during the COVID-19 Pandemic: Impact of Office-Based Laboratory and Ambulatory Surgery Center. *COVID* **2024**, *4*, 1204–1210. https://doi.org/10.3390/covid4080085

Received: 23 June 2024
Revised: 31 July 2024
Accepted: 2 August 2024
Published: 5 August 2024

1. Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic has devastated global health and placed an unprecedented strain on the availability of healthcare resources [1,2]. With guidelines from the American College of Surgeons (ACS) recommending the cessation of all elective surgical procedures, the ability of healthcare systems to effectively care for patients while maintaining financial infrastructure has been challenged in ways not previously seen [3]. Global initiatives, such as social distancing and sheltering in place, have been mandated at different periods to help curtail the very real possibility of healthcare systems being overwhelmed by a surge of COVID-19 cases/admissions. In addition, at the peak of the pandemic, surgical tiers of case urgency have been implemented to adequately allocate resources and personal protective equipment (PPE) while preserving patient care

standards [4]. The impact of these restrictions has created a significant burden upon vascular surgery practices to adapt, with an unprecedented decrease in inpatient surgical case volume and a concomitant decrease in office-based laboratory (OBL) and ambulatory surgery center (ASC) cases as well [5]. This study aims to evaluate how access to an OBL and ASC has affected the ability of a vascular surgery group to provide essential vascular care during the COVID-19 pandemic. Institutional review board approval was waived as no patient-specific data was used in this submission.

2. Materials and Methods

On 20 March 2020, guidelines were published by the ACS regarding the curtailment of elective surgical procedures in response to the COVID-19 pandemic. A retrospective review was conducted on the number and type of vascular procedures performed by our group between 3 February 2020 and 30 April 2020. The procedures were divided into two 6-week periods based on releasing the ACS guidelines, which our group immediately adopted. Group 1 included cases performed between 3 February 2020 and 20 March 2020, the 6-week period immediately prior to the guidelines' release and adoption. Group 2 included cases performed between 21 March 2020 and 30 April 2020, the 6-week period during the early surge of the pandemic and immediately following the release and adoption of the guidelines. Cases in Group 2 were limited to those deemed essential to the care and survival of the patient. For both groups, the procedures were further categorized by the type of care facility in which the procedure was performed. Categories included hospital inpatient (HIP), hospital outpatient (HOP), office-based lab (OBL), ambulatory surgery center (ASC), and vein center (VC). The cases were also grouped by type of procedure, including aneurysmal disease (AAA), carotid disease (CAR), peripheral arterial disease (PAD), amputation/wound care (AMP), vascular access (VA), deep vein thrombosis (DVT), and chronic venous insufficiency (CVI). Cases predominantly performed in our OBL include percutaneous peripheral angiography, interventions for lower extremity peripheral arterial disease, and percutaneous interventions to maintain hemodialysis access fistulas and grafts. In our ASC, typical procedures performed by our vascular surgeons include placing chemo-access ports for cancer patients and creating arteriovenous fistulas and grafts for hemodialysis. All patients were screened prior to their surgery for possible COVID-19 symptoms and exposure and had their temperature measured before the start of their procedure. Patients with positive screening results had their procedure canceled or rescheduled pending further evaluation according to published guidelines.

The number of healthcare worker contacts was also recorded during these periods for the different service sites in the 2 groups undergoing ambulatory care. These contacts included procedures done at the HOP, OBL, and ASC sites of service. A further comparison was made for patients in group 2 in this regard. The actual points of contact in group 2 were compared with the projected number of contacts for these patients if all their ambulatory care had to be provided in the HOP setting in lieu of the ASC and OBL. Differences between the results for Groups 1 and 2 were determined using the two-way ANOVA statistical method. Any patient or provider in our practice who developed COVID-19 infection during the period of review underwent contact tracing to determine if their infection was due to exposure as a consequence of our patient management strategy. This retrospective review was approved by the Pima Heart and Vascular research committee. Due to the retrospective nature of the review and the lack of patient identifiers, informed consent was not required.

3. Results

In the period of review, our group performed a total of 724 cases. From February 3 through March 20, group 1 comprised 509 cases, while group 2 cases completed from March 21 through April 30 comprised 215 cases. The overall volume of cases decreased by 58% due to COVID-19 restrictions. The distribution of the cases by type of facility is shown in Figure 1. Before the implementation of COVID-19 restrictions, 234 cases (46%) were HIP, 66 cases (13%) were HOP, 7 cases (1%) were ASC, 57 cases (11%) were OBL,

and 145 cases (28%) were VC. Under COVID-19 restrictions, 130 cases (60%) were HIP, 34 cases (16%) were HOP, 9 cases (4%) were ASC, 40 cases (19%) were OBL, and 2 cases (1%) were VC. Two-way ANOVA shows no significant difference between groups 1 and 2 when comparing procedure sites.

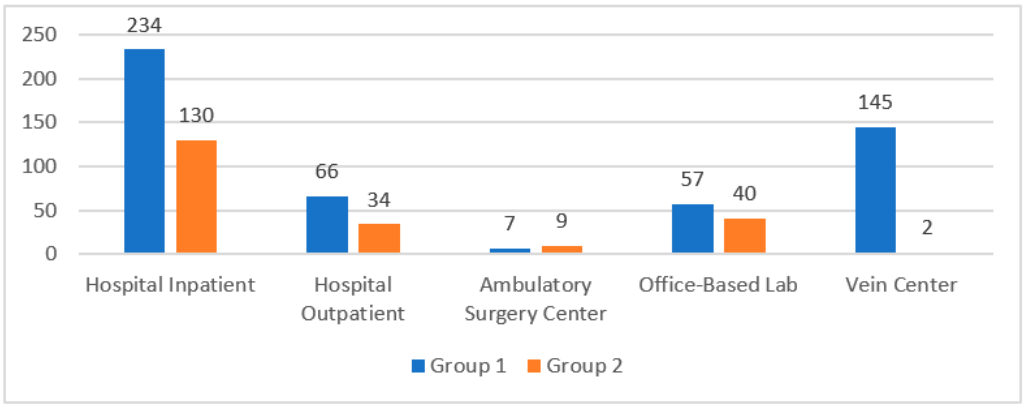

Figure 1. Venue for vascular surgical care. Group 1, pre COVID; Group 2, during COVID.

The types of cases performed for each time period appear in Figure 2. For group 1, 16 cases (3%) were AAA, 15 cases (3%) were CAR, 21 cases (4%) were DVT, 84 cases (17%) were AMP, 93 cases (19%) were VA, 121 cases (24%) were PAD, and 145 cases (29%) were CVI. In group 2, 4 cases (2%) were AAA, 10 cases (5%) were CAR, 13 cases (6%) were DVT, 48 cases (24%) were AMP, 61 cases (30%) were VA, 63 cases (31%) were PAD, and 2 (1%) cases were CVI. Two-way ANOVA demonstrates no significant difference in the type of cases, though not unexpectedly; CVI cases were most prominently affected by the COVID-19 restrictions as these types of cases were not considered essential.

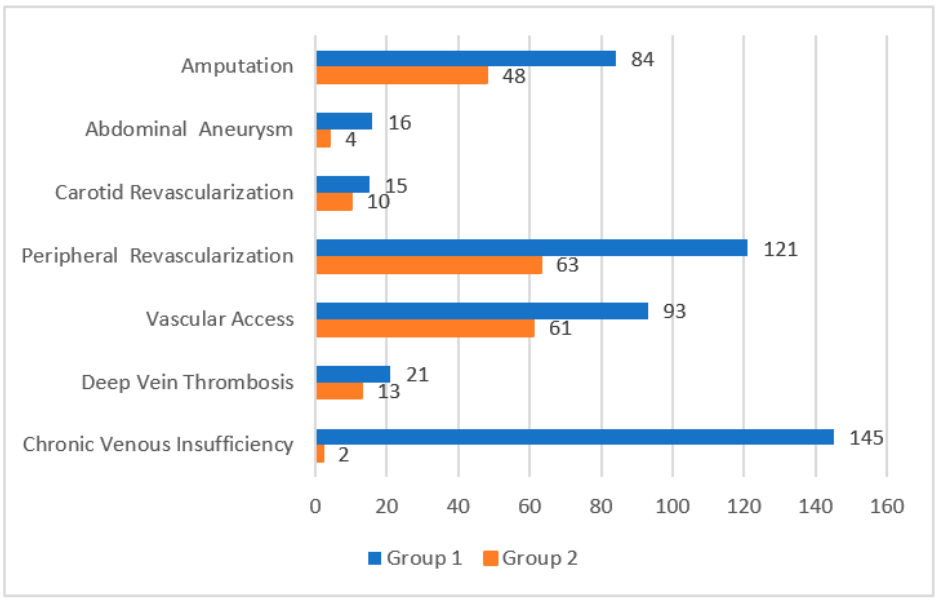

Figure 2. Types of vascular cases performed. Group 1, pre COVID; Group 2, during COVID.

Table 1 shows the types of touch points for each service site of HOP, OBL, and ASC to compare the number of healthcare worker encounters per patient for ambulatory care. For HOP, a patient encounters 11 healthcare workers during their stay for an outpatient procedure. For our OBL, a patient encounters 4 healthcare workers during their stay for an outpatient procedure. Finally, for our ASC, a patient encounters 6 healthcare workers during their stay for an outpatient procedure.

Table 1. The number of patient-healthcare worker contact points.

Hospital Outpatient (n = 11)	Office-Based Lab (n=4)	Ambulatory Surgery Center (n = 6)
Valet/Reception Staff	Pre- and Post-Operative Nurse	Pre-Operative Nurse
Screening Staff	Circulating Nurse	Circulating Nurse
Admitting Staff	Scrub Tech	Scrub Tech
Pre-Operative Nurse	Surgeon	Surgeon
Anesthesia Provider		Anesthesia Provider
Circulating Nurse		Post-Anesthesia Care Staff
Scrub Tech		
Surgeon		
Assistant		
Post-Anesthesia Care Staff		
Discharge Staff		

Table 2 displays the data comparing the total number of contact points for groups 1 and 2 for patients receiving their care at HOP, OBL, and ASC based on the number of ambulatory cases at each site of service for each group. A third column in Table 2 provides the projected points of contact for group 2 patients, assuming that the OBL and ASC were not available for care and all the ambulatory care was provided in the HOP setting. The total number of patient-provider contact points for the outpatient care we provided was significantly less when that care was provided in the OBL and ASC than if that care had to be provided in a hospital outpatient department. No patient or provider developed COVID-19 infection due to treatment at our OBL or ASC during the study period.

Table 2. Comparison of patient touch points with health care workers for ambulatory care.

Touch Points for Outpatient Care	Group 1	Group 2	Group 2 no OBL or ASC
HOP	726	374	913
OBL	42	54	0
ASC	228	160	0
Total	* 996	588	* 913

* $p < 0.05$ compared with Group 2, ANOVA.

4. Discussion

In efforts to prevent hospital services from becoming completely overwhelmed, state mandates on restrictions of surgical procedures were implemented during the national response to the COVID-19 pandemic. To preserve precious hospital resources and personal protective equipment (PPE), as well as consistent with the ACS guidelines, we halted all elective procedures in our hospitals on 20 March 2020 [2]. In addition to state-mandated cessation of all hospital-based elective cases, our group placed limitations on OBL and ASC services. However, in an effort to strike the right balance between the safety of patients and providers while providing necessary vascular surgical services, the OBL was used for the management of critical limb ischemia and dialysis maintenance [6]. These two disease states were considered to be essential to prevent the loss of a limb and avoid the unnecessary morbidity associated with hemodialysis access occlusion, respectively. Similarly, utilization of our ASC was limited to dialysis access creation and maintenance as well as port placement for chemotherapy. Delaying dialysis access creation in patients already dialyzing with a tunneled catheter would prolong the patient's catheter contact time, with the associated risk of catheter-related sepsis and death. Similarly, delaying the

creation of preemptive arteriovenous fistulas could have the same impact in unnecessarily exposing the patient to catheter-based dialysis. For cancer patients, timely initiation of chemotherapy is often dependent upon the patient getting a chemo-access port. Using our venues of the OBL and the ASC, the overall goal was to limit contact points between patients and essential medical staff, thereby limiting patients' exposure compared to that associated with the outpatient departments of our hospitals. By avoiding the congested environment associated with our hospitals and the numerous contacts between patients and essential health workers at those sites, a secondary objective of our using our OBL and ASC was to minimize the consumption of PPE necessary to provide these essential care services to our patients with CLI, dialysis access and chemo-access needs [7].

Our practice expected a decrease of 58% in the volume of hospital-based procedures under COVID-19 restrictions. The distribution between types of cases being performed remained relatively similar between the two time periods, except for AAA and CVI cases. The precipitous drop in CVI cases is expected as patients with chronic venous insufficiency can safely have their intervention deferred without creating any significant risk to the patient in most cases. While the presence of an AAA confers an increasing risk of rupture with treatment delay, the requirement for inpatient admission for even endovascular repair of an aortic aneurysm results in the utilization of limited hospital resources. These cases were deferred unless the patient was experiencing aneurysm-related symptoms or their aneurysm was considered large enough that delay would be too risky [8]. This strategy resulted in a decrease in AAA cases under COVID-19 restrictions.

While there were no significant differences between location or types of procedures for the two time periods, we did observe that OBL and ASC cases comprised a greater proportion of cases in the second time period, with such cases comprising only 12% of cases in group 1 and 23% of cases in group 2. This observation reflects the significant decrease in the volume of hospital-based procedures being performed by our practice under the statewide restrictions on elective procedures and with the implementation of surgical tiers pertaining to case urgency. The continued access to both ASC and OBL venues during these times of judicious allocation of hospital resources provided our group the ability to continue to provide essential patient care services during the COVID-19 pandemic in an ambulatory setting, effectively minimizing contact with healthcare workers while conserving hospital PPE and reducing the utilization of hospital resources.

Our findings also highlight critical contact points that patients must make when being provided vascular care in the HOP, ASC, and OBL. As one can see, hospital-based outpatient services require more contact points that a patient must navigate, with each touch point conferring a risk of possible COVID-19 transmission either to the patient or to a healthcare worker. The benefit of utilizing the ASC and OBL for outpatient services is striking. We found that the number of patient contact points was significantly less for patients receiving outpatient care in the OBL and ASC than would have been encountered if that care was only available using hospital outpatient services. A secondary and equally important observation in the context of the COVID-19 pandemic is that each patient contact point requires the use of PPE by the healthcare worker. Similar to the drop in contact points appreciated by the use of the OBL and ASC, it follows that there would be a proportionately significant reduction in PPE utilization compared with hospital outpatient venues.

A study by Pini et al. evaluated the possibility of maintaining a vascular surgical practice during the pandemic in Italy, the first country to be devastated by the COVID-19 global pandemic [9]. Pini et al. evaluated safety protocol measures instituted during the emergency COVID-19 pandemic response in Italy to maintain elective vascular surgery practices. All patients undergoing elective vascular surgery interventions were subjected to nasopharyngeal swabs for screening, and all urgent interventions were treated as COVID-19-positive until proven otherwise and subjected to appropriate infection control measures. They treated 151 patients during the pandemic, of which only 23% were acute/urgent interventions. None of their elective patients tested positive for COVID-19, and no providers were infected either. They concluded that a standardized protocol in handling preven-

tative screening with appropriate PPE allowed for the continuation of elective vascular surgery procedures with minimal burden on ICU resources and no infection of patients or providers. In our retrospective review of our own practice, we observed similar findings, with prevention and rigorous screening measures being keystones in maintaining patient care during the pandemic.

Hashmi et al. reviewed the quality and characteristics of surgery and interventional radiology procedures at a tertiary center in the Midwest amidst the COVID-19 pandemic [10]. They observed that while all case volumes decreased, the degree to which surgical subspecialty procedural volume decreased outpaced the decrease of interventional radiology procedural volume. This was attributed to the fact that a much higher proportion of surgical procedures require general anesthesia to perform and thus incur the risk of aerosol generation from intubation. In line with this observation, our study observed an increased proportion of vascular surgery procedures being performed in the ASC or OBL settings, where cases performed for urgent and semi-urgent indications, such as critical limb ischemia or dialysis maintenance, can be performed utilizing local anesthesia or minimal sedation.

We believe that with the institution of methodical and rigorous screening measures, and while widespread immunization with the COVID-19 vaccine is implemented, essential care can continue to be safely provided for vascular surgery patients in the ambulatory setting, such as an ASC or OBL. Furthermore, in the context of the COVID-19 pandemic, we believe that essential care in the ambulatory setting, when available, is the superior option in comparison to similar care provided in the hospital setting. This is due to the decreased touch points inherent to care provided in the ambulatory setting as well as the reduction of hospital resource utilization at a time when they are already stretched thin.

5. Conclusions

Our retrospective study evaluated the impact of utilization of the ASC and OBL venues for essential vascular care in an ambulatory environment during the early phase of the COVID-19 pandemic for a single vascular surgery group. Using our OBL and ASC resulted in limited contact points with healthcare workers. A secondary gain was a reduction in PPE utilization in our community health system. The ability to provide care for patients utilizing our ASC and OBL also afforded our group some degree of mitigation against the economic impact of the COVID-19 pandemic as compared to that which would have been appreciated if our only option were to use the hospital. In our opinion, such ambulatory services conferred a significant advantage in risk reduction during the COVID-19 pandemic compared to such services offered in a hospital-based setting.

Author Contributions: Conceptualization, S.S.B., D.N., M.L.B., J.A.B., J.C., L.R.L., B.M., J.E.S. and J.P.P.; methodology, S.S.B., M.L.B., J.A.B., J.C., L.R.L., B.M., J.E.S. and J.P.P.; validation, S.S.B., D.N., M.L.B., J.A.B., J.C., L.R.L., B.M., J.E.S. and J.P.P.; formal analysis, S.S.B., M.L.B., J.C., L.R.L. and J.P.P.; investigation, S.S.B., D.N., M.L.B., J.A.B., J.C., L.R.L., B.M., J.E.S. and J.P.P.; resources, S.S.B., M.L.B., J.A.B., J.C., L.R.L., B.M., J.E.S. and J.P.P.; data curation, S.S.B., M.L.B., J.A.B., J.C., L.R.L., B.M., J.E.S. and J.P.P.; writing—original draft preparation, S.S.B. and D.N.; writing—review and editing, S.S.B., D.N. and M.L.B.; visualization, S.S.B. and M.L.B.; supervision, S.S.B., M.L.B., J.C., L.R.L. and J.P.P.; project administration, S.S.B., M.L.B., J.C., L.R.L. and J.P.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Ethical review and approval were waived for this study due to there being no patient specific data used for this submission.

Informed Consent Statement: Due to the retrospective nature of this review and the lack of patient identifiers, informed consent was not required.

Data Availability Statement: The original contributions presented in the study are included in the article. Further inquiries can be directed to the corresponding author(s).

Conflicts of Interest: No conflicts of interest. This work was not supported by funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Sohrabi, C.; Alsafi, Z.; O'Neill, N.; Khan, M.; Kerwan, A.; Al-Jabir, A.; Iosifidis, C.; Agha, R. World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). *Int. J. Surg.* **2020**, *76*, 71–76. [CrossRef] [PubMed]
2. COVIDSurg Collaborative. Elective surgery cancellations due to the COVID-19 pandemic: Global predictive modelling to inform surgical recovery plans. *Br. J. Surg.* **2020**, *107*, 1440–1449. [CrossRef]
3. American College of Surgeons. COVID-19: Recommendations for Management of Elective Surgical Procedures. Available online: https://www.healio.com/news/orthopedics/20200316/american-college-of-surgeons-provides-recommendations-for-elective-surgery-during-covid19-pandemic (accessed on 18 December 2020).
4. Ross, S.W.; Lauer, C.W.; Miles, W.S.; Green, J.M.; Christmas, A.B.; May, A.K.; Matthews, B.D. Maximizing the calm before the storm: Tiered surgical response plan for novel coronavirus (COVID-19). *J. Am. Coll. Surg.* **2020**, *230*, 1080–1091. [CrossRef] [PubMed]
5. Mirza, A.K.; Manunga, J.; Skeik, N. Indirect casualties of COVID 19: Perspectives from an American vascular surgery practice at a tertiary care centre. *Br. J. Surg.* **2020**, *107*, e246. [CrossRef] [PubMed]
6. Kirksey, L.; Droz, N.M.; Vacharajani, T.; McLennan, G.; Clair, D.G.; Lyden, S.P. COVID era "essential surgery" dialysis access management considerations. *J. Vasc. Surg.* **2020**, *72*, 1845–1849. [CrossRef] [PubMed]
7. Cohen, L.M.; Ruthazer, R.; Moss, A.H.; Germain, M.J. Predicting six-month mortality for patients who are on maintenance hemodialysis. *Clin. J. Am. Soc. Nephrol.* **2010**, *5*, 72–79. [CrossRef] [PubMed]
8. Oliver-Williams, C.; Sweeting, M.J.; Jacomelli, J.; Summers, L.; Stevenson, A.; Lees, T.; Earnshaw, J.J. Safety of Men with Small and Medium Abdominal Aortic Aneurysms Under Surveillance in the NAAASP. *Circulation* **2019**, *139*, 1371–1380. [CrossRef] [PubMed]
9. Pini, R.; Faggioli, G.; Vacirca, A.; Gallitto, E.; Mascoli, C.; Attard, L.; Viale, P.; Gargiulo, M. Is it possible to safely maintain a regular vascular practice during the COVID-19 pandemic? *Eur. J. Vasc. Endovasc. Surg.* **2020**, *60*, 127–134. [CrossRef] [PubMed]
10. Hashmi, A.; Parikh, K.; Al-Natour, M.; Azar, N.; Sutter, C.; Ramaiya, N.; Davidson, J.; Tavri, S. Interventional radiology procedural volume changes during COVID-19 initial phase: A tertiary level Midwest health system experience. *J. Clin. Imaging* **2021**, *72*, 31–36. [CrossRef] [PubMed]