The Effects of a Recent Major Hurricane on a Reproductive Medicine Clinic

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Abstract: Natural disasters and major weather events can have a large impact on fertility treatment in the affected area through unplanned clinic closures leading to cancelled cycles, severe weather endangering cryopreserved embryos and gametes, and long delays in the resumption of care related to infrastructure damage. The cessation of fertility treatment in these circumstances can lead to increased stress, anxiety, and trauma for patients and staff. As major weather events are expected to increase as a result of our warming planet, both the immediate effects of unplanned clinic closures and the long-term impacts on the success of assisted reproductive technology (ART) and pregnancy outcomes call for a closer evaluation of the effects of these events on the field of reproductive medicine. Research on developing new strategies to mitigate potential negative effects and improving our disaster preparedness is needed.

Keywords: ART; IVF; climate change; emergency preparedness

1. Introduction

When the first wave of COVID-19 surged in the Spring of 2020, reproductive endocrinology and infertility (REI) providers nearly universally paused fertility treatments for the first time due the many unknowns surrounding the transmission and clinical consequences of SARS-CoV-2 infection [1]. These shutdowns had wide-reaching effects, not only negatively impacting the mental health and wellbeing of patients struggling with infertility, but may also leading to fewer desired pregnancies, particularly in older patients, during shutdowns that spanned several months in some cases [2,3]. Unplanned and sometimes lengthy shutdowns happen all too often on a smaller, but no less devastating scale because of major weather events and natural disasters, such as hurricanes, flooding, and wildfires.

2. Climate Change

According to the most recent report from the Intergovernmental Panel for Climate Change (IPCC), published in 2021, the influence of humans on the warming planet is “unequivocal” and this change is affecting weather and climate extremes all over the globe, suggesting that these major events may become an even more common challenge to our healthcare system and the world of reproductive medicine [4].

Hurricane Ida made landfall on the coast of Louisiana on 29 August 2021, 16 years to the day after Hurricane Katrina, a storm which had devastating effects on the city of New Orleans and much of the Gulf Coast region. As with many natural disasters, there was limited time prior to landfall for the city to prepare and execute emergency action plans ahead of Hurricane Ida. However, this storm in particular allowed even less time than a typical hurricane due to a phenomenon known as rapid intensification, defined by the national hurricane center as an increase of 35 mph wind speed in a 24 h period (https://www.nhc.noaa.gov/aboutgloss.shtml (accessed on 30 December 2021)). Hurricane Ida’s windspeed increased by 65 mph over the 24 h prior to landfall (https://www.nhc.noaa.gov/aboutgloss.shtml)
The city of New Orleans previously required that there be at least 72 h before a storm is predicted to make landfall to allow a mandatory evacuation to be issued and, with the added strains of the COVID-19 pandemic, they have increased this timeline to 82 h (https://ready.nola.gov/plan/hurricane/ (accessed on 30 December 2021)). At 5 a.m. on Friday 27 August, approximately 55 h before landfall, Hurricane Ida was projected to rapidly intensify over the warm waters of the Gulf of Mexico, but was still forecast to be a weak category 3 hurricane when it reached the coast. Only 12 h later, with the 5 p.m. update that day, 43 h before landfall, the forecast was upgraded to a category 4. In the case of Hurricane Ida, once the true strength of the storm was apparent, there was not enough time to conduct a mandatory evacuation, as is often ordered ahead of anticipated category 4 hurricanes. Analysis of hurricane behavior over time in different storms occurring from 1982 to 2009 suggests that hurricanes are now intensifying more rapidly, which may be due to climate warming trends [5]. Rapid intensification significantly shortens the timeline a city has to prepare and makes predicting the storm’s course and behavior more challenging, adding to uncertainty, as in this case [5].

3. American Society of Reproductive Medicine (ASRM) Guidelines to Navigate a Natural Disaster

In any natural disaster, the impact on fertility medicine can be especially devastating, given its intensely time-sensitive nature. In the event of a natural disaster, the American Society of Reproductive Medicine, the Society for Assisted Reproductive Technology (SART), and the Society of Reproductive Biologists and Technologists recommend that all in vitro fertilization (IVF) programs and clinics have their own emergency preparedness protocol [6]. These protocols must outline the clinic’s specific plan to protect patients, personnel, and fresh and cryopreserved human tissue (embryos, oocytes, and sperm) and provide for the continuation of patient care [6]. With decreasing time to prepare for hurricanes, the importance of a comprehensive, effective, and efficient emergency preparedness plan cannot be overstated.

4. Lessons from Previous Natural Disasters

While Hurricane Katrina in 2005 was not the strongest storm to hit the coast of Louisiana, its effect on the city of New Orleans and the surrounding area was near catastrophic. Physicians at The Fertility Institute of New Orleans wrote an editorial on their experience, their emergency activation plan, and lessons learned [7,8]. In this publication, they describe how they addressed the safety of the cryopreserved embryos by topping off the nitrogen tanks and moving them to the third floor of the facility to protect them from anticipated flooding. They also discuss the management of their ongoing IVF cycles [7]. The majority of their actively cycling patients cancelled their treatment to evacuate New Orleans. Displaced patients were given information on other IVF programs and had the option to transfer their care emergently. Two patients chose to transfer embryos early before evacuating, on day 3 instead of day 5, and two patients decided to leave their embryos in culture through the storm as they were planning for fresh embryo transfer after the storm passed. These embryos were subsequently lost when reentry to the city and access to the embryology lab was not possible for an extended period of time following the storm. In total, their clinic was closed for 10 weeks from 29 August to 7 November.

5. Our Experience with Hurricane Ida

At Audubon Fertility, we faced many of the same challenges with Hurricane Ida. The decision to prepare the clinic for closure was somewhat delayed as there was not a mandatory evacuation order. We ultimately started preparing for evacuation midday on Friday, approximately 48 h before Ida made landfall. There were no oocyte retrievals scheduled that weekend, and several patients had embryos in culture. In order to prevent the potential loss of embryos in culture in the event that our embryologists could not safely
access the clinic after the storm passed, we decided to cryopreserve several embryos prior to the blastocyst stage, on post fertilization days 2 and 3, delaying biopsy for patients planning PGT-A (preimplantation genetic testing for aneuploidy). There were 7 patients whose embryos were frozen on day 2 and 4 patients whose embryos were frozen on day 3. After embryology services ultimately resumed, these embryos were subse-quently thawed, cultured to the blastocyst stage, biopsied (if requested), and refrozen. Of these cycles, the overall blastulation rates were 50% for those frozen on day 2 and 60% for those frozen on day three. Of note, in these small groups, one patient in the day 3 group had only one embryo frozen, which did not continue to develop after the thaw and was discarded. The mean age for both groups was <35 and all women were younger than 40. We are collecting data on outcomes to determine if this deviation from our standard embryology protocol, resulting in at least two freeze/thaw cycles prior to transfer, may have any effect on pregnancy or live birth rate.

Power was disrupted to the majority of the city of New Orleans for several days, and even weeks in some cases, due to storm-related damage to an aging electrical grid. Our clinic at Audubon Fertility was able to open for staff after one week and for limited patient care after one and a half weeks. Fortunately, there was no significant flooding in the area, and we did not lose any access to the embryology lab or clinic after the storm. We were able to confirm the safety of the cryopreserved embryos and gametes as soon as the storm had passed, and there was no loss of embryo or gametes.

Despite the relatively short timeline for resuming clinical care, it was another 3–4 weeks before we could operate at full capacity. While the embryology lab did have emergency power from a backup gasoline-powered generator during the power disruption, obtaining gasoline to power the generator was difficult due to shortages in the area, and much of the laboratory supplies required replacement due to an extended time at elevated temperatures. This prevented essentially all embryology and andrology services from resuming until new supplies arrived and resulted in the cancellation of several cycles that were scheduled to start over the weekend that Ida occurred or in subsequent weeks. Additionally, some shipping companies were not servicing the city for several weeks and many medication shipments were significantly delayed or cancelled. Many patients shared stories of waiting in line for hours at shipping centers to attempt to retrieve packages containing medications that needed to be administered that day. Some were ultimately turned away without their package when the center closed for the day, which resulted in cycle cancellation in some cases. Many of our patients also did not have power to their homes, causing a loss of some temperature-sensitive medication. While commercial pharmacies did replace lost medication, the delays in the shipments of the new medication still interfered with the resumption of treatment.

6. Long-Term Effects of Natural Disasters on Reproduction

In addition to affecting fertility treatment, previous research has shown that natural disasters may have long-term effects on pregnancy outcomes as well. While hurricane exposure among pregnant patients has been associated with low birth weight and preterm birth, pregnancies conceived via IVF after a natural disaster do not seem to have significantly worse outcomes [9–12]. Meir and colleagues leveraged the SART Clinic Outcome Reporting System database to evaluate the impact of Hurricane Katrina on outcomes in singleton pregnancies conceived via IVF. They compared outcomes for women undergoing IVF in the affected areas in the period immediately before and immediately after Hurricane Katrina to data from women in other parts of the country over the same time period [12]. They did not detect any differences in clinical pregnancy rate, live birth rate, overall preterm delivery rate, spontaneous abortion, and infant birth weight among these groups [12]. However, there was a trend suggesting that IVF success rates increased over the observed time in parts of the country not affected by the hurricane due to progressive technological advances in the field, but these improved rates may not have been reflected in the SART CORS data.
from the affected areas. This suggests a more subtle but long-lasting regional effect on fertility medicine during the extended recovery after a major natural disaster [12]. While intriguing and thought provoking, we must be cautious to draw any conclusions from this, as it was not determined to be a statistically significant finding in one study addressing this question.

7. Action Item: Opportunities for Future Research

The short-term effects of natural disasters on reproductive medicine, including clinic closures and treatment delays, are clearly defined. However, many of the longer-term repercussions have not been fully evaluated and are not fully understood. Further research is needed to address these effects. Future questions to answer include:

- Providers and patients may decide to freeze or transfer embryos at unplanned times (day 2/3 vs. day 5/6) to prevent continuing to keep embryos in culture through an impending storm. Does unplanned earlier cryopreservation on day 2 or 3 followed by later thaw and culture to blastocyst stage for trophectoderm biopsy and re-freezing affect embryo development or live birth rates? How can we optimize these emergency cryopreservation protocols?
- What impact does the increased anxiety/stress of cancelling a cycle or delaying treatment have on future IVF success and pregnancy outcomes?
- How can we help support our patients and staff through the acute event and during the recovery period?
- Are the trends of lack of improvements in IVF success due to anticipated technological advancement over time, as suggested by Meir and colleagues after Hurricane Katrina, an isolated event, or does this reflect a larger concern during the regional recovery period after any major disaster?

8. Action Item: Updated Emergency Action Plans

As a result of our experience with Hurricane Ida, we have made several changes to our emergency action plan, as discussed below. We would encourage clinics to review their emergency action plans and consider updating these plans to reflect a shorter time frame, as our climate experts are predicting that future storms will continue to accelerate at much faster rates, allowing less time to prepare for evacuations. In addition, in the case of major hurricanes, clinics may consider modifications to the initiation of their action plans based on storm forecasts rather than mandatory evacuation orders, as local leaders may not have enough time to issue a mandatory evacuation order due to the increased occurrence of rapid intensification. As a component of a revised action plan, clinics should consider establishing a tiered communication system to efficiently communicate among the clinic staff and define responsibilities during the reopening of the clinic and the resumption of clinical care. We would also recommend that the emergency action plan be updated to address specific plans for communication with patients with information on the clinic’s disaster preparedness plan in real time, covering clinic closure, status of cryopreserved embryos, and when/how to expect the next communication from the clinic. This may limit some of the stress and anxiety experienced by the patient during the acute event. We found social medial platforms to be especially useful in this regard and would encourage their use for the real-time communication of essential information.

Given the expected increase in the frequency of major weather events, we should also consider strengthening relationships and referral networks among neighboring clinics. Unplanned clinic closures lead to cancelled cycles (ovulation induction, insemination, oocyte retrieval, and embryo transfers) and delays in care. Displaced patients could attempt to continue their cycles with a new team of REIs. However, the transfer of care mid-cycle may not be possible in every situation. According to the current ASRM committee opinion on developing an emergency action plan, a patient who may want to continue their cycle through another clinic can contact them through the SART website. However, building relationships with other clinics within the same region ahead of time could allow
an easier transition for patients who wish to continue their cycles and would otherwise have cancelled in addition to giving the receiving clinic more time to prepare for an influx of patients.

Lastly, communication with local government and first responders is essential. The security of cryopreserved embryos and oocytes depends on both their physical location in an elevated and structurally sound storage area as well as an adequate supply of liquid nitrogen. While a full tank can provide secure storage for a significant length of time, if there is not enough notice ahead of a natural disaster to fill the tank, or if there are issues with supply of this limited resource, the safety of embryos and gametes could become a concern. This would be particularly problematic if access to the embryology storage area is prevented for an extended period of time following a natural disaster, as occurred after Hurricane Katrina. The emergency action plan should include specific municipal authorities who need to be notified if embryo/oocytes need to be moved from their current place of storage due to an emergency situation and their up-to-date contact information.

9. Conclusions

While climate science and reproductive medicine may not be a historically common investigative pairing, recent events have clearly demonstrated the significant effect that major weather events and natural disasters have on our patients and the field of reproductive medicine. Unfortunately, climate scientists predict that these major events will continue to happen with more frequency and intensity and with less warning in the coming years as a result of human influenced climate change. Major city infrastructure damage as well as issues with shipping and supply chain concerns can further delay the arrival of embryology/andrology supplies, stimulation medications, and donor gametes, preventing the timely resumption of comprehensive fertility treatment. This leads to stress, anxiety, and emotional distress for patients and clinical staff as they try to help their patients navigate these challenging situations. In total, the impact of an unplanned interruption of care in infertility medicine is significant, financially, emotionally, psychologically, and physically. Both the immediate effects of canceled/delayed cycles and the possibility that the stress and trauma related to experiencing a natural disaster may have an impact on the success of assisted reproductive technology (ART) and pregnancy outcomes suggest that we should look deeper into these connections. Focusing research in this area with the goal of developing new strategies to understand and mitigate these potential negative effects, updating and streamlining disaster response plans, and strengthening relationships with nearby clinics and local governments have the potential to build resilience in our medical and non-medical communities and make us better prepared to face future natural disasters while we work together as a global community to limit the overall human-induced changes in our climate.

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