NEO FOR NAMIBIA
HELPING BABIES SURVIVE

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MISSION REPORT

Mission 2019 – 1

January 29, 2019 to February 22, 2019

NEO FOR NAMIBIA
HELPING BABIES SURVIVE

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1. INTRODUCTION

Our 7th mission to Namibia lasted from January 29, 2019 to February 22, 2019. This time, we first flew from Windhoek up to Ondangwa for a short visit of Onandjokwe State Hospital to see how the donated equipment has been put into use and how we can continue to support future developments (Fig. 1, 2). Once again, we felt very welcome and were impressed with the results achieved in this very demanding environment. In the near future, a temporary neonatal unit will be opened in a building next to the ICU. Clearly, this will be an improvement to the current Prem Unit even though its location is less than ideal (distance to the maternity ward, non-availability of X-rays). Hopefully, the Ministry of Health and Social Services will give high priority to the completion of the new maternity and neonatal units (see below).

Fig. 1. Teaching rounds in the Prem Unit at Onandjokwe State Hospital.

Fig. 2. In an attempt to avoid hypothermia, the smallest patients are wrapped in cotton inside the incubators.

Three days later, we drove 465 km east to Rundu. When we arrived on Saturday evening, we went to visit the Prem Unit. We were simply overwhelmed by what we saw: a busy, well organized neonatal ward with nurses calmly walking from bedside to bedside, taking care of small babies; three patients were supported with CPAP and their oxygen saturations were continuously monitored (Fig. 3). No doubt, the implemented changes have found their way into daily routine!

Fig. 3. Nurse Cecilia Ndepavali caring for an extremely low birth weight baby, observed by the infant's mother.

For a little over two weeks, we were able to support the local health care professionals in their daily work and introduce the Wallaby® warming tables in depth. In addition, we also could introduce a device that allows rapid measurements of bilirubin levels at the bedside (POCT: point of care testing).

From February 6–15, 2019 Regina Kaufmann, an experienced pediatric nurse and paramedic, joined us. She proved to be a very valuable addition to our team and was well liked by everybody (Fig. 4).

Fig. 4. Regina with her improvised classroom in front of the Prem Unit at Rundu State Hospital.

On February 17, 2019, we left Rundu by car and, after a stop-over at the Frans Indongo Lodge near Ojiwarongo, arrived in Windhoek one day later. The next day, we participated in the First Neonatology Conference that took place at the UNAM Medical School (speakers and topics: Beatrix Callard, NNP: Therapeutic hypothermia in LMICs; Prof. Clarissa Pieper: Costs of poor neonatal care; Prof. Thomas M. Berger: History of neonatology, Neonatal respiratory support, Fluid and nutrition therapy) (Fig. 5).

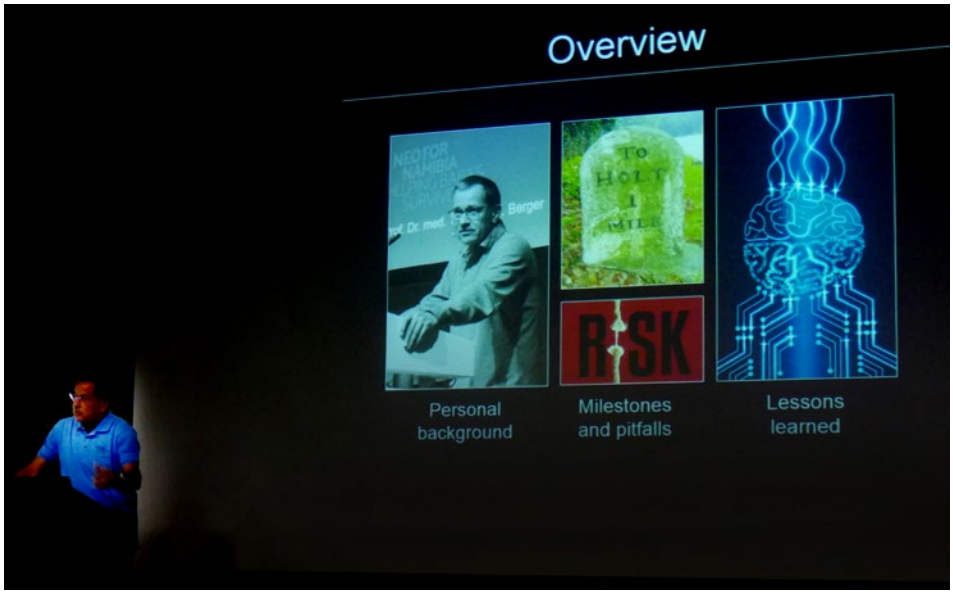

Fig. 5. Prof. Thomas M. Berger giving a lecture during the First Neonatology Symposium at the University of Namibia Medical School.

On Wednesday, February 20, 2019, we were able to discuss our future efforts with the former Health Minister, honorable Dr. Bernard Haufiku. Finally, on the day of our departure (February 21, 2019), we managed to meet both with the Permanent Secretary Ben T. Nangombe, as well as the new Health Minister, honorable Dr. Kalumbi Shangula, to explain our plans and efforts at the highest level.

2. MAIN MISSION GOALS

The main mission goals were:

1. To bring additional and new equipment to both Onandjokwe and Rundu State Hospitals and continue in-depth training

2. To introduce Regina Kaufmann to the local health care professionals

3. To follow-up on the CPAP registry and discuss the introduction of a Namibian Minimal Neonatal Data Set (Nam-MNDS)

4. To meet the new Permanent Secretary (PS), now called Executive Director (ED) of the Ministry of Health and Social Services, Dr. Ben T. Nangombe, and the new Minister of Health, Dr. Kalumbi Shangula.

3. EQUIPMENT

Thanks to our sponsors, we were able to deliver 5 additional Pumani® bubbleCPAP machines (2 for Rundu, 3 for Onandjowe), 5 additional pulse oximeters (2 for Rundu, 5 for Onandjokwe), including patient cables and 100 neonatal sensors (40 for Rundu, 60 for Onandjokwe).

Thus far, we have been able to provide 11 CPAP devices and 14 pulse oximeters, as well as the required consumables. We have also arranged for the delivery of additional open warming tables, phototherapy units and infant cot beds. Overall, we have purchased and delivered 7 Wallaby® warming tables (5 for Rundu, 2 for Onandjokwe), 5 Colibri® phototherapy lights (3 for Rundu, 2 for Onandjokwe) and 11 MTTS LifeKit® infant cot beds (8 for Rundu, 3 for Onandjokwe). We are very pleased to note that the equipment has been robust without any breakdowns (Fig. 6, 7).

Fig. 6. Equipment donated by NEO FOR NAMIBIA – Helping Babies Survive over a two-year-period.

Fig. 7. A near-term baby lying on a Wallaby® warming table supported with a Pumani® bubbleCPAP device and monitored with a Masimo® Rad-8 pulse oximeter.

Finally, we introduced an exciting new device (Bilimeter 3 from Pfaff Medical, Germany) that allows for the measurement of serum bilirubin concentrations from only 40 µl of blood in jaundiced newborn infants. This so-called point of care testing (POCT) has a turnaround time of only 5 minutes (from blood draw to test result) and greatly facilitates the work flow. Sabine Berger trained most of the nurses and all of the doctors (Fig. 8).

Fig. 8. Sabine Berger instructs nurse Cecilia to draw a small blood sample for POCT of the serum bilirubin concentration in a jaundiced neonate.

4. TRAINING

4.1 Formal educational sessions

At Onandjokwe State Hospital, nurses, interns and medical officers attended lectures on neonatal respiratory support with a particular focus on the proper use of pressure-limited, time-cycled continuous flow ventilators since two such devices are used in their ICU. Other lectures covered once again perinatal asphyxia and staging of hypoxic-ischemic encephalopathy (HIE), neonatal adaptation and resuscitation, vascular access and fluid & nutrition requirements and orders.

At Rundu State Hospital, several formal lectures were offered to the pediatricians at 8:00 o'clock prior to their morning report (Dr. Nyembo, Dr. Kamara, Dr. Banza, Dr. Alfonso, Dr. Moya and Dr. Mapanga). This time slot was also used to discuss specific cases. We reemphasized the fact that most admission diagnoses are mostly suspected conditions (e.g., neonatal sepsis, meconium aspiration syndrome), many of which will have to be revised during the hospital stay. This is particularly important for babies with suspected early-onset sepsis: often, antibiotics can be stopped after 48 hours when the diagnosis can be ruled out (Fig. 9, 10).

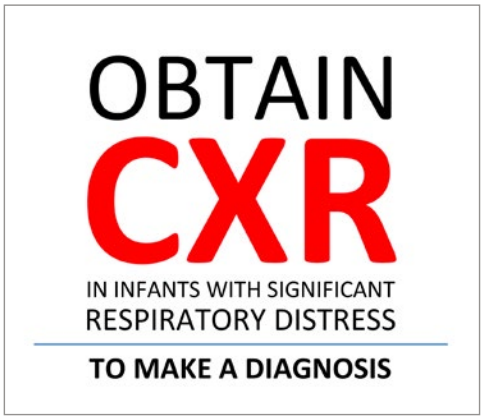

Fig. 9. To better understand what might be the cause of respiratory distress, chest X-rays should be obtained and interpreted.

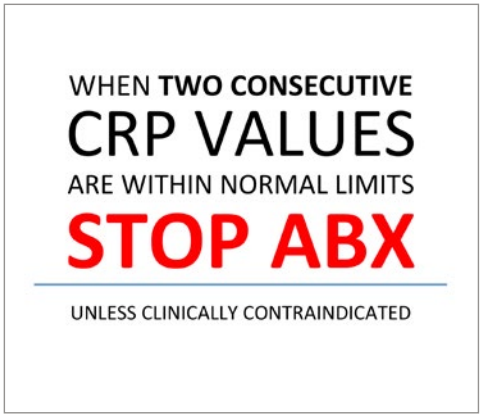

Fig. 10. To curb the highly prevalent overuse of antibiotics, serial CRP measurements can be very helpful (POCT would be extremely helpful, see above).

Hypoxic-ischemic encephalopathy is also over-diagnosed when babies who were assigned low Apgar scores or who required some bag mask ventilation in the delivery room are assigned Sarnat stages II and even III even if they have fully recovered within a short period of time.

We also highlighted the importance of adhering to standards (unité de doctrine): this simplifies daily work routines; it is good for the patients and a question of fairness among colleagues.

4.2 Bedside teaching

We enjoy working with our colleagues on a daily basis (Fig. 11, 12). The Prem Unit is well organized and, lead by the head nurse Cecilia Ndepavali, the staff continues to implement changes that improve patient care.

Fig. 11. Prof. Thomas M. Berger demonstrates the insertion of an umbilical venous catheter to Dr. Mapanga and Dr. Matthäus (visiting intern from Onandjokwe State Hospital).

Fig. 12. Twin-to-twin transfusion syndrome resulting in a polycythemic (left) and an anemic (right) twin.

Survival rates for extremely low birth weight infants (ELBW; i.e. with a birth weight < 1000 g) remain very low (see statistical information below). Even if their respiratory status can now be stabilized with INSURE (intubate – surfactant – extubated) and CPAP, fluid and nutrition management of these patients remains challenging because parenteral nutrition is not available. Often weight loss rapidly exceeds 20 % of birth weight and the babies get severely dehydrated. Significant electrolyte imbalances are likely to occur in these situations (Fig. 13). Serial electrolyte measurements are not possible (large sample volumes required, long turnaround times, lost or clotted samples).

Fig. 13. Due to their immature skin, extremely low birth weight infants have large insensible water losses during the first days to weeks of life.

Incidentally, while discussing the management of ELBW infants, we realized that some of the incubators can provide high levels of humidification and therefore can significantly reduce insensible water losses in some of the most immature babies. We had previously been told that these systems are broken, but, in fact, the systems do work but proper instructions have never been provided. During our stay, we instructed the nurses to choose high levels of humidification for ELBW infants, to obtain weights twice daily and to adjust total fluids as needed. We will see whether this leads to better outcomes for such patients.

4.3 Neonatology Training Center

We were very happy to welcome two visitors from Onandjokwe during our stay in Rundu. Dr. Pauline Matthäus, an intern, was accompanied by a nurse and together they worked with us and the local team (Fig. 14). They both agreed that this experience was most helpful. They returned to Onandjokwe with new ideas and promised to instruct their peers.

Fig. 14. A visiting intern (Dr. Matthäus) from Onandjokwe State Hospital during ward rounds with Dr. Mapanga.

As mentioned before, once the new Maternity and Prem Units can be opened at Rundu State Hospital, a Neonatology Training Center could be established to train visitors from other hospitals in the northern part of Namibia. This plan has once again been discussed with the Director, Dr. Joseph Mukerenge, and representatives of the Ministry of Health and Social Services.

5. IMPACT ANALYSIS

5.1 CPAP registry data

A total of 11 Pumani® CPAP devices are now in regular use at both Rundu State Hospital and Onandjokwe State Hospital. Between August 2017 and February 2019, a total of 163 patients have now been treated with CPAP (Fig. 15). Of these, 112 have survived to discharge (survival rate 69 %) (Fig. 16).

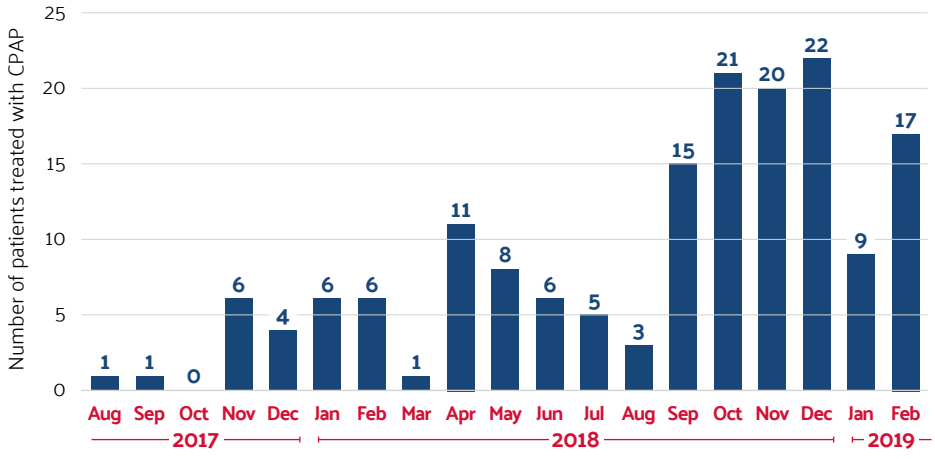

Fig. 15. CPAP registry: number of patients treated by month since August 2017.

CPAP registry data – August 2017 to February 2019

Total number of patients recorded	163
Median birth weight, g (range)	1550 (600–4170)
CPAP days (median, range)	618 (3, 1–20)
Survival rate	69 % (n=112)

Fig. 16. The survival rate of patients requiring CPAP support is 69 %.

As expected, the survival rates are greatly influenced by the degree of immaturity (birth weight used as a proxy). The survival rate of infants with a birth weight of less than 1000 g who present with respiratory distress remains very low with only 1 of 28 babies treated surviving (survival rate 4 %). Many of these babies can be stabilized on CPAP, but later die from complications other than respiratory failure (e.g., severe apnea spells, late-onset sepsis). In contrast, survival chances for infants with a birth weight between 1000–1499 g are 76 % (39 of 51 surviving), increasing even further to 83 % (72 of 87 surviving) for those weighing ≥ 1500 g.

It is noteworthy that the observed overall survival rate is very close to the one observed in a clinical trial from Malawi (71 %). Assuming that the survival rate without the availability of CPAP would be similar to the one reported in this study (44 %), there would be an absolute difference in survival rate of 25 % (from 44 % to 69 %). This means that the number needed to treat (NNT) to obtain one additional survivor is 4 (Fig. 17), indicating that this intervention is highly effective.

Use of the Pumani® bubbleCPAP device increases survival from 44% to 69%

NNT 4.0 (number needed to treat)

From July 2017 to February 2019, 163 babies have been treated with bubble CPAP at Rundu and Onandjokwe State Hospitals resulting in an estimated number of (163/4.0)

41 additional survivors

Fig. 17. CPAP therapy for infants with respiratory distress is a highly effective medical intervention that improves survival rates with a number needed to treat (NNT) of only 4.

deaths
survivors

5.2 Prem Unit admission book data

Once again, we analyzed the Prem Unit mortality rate data. The observation of an increasing mortality rate in the last three months of 2018 (leading to an overall mortality rate in 2018 of 9.6 %) following a continuous reduction (from 12.7 % in 2015 to 8.6 % in 2017 and 6.6 % in the first 8 months of 2018) lead us to review the most recent available data in detail (Fig. 18).

Prem Unit admission book date – 09 2017 to 02 2019

Patient characteristics	Admissions	Mortality rate
Birth weight < 1000 g	20	85 % (17/20)
Birth weight 1000 g – 1499 g	33	18 % (6/33)
Outborn	38	34 % (13/38)
Inborn	212	10 % (21/212)

Fig. 18. Extremely low birth weight infants and outborn patients have a very high mortality risk.

Note: during the 6-month-time period, there were a total number of 250 admissions and a total number of 34 deaths (mortality rate 13.6 %)

There are obvious high-risk populations: from September 2018 to February 2019, ELBW infant accounted for 8 % (20/250) of all admissions but 50 % (17/34) of all deaths; similarly, outborn infants (often late referrals) accounted for 15 % (38/250) of all admissions but 38 % of all deaths. Since there was a policy change in September 2018 to admit all outborn infants to the Prem Unit (rather than the General Pediatric or High Care Wards) and since a large number of ELBW infants were born in the last quarter of 2018, the increase in the observed mortality rate can easily be explained.

5.3 Limitations and future direction

The above observations highlight the importance of prospective uniform data collection that allows stratification by birth weight category and identification of in- and outborn infants. This would enable us to track outcomes in various subgroups. In addition, more information on causes and circumstances of deaths would be helpful to identify and address the most pressing issues.

A proposal for a Namibian Minimal Neonatal Data Set (Nam-MNDS) has been drafted and distributed to the doctors at bot Rundu State Hospital and Onandjokwe State Hospital (Fig. 19). If all agree on the data set, an online version will be developed for easy data entry. However, data entry on paper will also be possible (requiring separate entry into the database at a later time point).

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Namibian Minimal Neonatal Data Set (NMNDS)			Rundu State Hospital
Patient identification	**Instruction**	**Enter patient data here**	**Additional comments**
First name	free text		
Family name	free text		
Sex	male/female		
Date of birth	XX.YY.ZZZZ		
Date of admission to Prem Unit	XX.YY.ZZZZ		
Mother	**Instruction**	**Enter patient data here**	**Additional comments**
Age	years		
Gravidity	number		
Parity	number		
HIV status	pos/neg		
HIV treatment	yes/no		
Antenatal corticosteroids	yes/no		
Mode of delivery	**Instruction**	**Enter patient data here**	**Additional comments**
Inborn	yes/no		
Normal vaginal delivery	yes/no		
Vacuum/forceps delivery	yes no		
Primary Cesarean section	yes/no		
Secondary Cesarean section	yes/no		
Apgar score	**Instruction**	**Enter patient data here**	**Additional comments**
5 minutes	number		
10 minutes	number		
Resuscitation	**Instruction**	**Enter patient data here**	**Additional comments**
none	yes/no		
Oxygen supplementation	yes no		
Bag-mask ventilation	yes/no		
Chest compressions	yes/no		
Adrenaline	yes/no		
Birth weight and gestational age	**Instruction**	**Enter patient data here**	**Additional comments**
Birth weight	grams		
Weight on admission to Prem Unit	grams		
Estimated gestational age at birth	weeks		
Admission temperature	degrees C		

Diagnoses	**Instruction**	**Enter patient data here**	**Additional comments**
Wet lung	yes/no		
Hyaline membrane disease	yes no		
Meconium aspiration	yes/no		
Pneumonia	yes/no		
Pneumothorax	yes/no		
Other cause of respiratory distress	free text		
Neonatal sepsis, proven	yes/no		positive blood/CSF culture
If yes, organism isolated	free text		
Neonatal sepsis, suspected	yes no		risk factors + clinical signs + CRP elevation
HIE, stage I	yes/no		
HIE, stage II	yes no		
HIE, stage III	yes/no		
PDA	yes/no		
If yes, medical treatment	yes/no		
if yes, referred for surgical ligation	yes/no		
NEC, suspected	yes/no		
NEC, proven	yes/no		
Neonatal jaundice (phototherapy)	yes/no		
Other diagnosis - 1	free text		
Other diagnosis - 2	free text		
Other diagnosis - 3	free text		
Therapies	**Instruction**	**Enter patient data here**	**Additional comments**
Antibiotics	yes/no		
If yes, number of days	number		
Oxygen	yes/no		
CPAP	yes/no		if yes, fill out CPAP registry form
Mechanical ventilation	yes/no		
Surfactant	yes/no		
Anticonvulsants	yes/no		
Others	free text		
Others	free text		
Outcome	**Instruction**	**Enter patient data here**	**Additional comments**
Discharged alive	yes/no		
If yes: date of discharge	XX.YY.ZZZZ		
If yes: weight at discharge	grams		
If yes: type of nutrition	MM/F/MM&F		
Transferred	yes/no		
If yes: date of transfer	XX.YY.ZZZZ		
If yes: destination	free text		
Died	yes/no		
If yes: date of death	XX.YY.ZZZZ		
If yes: cause of death	free text		

Fig. 19. Draft of the suggested Namibian Minimal Neonatal Data Set (Nam-MNDS).

The CPAP registry form has been adapted: details on respiratory support prior to starting CPAP has been eliminated; on the other hand, information on CXR findings and surfactant administration should now be collected (Fig. 20).

CPAP Patient Registry
Rundu State Hospital

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1. First name, family name _____
2. Date of birth _____
3. Estimated gestational age _____ weeks
4. Birth weight _____ grams
5. Sex ☐ male ☐ female
6. Main diagnoses _____
7. CXR obtained ☐ yes ☐ no
8. CXR findings _____
9. Surfactant ☐ yes ☐ no
10. Date when put on CPAP _____
11. Date when CPAP stopped _____
12. Days on CPAP _____
13. Complications while on CPAP _____
14. Outcome ☐ survived ☐ died
15. Date of death _____
16. Cause of death _____

Fill out for each patient who is put on CPAP:
1. When going on CPAP (numbers 1-10)
2. When going off CPAP (numbers 11-13)
3. Complete when patient is discharged /has died (numbers 14-16)

Prof. Thomas M. Berger
Version 01 02 2019

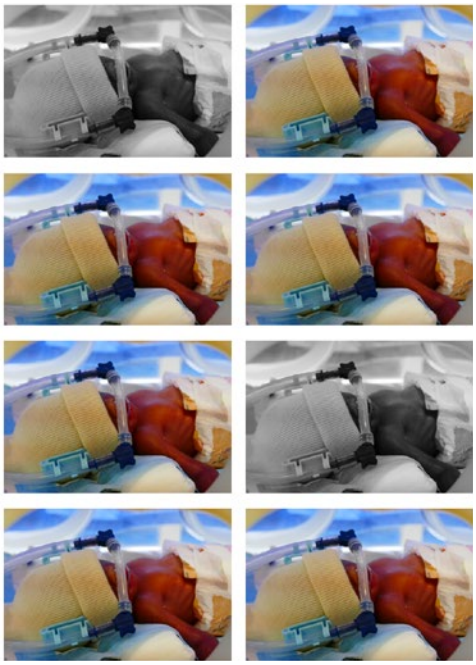

Fig. 20. Modified CPAP registry form (including CXR findings and Surfactant administration).

6. VERY SPECIAL PATIENTS

6.1 Nicoteh

Nicoteh was born in September 2018 with a birth weight of 1150 g and an estimated gestational age of 30 weeks (Fig. 21). Due to an ill-defined gastrointestinal inflammatory process, she was transferred to Windhoek General Hospital for more advanced care. Fortunately, she made a full recovery. We were very happy to meet her and her mother at Rundu State Hospital (Fig. 22), both obviously in good health!

Fig. 21. Sabine Berger taking care of Nicoteh during her first week of life.

Fig. 22. Meeting again: Nicoteh and her mother visiting us at the Rundu State Hospital: they are both doing very well.

6.2 Snake bites

During our stay, we encountered three boys who had been hospitalized because of snakebites (Fig. 23). Some of the snakes in the area are quite poisonous (black mambas, various cobras, puff adder) and can cause severe compartment syndromes requiring fasciotomies and even amputations. During her stay with us, Regina regularly entertained the kids from the surgical ward (Fig. 24).

Fig. 23. Snake bites often cause significant swelling and ensuing compartment syndromes can threaten the affected limb.

Fig. 24. Regina Kaufmann with the kids from the surgical ward.

6.3 Attacked by a crocodile

One morning, we encountered a young man outside of the surgical ward: he was covered with sutured wounds all over his body (Fig. 25, 26). When we asked him what had happened, he shrugged and said: "I was attacked by a crocodile." When asked how he fought the animal, he said: "I stuck my fingers in his nose."

Fig. 25. This young man was attacked by a crocodile when getting water from the river.

Fig. 26. To fight off the crocodile, he stuck his fingers into the nose of the reptile.

6.4 Heteropagus malformation

Quintolina is a now 13 month-old little girl who was born with a so-called heteropagus malformation (Fig. 27–29). This is an extremely rare form of asymmetrical conjoined twins (estimated incidence 1 per 1 million live births. We had previously heard of this patient from Dr. Wim De Mey (neonatologist at Windhoek General Hospital). We had the opportunity to meet the patient in person when we returned to Windhoek. We took a thorough history, examined the patient and documented the anatomy as best as we could. We are currently trying to see whether a Swiss surgical team would be willing to correct this complex malformation since this is not possible in Namibia.

Fig. 27. Quintolina at the age of 13 months.

Fig. 28. Heteropagus malformation: Quintolina suffers from an extremely rare form of asymmetrical conjoined twins.

Fig. 29. Quintolina and her mother during the consultation at the Windhoek General Hospital.

6.5 Infant of a diabetic mother

This infant was referred to the Rundu State Hospital from the Private Hospital in town because the attending pediatrician was planning to go on leave. Pregnancy had ben complicated by gestational diabetes and abnormal umbilical cord Doppler examination with reversed flow. In addition, pleural effusions, ascites and a small pericardial effusion were seen on fetal ultrasound.

The infant was delivered by Cesarean section at 32 weeks of gestation, and, soon after delivery, developed severe respiratory distress. Since she could not be stabilized on CPAP, bag-mask ventilation was initiated with an FiO_2 of 100 % and her SpO_2 slowly rose above 90 %. Unfortunately, the portable X-ray machine at Rundu State Hospital was broken and the cause of her respiratory distress could not be further evaluated.

When there was no evidence for a rapid recovery, a decision had to be made whether the baby should be intubated and transferred to the Private Hospital for invasive mechanical ventilation or whether all life-sustaining therapies should be withdrawn (the baby would then die). Given her gestational age and birth weight, she was felt to have a reasonable chance for survival. An umbilical venous catheter was inserted, she was intubated without premedication (not available) and surfactant was administered. She was then transferred to the Private Hospital (Fig. 30). A chest X-ray showed marked cardiomegaly with bilateral hazy lung fields (Fig. 31). Dr. Kamara and Prof. Berger cared for the patient until she could be extubated and remained stable off respiratory support.

Fig. 30. Discussing the patient's ventilator management with the nursing staff at the Private Hospital.

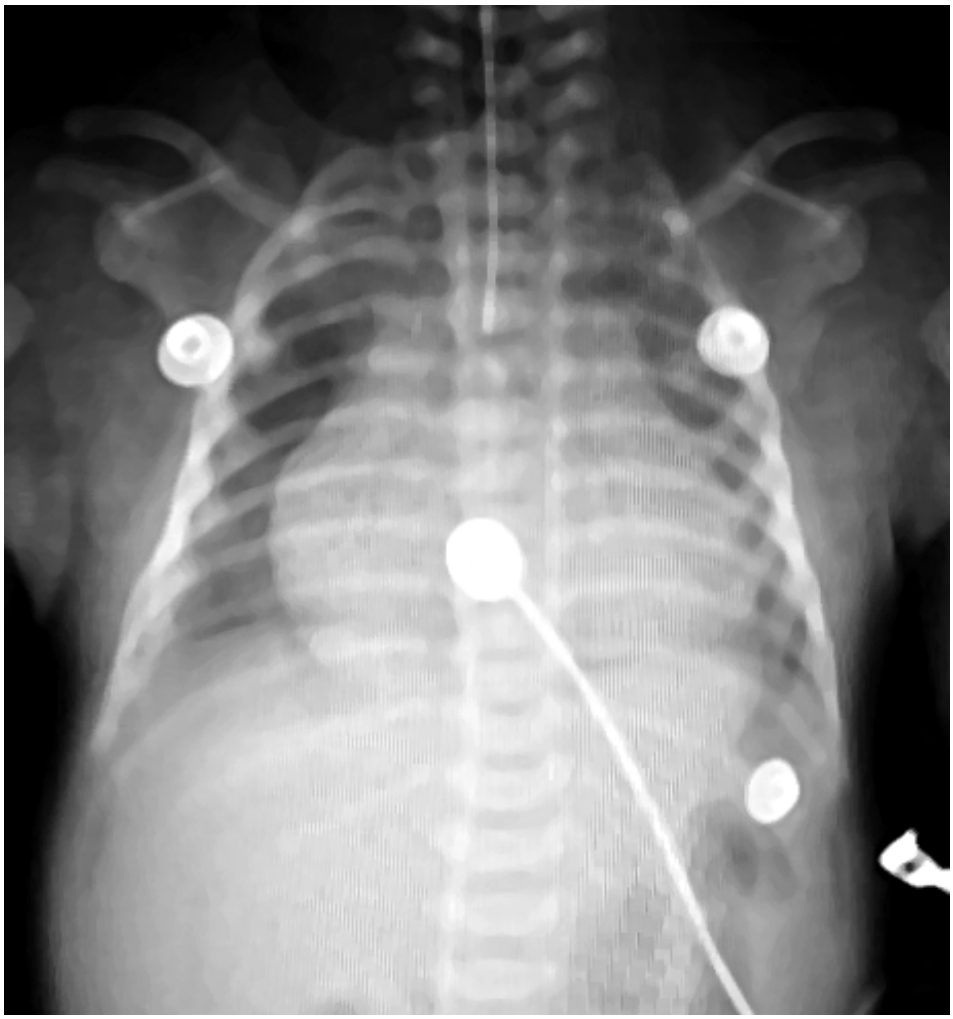

Fig. 31. CXR showing significant cardiomegaly and bilateral hazy lung fields.

7. FUTURE DIRECTIONS

7.1 Mission 2019-2

We plan to return to Namibia in June 2019 for our 8th mission to continue our support at Rundu State Hospital. Triggered by a number of critical situations we had encountered on previous visits (see 6.5 above), we consider purchasing a mechanical ventilator for the hospital (turbine-driven since compressed air is currently still not available). If we succeed, intensive training will be required to optimize the safety of patients who will be put on invasive mechanical ventilation.

7.2 CPAP registry and Minimal Neonatal Data Set (MNDS)

Patient outcome must be better documented. As outlined above, we will encourage and support the health care professionals to collect data for the CPAP registry and the Namibian Minimal Neonatal Data set (Nam-MNDS).

7.3 Contact with Rice 360° Institute for Global Health

Prof. Berger has been invited to visit the Rice 360° Institute for Global Health in Houston Texas (www.rice360.rice.edu). This is the place where the Pumani® bubbleCPAP device was developed. The same researchers plan to create and deploy a comprehensive set of Newborn Essential Solutions and Technologies (NEST), consisting of 17 different devices. Their goal is to ensure that a baby born in Africa has the same chance of survival as a baby born in the United States. This appears to be a unique opportunity to meet a group of like-minded people and to exchange ideas.

7.4 Fundraising efforts

NEO FOR NAMIBIA – Helping Babies Survive will have to increase its funding efforts to continue the support of hospitals in the northern region of Namibia. The efficacy of the interventions has been proven; now, it is desirable that a larger number of babies and mothers can benefit from what has been learned.

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